

# Feeding Habits of *Hippocampus mohnikei* in an Eelgrass (*Zostera marina*) Bed

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**ABSTRACT** Feeding habits of *Hippocampus mohnikei* (4.1 ~ 10.4 cm SL) collected from an eelgrass bed in Dongdae Bay, Korea were studied. *H. mohnikei* was a carnivore fish which consumed mainly gammarid amphipods. Its diets also included a small amount of caprellid amphipods, tanaids, copepods, mysids, and eelgrass. Gammarid amphipods were the most important prey organisms to the diet of all size classes of *H. mohnikei* despite smaller *H. mohnikei* (<4.5 cm SL) fed copepods. *H. mohnikei* fed on larger sizes of prey as their size increased. The dietary breadth of *H. mohnikei* were decreased with increasing their size.

**Key words** : *Hippocampus mohnikei*, feeding habits, eelgrass bed, gammarid amphipods

## INTRODUCTION

*Hippocampus mohnikei* (Family Syngnathidae) is commonly associated with particular habitat types (e.g. seagrass beds, mangroves, and corals) where they often mimic leaves (Pollard, 1984; Klumpp *et al.*, 1989). Such association may reflect the distinctive functional morphology of fishes and their adaptation to particular environmental conditions (Keast and Webb, 1966; Motta *et al.*, 1995; Kendrick and Hyndes, 2003). The family Syngnathidae including *Hippocampus mohnikei* and *Syngnathus schlegeli* is widely distributed in the eelgrass beds along the southern coast of Korea, and it is valued as aquarium fishes (Huh and Kwak, 1997; Lee *et al.*, 2000; Im, 2004). Although these species are prevalent in the eelgrass beds, little has been known of the feeding ecology of *H. mohnikei* and syngnathid fishes. The wide feeding habits of *H. mohnikei* in the eelgrass bed was particularly interested despite it has been documented that a syngnathid fish, *S. schlegeli* consumed on mainly copepods and gammarid amphipods in the eelgrass bed of Kwangyang Bay (Huh and Kwak, 1997).

Feeding habits of some members of syngnathids fish in the seagrass beds have been reported by several workers worldwide. Burchmore *et al.* (1984) recorded that am-

phipods and mysids as major prey for *H. whitei* in the Port Hacking, Australia, and *S. scovellii* fed on copepods in Redfish Bay, U.S.A. (Huh and Kitting, 1985). Ryre and Orth (1987) reported that *S. fuscus* consumed considerable amounts of amphipods as well as copepods in Chesapeake Bay, U.S.A.

This study examines overall diets of *H. mohnikei* in an eelgrass bed and variations in diet in relation to fish size.

## MATERIALS AND METHODS

All the sampling was carried out in an eelgrass bed in Dongdae Bay, Korea (35° 54'N, 128° 03'E). *Z. marina* was forming subtidal bands (500 ~ 700 m wide) in the shallow water (< 3 m) along the shoreline of Dongdae Bay.

*Hippocampus mohnikei* were collected monthly with 5 m otter trawl (1.9 cm mesh wing and body; 0.6 cm mesh liner) throughout 2005. 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

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standardized index (Krebs, 1989):

