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# Feeding Habits of *Rudarius ercodes* in a *Zostera marina* Bed

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Feeding habits of *Rudarius ercodes* collected from a *Zostera marina* bed in Jindong Bay, Korea were studied. *R. ercodes* was a omnivore which consumed mainly gammarid amphipods, polychaetes and eelgrass (*Z. marina*). Its diets also included a small amount of copepods, urochordates and caprellid amphipods. *R. ercodes* showed ontogenetic changes in feeding habits. Small individuals less than 2 cm SL fed mainly on copepods, however, gammarid amphipods and polychaetes were heavily selected with increasing fish size. The consumption of eelgrass by *R. ercodes* was 10-20% all size classes. The dietary breadth of *R. ercodes* were varied with fish size

Key words: *Rudarius ercodes*, Feeding habits, *Zostera marina* bed, Gammarid amphipods, Polychaetes

## Introduction

*Rudarius ercodes* (Family Monocanthidae) is widely distributed in a *Zostera marina* bed along the southern coast of Korea, and it is an important common fish species in several areas (Huh and Kwak, 1997; Lee et al., 2000). Despite their higher abundance in a *Z. marina* bed, very little has been known on the feeding ecology of *R. erocdoes*. Kwak et al. (2003) recorded that a monocanthid fish, *Stephanolepis cirrhifer* is a omnivore of consuming mainly amphipods (gammarids and caprellids) and *Z. marina*.

Feeding habits of many members of the family Monocanthidae have been reported by several workers (Randall, 1967; Bell et al., 1978; Kikuchi, 1974; Horinouch et al., 1998). Horinouchi et al. (1998) recorded that caprellid amphipods and polychaetes as a major prey for the *R. ercodes* and Kikuchi (1974) found that monocanthid fish species in Japan fed on bryozoan and polychaetes. Randall (1967) recorded seagrass as a major food items for the West Indian monocanthid fish. On the other hand, three sympatric monocanthid fish species (*Monacanthus chinensis*, *Meuschenia freycineti*, and *Meuschenia trachylepis*) in Australian seagrass beds consumed considerable amounts of seagrass and algae as well as animal material (Bell et al., 1978).

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The aim of this study is to investigate feeding habits of *R. ercodes* in a *Z. marina* bed and to determine the overall diet of this species and variations in diet in relation to fish size.

## Materials and Methods

All the sampling was carried out in an eelgrass (*Z. marina*) bed in Jindong Bay, Korea (35°06'N, 128°32'E). *Z. marina* was forming subtidal bands (500-700 m wide) in the shallow water (<3 m) along the shoreline of Jindong Bay.

*R. ercodes* were collected monthly with 5 m otter trawl (1.9 cm mesh wing and body; 0.6 cm mesh liner) from August 2001 to July 2002. Stomachs of fish were preserved immediately in 10% formaline, and length and weight of each fish were measured. Stomach contents were removed and transferred to 70% isopropanol for storage. Gut contents from each fish were identified and occurrence, number of individuals and dry weight of each prey species were recorded.

Dietary breadth index was calculated using Levins standardized index (Krebs, 1989):

$$B_i = 1/n\text{-}1(1/\sum_j P_{ij}^2\text{-}1)$$

Where $B_i$=Levins standardized index for predator i, $P_{ij}$=proportion of diet of predator i that is made

up of prey j, and n=number of prey categories. This index ranges from 0 to 1, with low values indicating diets dominated by a few prey items (specialist predators) and high values indicating generalist diets (Gibson and Ezzi, 1987; Krebs, 1989).

## Results and Discussion

### Size distribution

*R. ercodes* was present in a *Z. marina* bed from August 2001 to January 2002 (Fig. 1). Size range was 1.5-4.7 cm SL during the study period. *R. ercodes* first appeared as smaller individuals in August 2001 at a mean length class of 2-3 cm SL. This size group remained in a *Z. marina* bed until January 2002. Number of individuals peaked in September (139 individuals) and October 2001 (145 individuals) and then declined to a minimum value in January 2002.

