

Note

Monthly Changes of Fish Fauna at Experimental Artificial Reef in Tongyeong Marine Ranching Area, Korea

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Abstract : Eighteen species of fish were identified by SCUBA diving observations around experimental artificial reefs at Tongyeong marine ranching area between November 1998 and November 1999. The highest species number of 14 was observed in September while the lowest number of 2 was observed in November. Fishes showed three typical behavioral patterns against the experimental artificial reef.

Key words : fish fauna, artificial reef, marine ranching area, behavioral patterns.

Preparation of fishing ground to enhance fish stocks is one of the most important sectors in marine ranching program, and ecological characteristics of target species should be considered in preparation of the ground. Artificial reef has been known to build fishing ground since it provides fish with spawning, nursing and feeding grounds and hiding place. Moreover it attracts and protects other marine organisms.

Sebastidae fish distribute widely over the rocky coast of Korea (Chung 1977) and 13 species has been reported in the Korean waters. Among them, *Sebastes inermis* and *S. schlegeli*, which distribute abundantly along the coast of Tongyeong, Gyeongsangnam-do, were selected as the target species of propagation for the Tongyeong Marine Ranching Program (1998-2006). However, population size is diminishing dramatically by overexploitation, and which results in a sharp increasing of the market value. The present study aims at not only getting biological knowledges but also developing a new type of artificial reefs for them.

Experimental artificial reef (6 m×8 m×4 m) was constructed with polypropylene bars (90 mm×90 mm×6 m) and concrete bars for their weights (Fig. 1). This experimental reef have four different inside structures as described by KORDI (1998). The reef was placed on a mud bottom at the depth of 13 m near the west coast of Cho-do, Tongyeong, (Fig. 2) in November, 1998. Fish

fauna was investigated by SCUBA diving 1-3 times at every two months between November 1998 and October 1999.

Fishes at the reef were identified, and those found in the experimental reef was recorded on an underwater board and the information on fish behavior was obtained by underwater photography (Nikonos -V and Nikon F-801s).

Identification of fishes was followed by The Korean Society of Systematic Zoology (1997), Chyung (1977), Masuda *et al.* (1984), and Nakabo (1995).

With time, many kinds of marine organisms such as *Ciona intestinalis*, unidentified bryozoans and hydrozoans etc, attached to the surface of the reef, and fish population increased. The list of fish found around the experimental reefs showed Table 1.

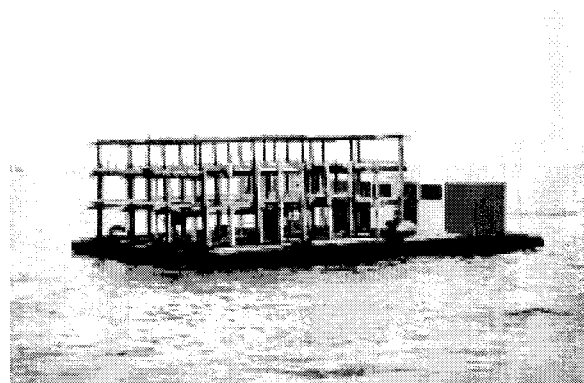


Fig. 1. The experimental artificial reef.

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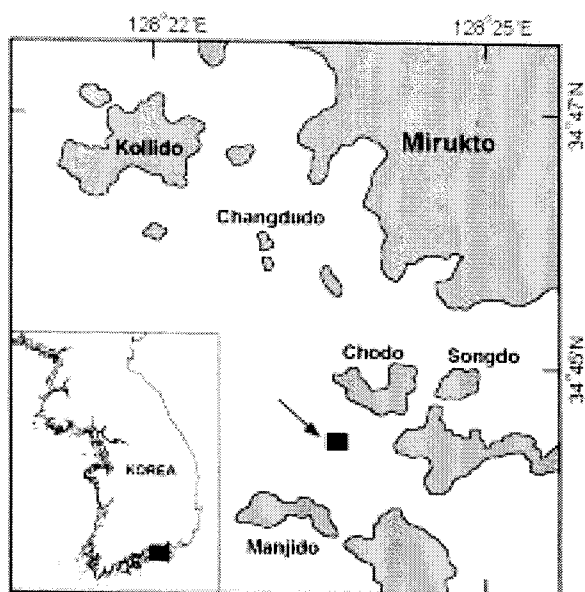


Fig. 2. A map showing the experimental reef site.