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

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

### 1. Size distribution

*Hippocampus mohnikei* presented in an eelgrass bed

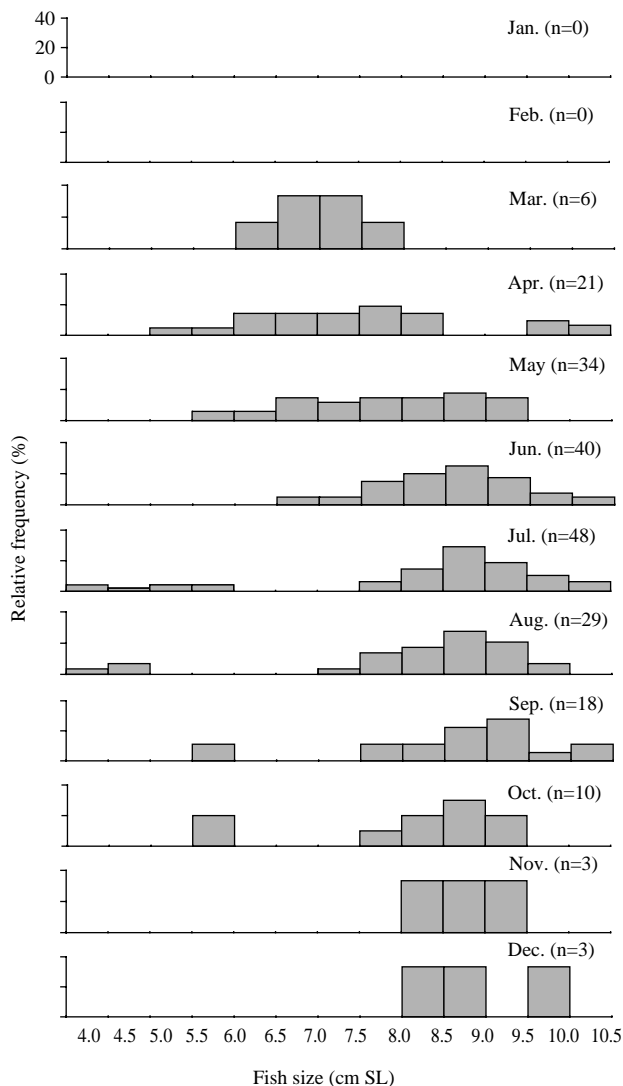


Fig. 1. Monthly variation in size distributions of *Hippocampus mohnikei*.

from March 2005 to December 2005 (Fig. 1). Size range was 4.1 ~ 10.4 cm SL during the study period. *H. mohnikei* first appeared as 6.0 ~ 7.5 cm SL individuals in March 2005, and the most of individuals were 5.0 ~ 10.4 cm SL from April 2005 to June 2005. On the other hand, smaller individuals (4.0 ~ 4.5 cm SL) moved in July 2005 and August 2005, and this size group remained in the study area until December 2005 when occurred in size ranged from 5.5 ~ 9.5 cm SL. Number of individuals was few in March 2005 and April 2005, peaked in June 2005 and July 2005 and then declined gradually in the remaining periods. Several studies were demonstrated that the smaller individuals (< 10 cm SL) of syngnathid fishes including *Hippocampus* sp. were occurred in the eelgrass beds worldwide (Klumpp *et al.*, 1989; Hoang *et al.*, 1998; Kendrick and Hydnes, 2003)

### 2. Stomach contents analysis

A total of 198 stomachs were examined, of which 14 (6.6%) were empty. The stomachs contained 20 identifiable prey components (Table 1). Gammarid amphipods account for the almost entire diet by weight (83.2%), comprising 80.0% of the diet by number and occurring in 71.8% of all stomachs examined. *Ericthonius pugnax*, *Ampelisca* sp., and *Corophium* sp. were the principal