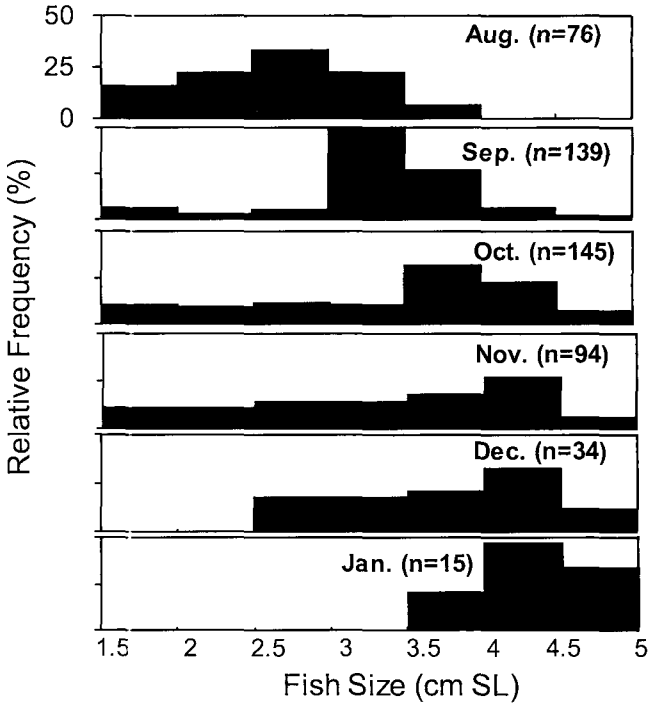


Fig. 1. Monthly variation in size distributions of *Rudarius ercodes*.

### Stomach contents analysis

A total of 454 stomaches were examined, of which 31 (6.8%) were empty. The stomachs contained 20 identifiable prey components (Table 1). Gammarid amphipods were the most important prey group for *R. ercodes*, comprising 32.5% of the diet by dry weight, 53.8% of the diet by number and occurring in 69.7% of all stomachs examined. *Ericthonius pugnax*, *Ampelisca* sp., *Corophium* sp. and *Ampithoe* sp. were the principal genera of gammarid amphipods consumed. After gammarid amphipods, polychaetes were secondary in importance, comprising 20.7% of the diet by weight, 8.1% of the diet by number and 34.9% of the diet by occurrence. Polychaetes *Platynereis* sp. and *Cirratulus* sp. were the principal prey items. Eelgrass, *Z. marina* (15.3% of the diet by dry weight and 49.5% of the diet by occurrence) was the next important dietary components. Urochordates, *Stylea* sp. and copepods were frequent prey groups, comprising 10.7%, 10.8% of the diet by dry weight. *Calanus sinicus* and *Centropages* sp. were the principal genera of copepods fed. Caprellid amphipods, tanaids and isopods were of minor importance.

### Variations in stomach contents in relation to fish size

Relationship between relative prey composition and body length of *R. ercodes* were presented in Fig. 2. Smaller *R. ercodes* (<2 cm SL) fed mainly on copepods. Some gammarid amphipods and eelgrass were also found. The portion of the diet attributable to copepods decreased gradually with increasing size, while proportions of gammarid amphipods, polychaetes and urochordates increased. On the other hand, the consumption of eelgrass by *R. ercodes* was relatively constant (10.1-20.3%) in all size classes. This size-related change of feeding habits of *R. ercodes* observed in the study area is generally similar to that of the fish in other *Z. marina* beds. Juvenile *R. ercodes* (<3 cm SL) fed mainly on copepods, whereas the larger individuals fed mainly gammarid amphipods in Kwangyang Bay (Kwak, 1997) and larger individuals of *R. ercodes* (>4 cm SL) consumed mainly on caprellid amphipods and polychaetes in Aburatsubo, central Japan (Horinouchi et al., 1998). Likewise, small individuals of *S. cirrhifer* (<2cm SL), one of monocanthid fish species in study area, consumed on copepods, while larger individuals fed on gammarid and caprellid amphipods (Kwak et al., 2003).