A school (above 1,000 individuals) of *Sebastes schlegeli* which was released with the underwater releasing method at the experimental artificial reef at 13 m bottom was found for two months. However, they were not found after 3 months but found again 4 months after releasing.

At the first time (November 1998), only two species such as *Parapercis sexfasciatus* and *Sagamia geneionema* which usually live at the mud bottom were observed but two month after installation of the reef *Hypodytes rubripinnis*, *Rudarius ercodes* and *Apogon semilineatus*

etc. appeared.

In March of 1999, the reef was covered with *Styela* spp. and *Ciona intestinalis*, and the number of fish species increased up to six (*Neoditrema ransonneti*, *Ditrema temmincki*, *Thamnaconus modestus*, *Stephanolepis cirrhifer* etc). At that time disappeared *Sebastes schlegeli* were observed again.

After then, the number of fish species was also six in May, nine in July and fourteen in September, which was the highest number (Table 1).

From July, 1999, number of species and abundance of fishes increased with increasing water temperature (above 20 °C). The number of *Thamnaconus modestus* and *Neoditrema ransonneti* were counted above 100 and 1,000, respectively, and they formed large school.

From this results, it was estimated that some of the released 0 age *Sebastes schlegeli* spreaded near the rocky shore of islands such as Cho-do, Yeondae-do, Manji-do and some of them stayed in the reef. It seemed that these fishes which grew at both rocky bottom near the islands and at the reefs moved to the artificial reefs or other rocky bottom from rocky shore.

Fishes showed three typical behavioral patterns against the experimental artificial reef (Fig. 3). First group (Fig. 3a), like a school of *Neoditrema ransonneti*, stayed above the reef. Second group (Fig. 3b) was observed in or on the reefs, which was composed of *Neoditrema ransonneti*, *Thamnaconus modestus*, *Stephanolepis cirrhifer*, *Ditrema temmincki*, *Neoditrema ransonneti*, *Rudarius ercodes*, *Sebastes thompsoni*, *Sebastes inermis*, *Sebastes schlegeli*,

Table 1. The list of fishes observed at the artificial reef located at 13 m depth bottom near the Manji-do, Tongyeong, Korea.

| Species | ⁹⁸ Nov. | ⁹⁹ Jan. | Mar. | May | July | Sep. | Nov. |
|----------------------------------|--------------------|--------------------|------|-----|------|------|------|
| <i>Sebastes schlegeli</i> | | | ○ | ○ | ○ | ○ | ○ |
| <i>Sebastes inermis</i> | | | | | ○ | ○ | ○ |
| <i>Sebastes thompsoni</i> | | | | | | ○ | ○ |
| <i>Sebastes vulpes</i> | | | | | | | ○ |
| <i>Ditrema temmincki</i> | | | ○ | ○ | ○ | ○ | ○ |
| <i>Neoditrema ransonneti</i> | | | ○ | ○ | ○ | ○ | ○ |
| <i>Stephanolepis cirrhifer</i> | | | ○ | | ○ | | |
| <i>Thamnaconus modestus</i> | | | ○ | | | | |
| <i>Rudarius ercodes</i> | | ○ | ○ | ○ | ○ | ○ | |
| <i>Hypodytes rubripinnis</i> | | ○ | ○ | ○ | ○ | ○ | ○ |
| <i>Halichoeres poecilopterus</i> | | | | | | ○ | |
| <i>Sillago japonica</i> | | | | | | ○ | |
| <i>Parapercis sexfasciatus</i> | ○ | ○ | | | ○ | ○ | ○ |
| <i>Sagamia geneionema</i> | ○ | ○ | | | ○ | | ○ |
| <i>Oplegnathus fasciatus</i> | | | | | | ○ | |
| <i>Apogon semilineatus</i> | | ○ | | | | | |
| <i>Pseudoblennius cottoides</i> | | | | ○ | | ○ | |
| <i>Hexagrammos otakii</i> | | | | | | | ○ |
| Number of species | 2 | 5 | 7 | 6 | 9 | 14 | 10 |

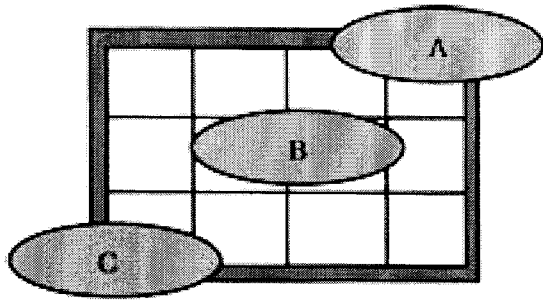


Fig. 3. Distributional aspect of gathering to the experimental artificial reefs. A : Attach and above of reef; B : Insides of reef; C : Bottom layer of reef.