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

Prey organisms	Occurrence (%)	Number (%)	Dry weight (%)
<b>Crustacea</b>			
<b>Amphipoda</b>			
<b>Gammaridea</b>	<b>71.8</b>	<b>80.0</b>	<b>83.2</b>
<i>Ericthonius pugnax</i>	35.8	17.1	17.2
<i>Ampelisca</i> sp.	30.6	15.6	15.7
<i>Corophium</i> sp.	29.7	13.4	13.6
<i>Elasmopus</i> sp.	24.3	8.7	8.8
<i>Melita</i> sp.	20.1	7.8	8.3
<i>Ampithoe</i> sp.	13.5	6.6	6.9
<i>Leucothoe</i> sp.	11.1	3.4	4.9
<i>Podocerus</i> sp.	9.8	3.8	3.9
<i>Cymadusa</i> sp.	7.7	2.3	2.4
<i>Ericthonius</i> sp.	5.5	1.3	1.5
<b>Caprellidea</b>	<b>13.6</b>	<b>6.9</b>	<b>5.6</b>
<i>Caprella kroeyeri</i>	15.6	5.1	4.5
<i>Caprella scaura</i>	7.3	1.8	1.1
<i>Caprella</i> sp.			
<b>Tanaidacea</b>			
<i>Tanais cavolinii</i>	<b>10.6</b>	<b>6.0</b>	<b>3.7</b>
<b>Copepoda</b>	<b>12.2</b>	<b>5.6</b>	<b>3.2</b>
<i>Acartia omorii</i>	11.1	2.2	1.8
<i>Calanus sinicus</i>	5.8	1.4	0.7
<i>Centropages yamadai</i>	4.2	0.6	0.5
<i>Oncaea</i> sp.	2.8	1.4	0.2
<b>Mysidacea</b>	<b>2.1</b>	<b>1.5</b>	<b>2.3</b>
<b>Seagrass</b>			
<i>Zostera marina</i>	<b>12.8</b>		<b>2.0</b>
Total		100	100

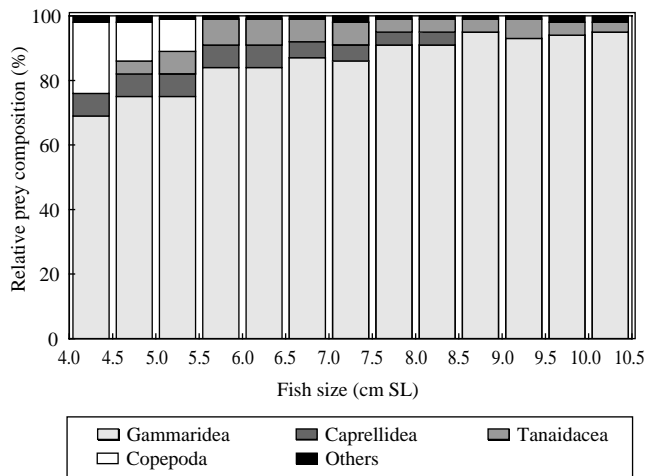


Fig. 2. Relationships between relative prey composition (DW, %) and body length of *Hippocampus mohnikei*.

genera of gammarid amphipods consumed. After gammarid amphipods, caprellid amphipods were secondary in importance, comprising 5.6% of the diet by weight, 6.9% of the diet by number and 13.6% of the diet by occurrence. *Caprella kroeyeri* was the principal prey items. Taniads, *Tanais cavolinii* and copepods were frequent prey groups, comprising 3.7%, 3.2% of the diet by dry weight. Mysids and eelgrass, *Z. marina*, were of minor importance. Such conclusion are in general agreement with other studies of feeding habits of *H. whitei* in New South wales, Australia consumed mainly on amphipods (Burchmore *et al.*, 1984).

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

Relationship between relative prey composition and body length of *H. mohnikei* were presented in Fig. 2. Gammarid amphipods were the most important contributor to the diet of all size classes of *H. mohnikei* although smaller *H. mohnikei* (<4.5 cm SL) fed copepods. This size-related change of feeding habits of *H. mohnikei* observed in the study area is generally similar to that of the syngnathid fishes in other seagrass beds. Most of *H. whitei* in New South wales, Australia consumed mainly on amphipods regardless of age and size, and the smallest individuals of *S. fuscus* fed on copepods and amphipods, whereas the larger individuals fed heavily on gammarid amphipods in Chesapeake Bay, U.S.A (Burchmore *et al.*, 1984; Ryre and Orth, 1987). Likewise, all size classes of *S. schlegeli* fed on gammarid amphipods and copepods in Kwangyang Bay (Huh and Kwak, 1997).