*R. ercodes* fed on larger sizes of prey with increasing size (Fig. 3). Larger *R. ercodes* more than 3 cm SL fed on larger gammarid amphipods (2.0-2.6 mm, mean length) and copepods (0.63-0.82 mm, mean length). The dietary breadth of *R. ercodes* varied with fish size (Fig. 4). The low dietary breadth of smaller *R. ercodes* increased to a maximum value at 2 cm SL, however, this value decreased with larger

Table 1. Percent composition of the stomach contents of *Rudarius ercodes* by frequency of occurrence, number and dry weight

| Prey organisms | Occurrence (%) | Number (%) | Dry weight (%) |
|---|---|---|---|
| Crustacea | | | |
| Amphipoda | | | |
| Gammaridea | 69.7 | 58.8 | 32.5 |
| *Ericthonius pugnax* | 34.8 | 14.8 | 8.1 |
| *Ampelisca* sp. | 35.4 | 13.6 | 7.4 |
| *Corophium* sp. | 25.8 | 11.8 | 6.5 |
| *Ampithoe* sp. | 20.6 | 10.6 | 5.9 |
| *Elasmopus* sp. | 17.4 | 4.7 | 2.7 |
| *Melita* sp. | 15.6 | 3.3 | 1.9 |
| Caprellidea | 10.7 | 4.6 | 1.5 |
| *Caprella kroeyeri* | 5.7 | 2.7 | 0.9 |
| *Caprella* sp. | 3.4 | 1.9 | 0.6 |
| Copepoda | 23.7 | 20.7 | 10.8 |
| *Calanus sinicus* | 15.8 | 9.7 | 5.0 |
| *Centropages* sp. | 10.6 | 8.4 | 4.4 |
| *Tortanus forcipatus* | 9.8 | 2.6 | 1.4 |
| Tanaidacea | | | |
| *Tanais cavolinii* | 3.7 | 0.5 | 0.1 |
| Isopoda | | | |
| *Cymodoce japonica* | 1.7 | 0.2 | 0.1 |
| Polychaeta | 34.9 | 8.1 | 20.7 |
| *Platynereis* sp. | 17.6 | 2.4 | 6.1 |
| *Cirratulus* sp. | 15.2 | 2.3 | 5.9 |
| *Lumbrineris* sp. | 10.8 | 1.1 | 2.8 |
| Unidentified | 15.4 | 2.3 | 5.9 |
| Bivalvia | 19.7 | 2.4 | 7.8 |
| Urochordata | | | |
| *Stylea* sp. | 29.7 | 4.8 | 10.7 |
| Seagrass | | | |
| *Zostera marina* | 49.5 | | 15.3 |
| Total | 100 | 100 | 100 |

fish size.

Several authors have reported changes in feeding habits of monocanthid fish species with size in the seagrass beds. For example, *M. chinensis* (<10 cm SL) in *Posidonia australis* beds in Quibary, New South Wales, Australia, fed mainly on gammarid amphipods, whereas larger individuals (>10 cm SL) consumed mainly on seagrass and gammarid amphipods (Conacher et al., 1979; Bell et al., 1978) and amphipods and algae were mainly consumed by larger size of *M. australis*, *M. freycineti* (Last, 1975). However, seagrass as a major food item (67%) for the West Indian monocanthid species, *Alutera schoepfi*, and small crustaceans adhering to *Z. marina* were important prey group for larger monocanthid fish in Japan (Randall, 1967; Kikuchi, 1974).

Thus most of monocanthid species undergoes a similar type of size-related changes regardless of location and climate, although relative percentage of main prey organisms consumed is different among species. This results is probably due that monocanthid species have specialized mode of feeding on epiphytic organisms with small mouth and their secretive behavior (Bell et al., 1978; Conacher et al., 1979; Kwak, personal observation). Most of monocanthid species use specialized teeth to bite off heavily small invertebrates and pieces of seagrass and after digesting the encrusting organisms, the seagrass pieces are apparently expelled undigested (Bell et al., 1978). Secondly high abundances of small epiphytic invertebrates such as crustaceans and polychaetes support monocanthid fish species in a *Z. marina* bed (Horinouchi et al., 1998; Kwak, unpublished data), as it also is elsewhere (Last, 1975; Bell et al., 1978;