Halichoeres poecilopterus and *Pseudoblennius cottoides*, etc. Among them, *P. cottoides* and *Hypodytes rubripinnis* sat down on the reef and *S. cirrhifer* and *T. modestus*, were swimming or stayed in the reef.

The last group (Fig. 3c), *Parapercis sexfasciatus*, *Sillago japonica*, and *Sagamia geneionema*, stayed at or near reef placed on mud bottom. The experiment on the behavioral response patterns of *S. inermis* and *S. schlegeli* on floating objects was conducted from August to November, 1998 at sea cages (12 m×12 m×7 m) in the experimental fish culture station of KORDI located at Tongyeong Bay. *Sebastes schlegeli* showed more attaching behavior to the objects than *S. inermis*. Large school of *S. schlegeli* was found only under a rope style object and a horizontally covered object, while a school of *S. inermis* remained near all the objects. The horizontally covered objects was more effective to attract the school of *S. inermis* and *S. schlegeli* than the vertically covered ones (KORDI 1998, 1999).

Four types of the experimental reefs were designed for the preliminary experiment in sea cages condition (KORDI 1998, 1999). There was no distinct behavioral pattern of *Sebastes* spp. to each structure. This may be due to the different environmental condition (water depth, illumination condition etc.). The experiment in the sea cages was conducted at the 1.5-3.5 m water depth with light condition but this reefs were positioned at 13 m depth. Therefore, fish behaviors and schooling patterns could be recorded under the various environmental conditions with combination between light condition and each structure.

Almost same fish fauna was found with 19 species at the artificial (plastic) seaweed bed which was placed near the reef (KORDI 1999). In this experiment, unfortunately, due to low transparency at the investigated area, it was impossible to estimate the exact number of fishes.

It is well known that the artificial reefs provided an essential habitat to marine organism including commercial species (Carter *et al.* 1985; Davis 1985; Spanier *et al.* 1985).

Consequently, more detailed and long-term studies on the fish behaviors and development of reef's structure and positioning should necessary to understand those fishes' ecology and to develop the new type of reefs for the marine ranching program.

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Reference

- Carter J.W., A.L. Carpenter, M.S. Foster, and W.N. Jessee. 1985. Benthic succession on an artificial reef designed to support a kelp-reef community. *Bull. Mar. Sci.*, 37(1), 86-113.
- Chung, M.K. 1977. *The Fishes of Korea*. Iljisa, Seoul, 727 p. (In Korean).
- Davis, G.E. 1985. Artificial structures to mitigate marine construction impacts on spiny lobster, *Panulirus argus*. *Bull. Mar. Sci.*, 37(1), 151-156.
- KORDI. 1998. *Studies on the Development of Marine Ranching Program in Tongyeong, Korea*. KORDI Report BSPM 98005-01-1116-3. MOMAF, Seoul, 980 p. (In Korean).
- KORDI. 1999. *Studies on the Development of Marine Ranching Program in Tongyeong, Korea*. KORDI Report BSPM 99021-00-1203-3. MOMAF, Seoul, 902 p. (In Korean).
- Masuda, H., K. Amaoka, C. Arage, T. Uyeno, and T. Yoshino. 1984. *The Fish Fauna of the Japanese Archipelago*. Tokai Univ. Press, Tokyo, Text 437 p., Plates 370 (In Japanese).
- Nakabo, T. 1993. *Fishes of Japan with Pictorial Keys to the Species*. Tokai Univ. Press, Tokyo, 1474 p. (In Japanese).
- Spanier, E., M. Tom, and S. Pisanty. 1985. Enhancement of fish recruitment by artificial enrichment of man-made reefs in the southeastern Mediterranean. *Bull. Mar. Sci.*, 37(1), 356-363.

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