Thus most of syngnathid fish species undergoes a similar type of size-related changes regardless of location and climate, although relative percentage of main

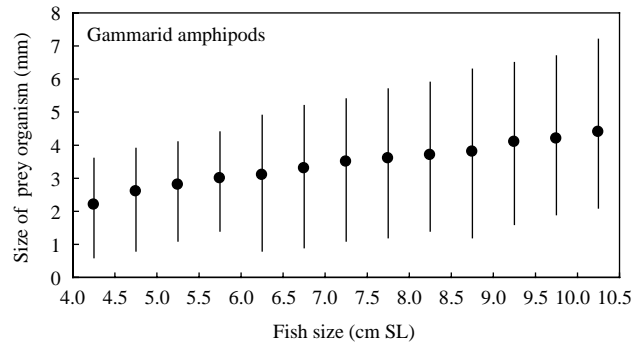


Fig. 3. Relationships between size of prey organisms and body length of *Hippocampus mohnikei* (total length for gammarid amphipods). Solid circle and vertical bar represent the mean and range, respectively.

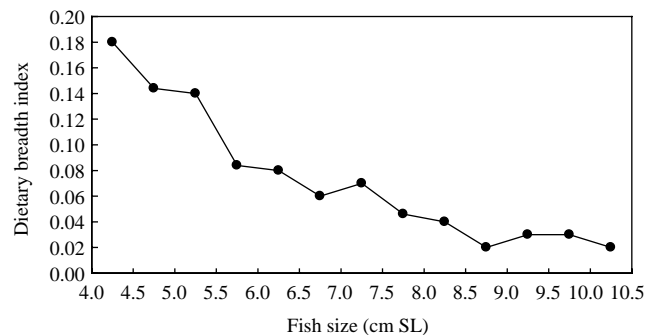


Fig. 4. The size-related variations of dietary breadth index of *Hippocampus mohnikei*.

prey organisms is different among species. These results probably due to syngnathid fish species' feeding mode on epiphytic organisms with small mouth and with long projecting snouts which is a probe for food (Hoang *et al.*, 1998; Kendrick and Hydnes, 2003). Secondly these fish species were found particular habitat types such as seagrasses, mangroves, and corals in temperate and tropical areas because of their peculiar morphology of bodies. For example, most of syngnathid fish species including genus *Hippocampus* use weakly prehensile tails to grasp seagrass leaves, which they closely mimic in colour and shape (Gomon *et al.*, 1994; Kuitert, 2000; Kwak personal observation). Such developed camouflage has been suggested to enhance both ambush predation by these fish species and avoidance of predators. Furthermore high abundances of amphipods in an eelgrass bed may be more available for predation of syngnathid fish species.

*Hippocampus mohnikei* fed on larger size of prey organisms as their size was increased (Fig. 3). Larger *H. mohnikei* more than 9.0 cm SL fed on larger gammarid amphipods (4.1 ~ 4.4 mm, mean length). The dietary breadth of *H. mohnikei* varied with fish size (Fig. 4). Higher dietary breadth of smaller *H. mohnikei* decreased

very sharply to minimum value in the largest individuals of *H. mohnikei*.

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## 동대만 잘피밭에 서식하는 산호해마의 식성

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**요 약 :** 2005년 1월부터 2005년 12월까지 동대만의 잘피밭에서 채집된 산호해마(4.1~10.4 cm SL)의 식성을 조사하였다. 산호해마의 주요 먹이는 옆새우류였으며, 그 외, 카프렐라류, 주걱벌레붙이류, 요각류, 곤쟁이류 및 잘피 등을 소량 섭식하였다. 산호해마는 모든 체장에서 옆새우류를 주로 섭식하였으며, 작은 크기(<4.5 cm SL)에 서는 요각류도 섭식하였다. 또한 성장함에 따라 섭식하는 먹이생물의 크기는 증가하였으나, dietary breadth는 서서히 감소하는 양상이었다.

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**찾아보기 낱말 :** 산호해마, 식성, 잘피밭, 옆새우류