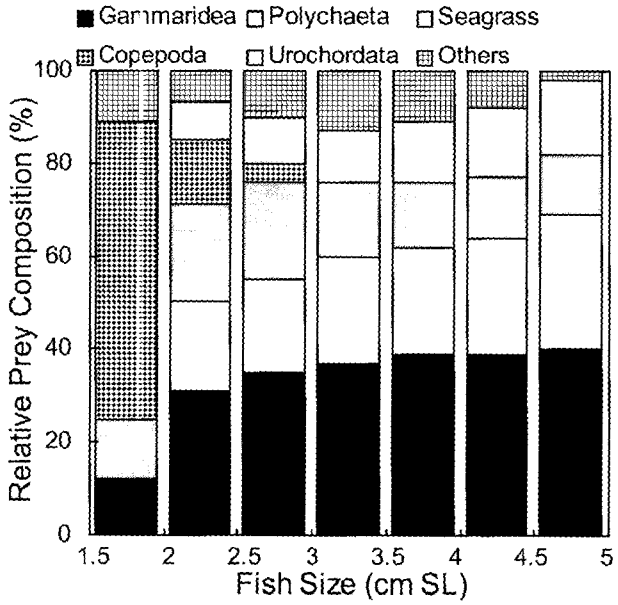


Fig. 2. Relationships between relative prey composition (DW, %) and body length of *Rudarius ercodes*.

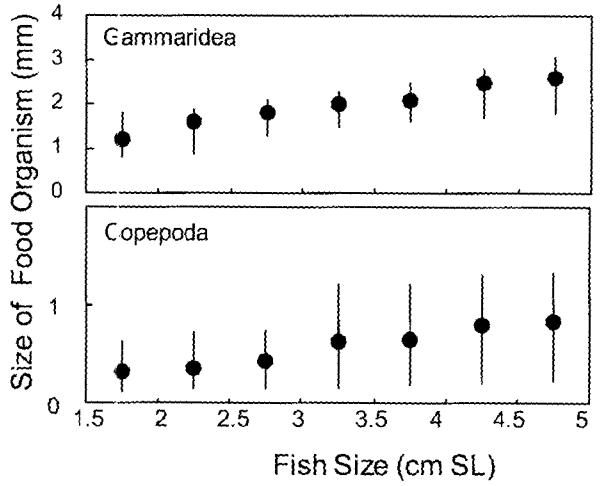


Fig. 3. Relationships between size of food organisms and body length of *Rudarius ercodes* (total length for Gammaridea and Copepoda) Solid circle and vertical bar represent the mean and range, respectively.

Pollard, 1984; Edgar, 1992).

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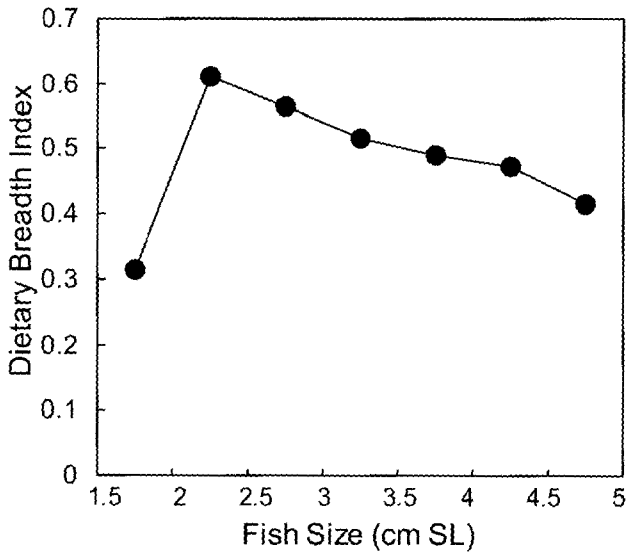


Fig. 4. The size-related variations of dietary breadth index of *Rudarius ercodes*.

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