Ecological Analyses of Benthonic Shoals—I. Habitat segregation found in the early autumnal night pole-trawl (Utase-ami) association in the central part of Osaka Bay.*

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In the preceding report of the coastal (Maeda, 1955)4) and this series (Maeda, 1955)5), I reported on the habitat segregations found in the beach seine association in the northern coast of Osaka Bay and in the day-time pole-trawl association in the central part of that bay. The professional pole-trawlers work in the day-time in summer, while in the other seasons they work at night at about the similar fishing ground. Thus, I was much interested in the question what seasonal and nocturnal modifications may occur on members of the association and on the habitat segregation. These circumstances compelled me to work on board some night pole-trawlers in early autumn.

Material, method and result

The equipment of the pole-trawlers and the fishing ground are quite the same as those of the day-time pole-trawlers,5) but they begin to work at about 7 p.m. and finish the work at about 5 a.m. next morning. During the working time the catches are brought up every 1 1/2—2 hrs.; the materials for this study were collected on board the actually working trawlers on September 6-7 and 23-24 of 1951 and immersed immediately into 10% formalin.

The catches were composed chiefly of various crabs, shrimps, Squilla and Rhinogobius virgatulus, and next Apogon lineatus, Areliscus joyneri, Cryptocentrus filifer and Callionymus valenciennesi. Mingling with them the following animals were fished: Penaeus japonicus Bate, Harengula zunasi Bleeker, Engraulis japonica T. & S., Saurida argyrophanus (Richardson), Conger myriaster (Brevort), Decapterus maruadsi (T. & S.)*, Leiognathus argentus Lacépède*, Pagrosomus major (T. & S.),Nibea schlegeli (Bleeker)*, Sillago sihama (Forskal), Monacanthus setifer Bennett, Sphoeroides inermis (T. & S.), Hexagrammos otakii Jordan & Starks and Limanda yokohamae ( Günther). The fishes which were not represented in the day-time association are marked with an asterisk, while the fishes which were not found in the night catches but found in the day-time association, although they are not so much, are as follows: Trachurus trachurus Linné, Psenopsis anomala (T. & S.), Acanthocepola krusenterni (T. & S.), Sphoeroides alboplumbus (Richardson) and Acanthogobius flavimanus (T. & S.). It is doubtful,

* Contributions from the Shimonoseki College of Fisheries, No. 150
however, to assert on the above-mentioned fact, that the formers are nocturnal and the latters are diurnal. Rather it is possible that the formers are situating near the bottom and the latters near the surface at night. Moreover, some of the fishes caught either in the day-time or at night must be placed out of the consideration, because they were found only scarcely.

Then, by the similar method as to the case of the beach seine association (MAEDA, 1955 a) and the day-time pole-trawl association (MAEDA, 1955 b), the food habits and their segregation among the members of this association is analysed. And the results are shown in Table 1 and Fig. 1. In order to know the out line of the habitat segregation among the fishes belonging to the same group of food habits, two factors, weight difference reaching more than 50% of the lighter fishes and presence or absence and kinds of the secondary food which are not so important as to alter the food type, are used and reached to the conclusion which are schematically summarised into Fig. 2.

**Conclusion**

From this figure, I found that the most part of catches are consist of polychaeta feeders which are composed of 2 different size groups and each of them consist of the fishes differing from their secondary food.

**Table 1.** The number of individuals examined, mean body weight, composition of stomach contents and confidence interval of food taking ratio* at 0.05 level of significance.

<table>
<thead>
<tr>
<th>Species</th>
<th>No.</th>
<th>W (gr.)</th>
<th>Composition of stomach contents</th>
<th>Confidence interval of F.T.R.* at 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harengula</td>
<td>2</td>
<td>18.3</td>
<td>Nk Fry S.B. C. M.Z. P. S.Z. P.</td>
<td>0.98-0.37</td>
</tr>
<tr>
<td>Engraulis</td>
<td>14</td>
<td>3.2</td>
<td>0 0 0 0 1 2 0 0 0 0</td>
<td>0.85-0.49</td>
</tr>
<tr>
<td>Saurida</td>
<td>7</td>
<td>9.2</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
<td>0.89-0.40</td>
</tr>
<tr>
<td>Conger</td>
<td>3</td>
<td>5.7</td>
<td>0 0 0 1 0 0 0 0 0 0</td>
<td>0.90-0.25</td>
</tr>
<tr>
<td>Decapterus</td>
<td>28</td>
<td>12.0</td>
<td>0 0 0 0 0 1 0 0 0 0</td>
<td>0.25-0.05</td>
</tr>
<tr>
<td>Leolognathus</td>
<td>2</td>
<td>8.9</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
<td>0.86-0.14</td>
</tr>
<tr>
<td>Apong</td>
<td>31</td>
<td>6.0</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
<td>0.81-0.58</td>
</tr>
<tr>
<td>Pagrosomus</td>
<td>5</td>
<td>12.5</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
<td>0.92-0.61</td>
</tr>
<tr>
<td>Nibea</td>
<td>3</td>
<td>21.2</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
<td>0.90-0.25</td>
</tr>
<tr>
<td>Sillago</td>
<td>9</td>
<td>15.9</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
<td>0.61-0.15</td>
</tr>
<tr>
<td>Monacanthus</td>
<td>2</td>
<td>10.4</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
<td>0.61-0.02</td>
</tr>
<tr>
<td>Sphoeroides</td>
<td>1</td>
<td>17.5</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
<td>0.61-0.02</td>
</tr>
</tbody>
</table>
Remarks

Food habits (1) Mean body weight (2)

Engraulis
Harengula

(Apogon
Decaptersus
Nibea (Hexagrammos), (Spheroideas)

Cryptocentrus
Rhinogobius

(Areliscus
Leiognathus

Silago, Limanda
Callionymus

Fig. 2. Habitat segregation found in the early autumnal night pole-trawl association.

Comparing Fig. 2 in this report with that in the case of the day-time association (Maeda, 1955) it may be concluded safely that the seasonal or nocturnal modification on the pole-trawl association are not so conspicuous but summer day-time and early autumnal night associations are essentially invariable, because most fishes are caught in both day and night and the main foods are nearly invariable even when the fishes change the food type with day and night, although the members of the association, the food types of several fishes and the detail of the habitat segregation differ slightly between the association in the day-time and night.
References