# Feeding Selection on Mollusk by the Indochinese Molluscivorous Catfish (*Helicophagus leptorhynchus* Ng & Kottelat, 2000) in the Mun River, Thailand

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## ABSTRACT

The gut contents of the Indochinese molluscivorous catfish, *Helicophagus leptorhynchus* were investigated. The fish were collected from the Mun River, the largest Mekong tributary in Thailand, between February 2008 and February 2009. Two sampling sites with different geographical characteristics, i.e. Tha Ngoi and Khong Chiam, were selected. The first site has a muddy and sandy bottom and the other site has rapids with deep pools. Food items were dominated by mollusks with some other food types occasionally found. Twenty species of mollusks, both gastropods and bivalves, were observed, namely *Corbicula moreletiana*, *Pachydrobia zilchi reducta*, *Melanoides tuberculata*, *Lacunopsis munensis* and *Limnoperna siamensis*. The finding is contrary to previous reports on the feeding habits of *H. leptorhynchus* which said that this fish species feeds exclusively on bivalves. This study showed that food items were manipulated by space and time as well as life stage of the fish. Results also showed that the larger the fish grows, the bigger the mollusks that are being chosen as food.

**Keywords:** *Helicophagus leptorhynchus*, gut contents, mollusks

## INTRODUCTION

Pangasiid catfish is a genus of medium-large to very large catfishes native to freshwaters in South and Southeast Asia which dominate among fish families in the Lower Mekong Basin (Valbo-Jørgensen *et. al*., 2009). They are skin fishes with the maximum sizes of adults varying from less than 40 cm in *Pseudolais pleurotaenia* to more than 200 cm in *Pangasianodon gigas* (Ferraris, 2007). The fish in this family are known as long distance migratory species along the river mainstream to complete their cycle, *aka* protamodromous fishes (Roberts and Vidthayanon, 1991).

The Indochinese molluscivorous catfish, *Helicophagus leptorhynchus* Ng & Kottelat, 2000, is one of the economically important species among the pangasiids. The adults can reach up to 70 cm TL and

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mature at about 30 cm TL with the adhesive egg type (Jutagate *et. al*., 2007). This species is particularly common along the middle area of the lower Mekong Basin, i.e. between the upper Khone Falls and upstream to the Loei River (Poulsen *et. al*., 2004). *H. leptorhynchus* feeds almost entirely on mollusks and migrates upstream when water levels begin to rise at the beginning of the rainy season, then moves downstream as water clears at the end of the rainy season (Rainboth, 1996).

The Mun River, the largest Mekong tributary in Thailand (117,000 $km^2$), and the longest (641 km) in northeastern Thailand, is the native habitat of *H. leptorhynchus* (Thai National Mekong Committee, 2004). In the Mun River, the spawning ground of *H. leptorhynchus* covers the area from Tana Rapids to Sapue Rapids, i.e. in total about 44 km. Then, after hatching, the juveniles, accompanying their adults, drift along the reverse flow and migrate further upstream to the floodplain in Swang Weerawong District for nursing and feeding purposes (Thapanand, 2006).

Similar to the other two *Helicophagus* species (i.e. *H. typus* and *H.waandersii*), fishes of this genus are always reported as feeding predominantly on bivalves (e.g. Roberts and Vidthayanon, 1991; Ng and Kottelat, 2000; Jiwyam and Tippayadara, 2009; Kulabtong *et. al*., 2012). Therefore, the aim of this paper was to determine the variation on feeding selection of *H. leptorhynchus* collected from the Mun River. Moreover, the relationships between the mouth- and mollusk-shapes were also presented to elucidate how the fish feed on the mollusks.

## MATERIALS AND METHODS

Field surveys were conducted monthly between February 2008 and February 2009. There were 2 sampling sites, namely Tha Ngoi and Khong Chiam (Fig. 1). The first site has muddy and sandy bottom while the other site is the area of rapids with deep pools. Fish specimens were collected from local fishermen and preserved immediately in 10% buffer formalin, then transferred to 80% ethanol after a week of preservation. All specimens were catalogued at Ubon Ratchathani University Natural History Museum of Fishes. In the museum, each individual specimen was measured (cm. SL.) and weighed. The mouth width and length (Fig. 2) of each specimen were also measured. Each fish was then dissected to study the gut contents. Food items found in the guts, were washed in a Petri dish, taxonomically identified and counted under a stereomicroscope. Shapes of the mollusk-shell, two dimensions each for gastropods and bivalves, were also measured (Fig. 3). The obtained data was presented by number and frequency of occurrence and calculated as percentage, i.e. % number and % occurrence, respectively.

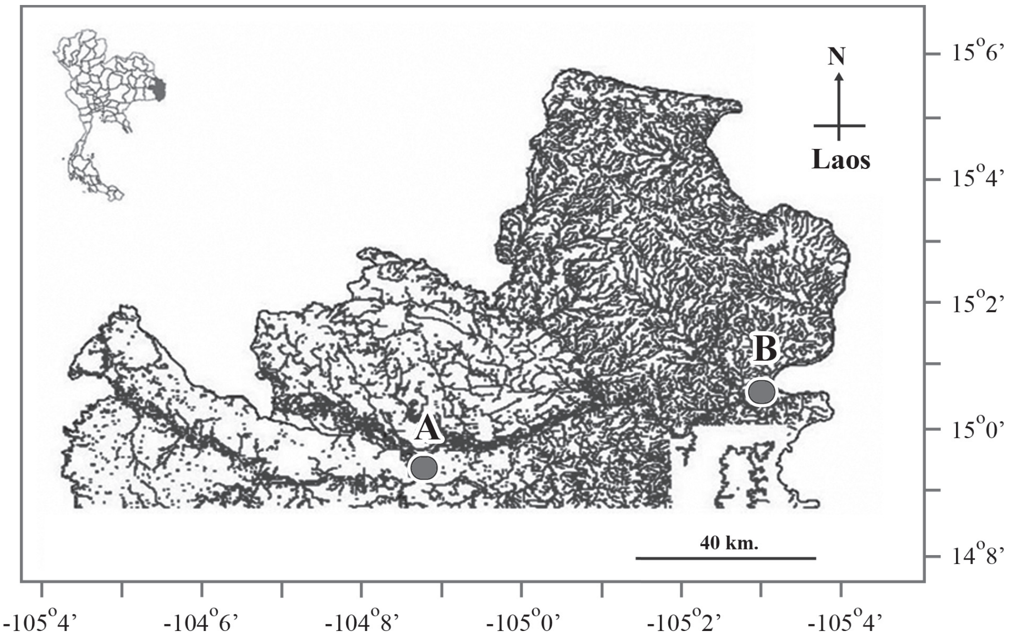


Figure 1. Location and map of the sampling sites (A = Tha Ngoi and B = Khong Chiam).

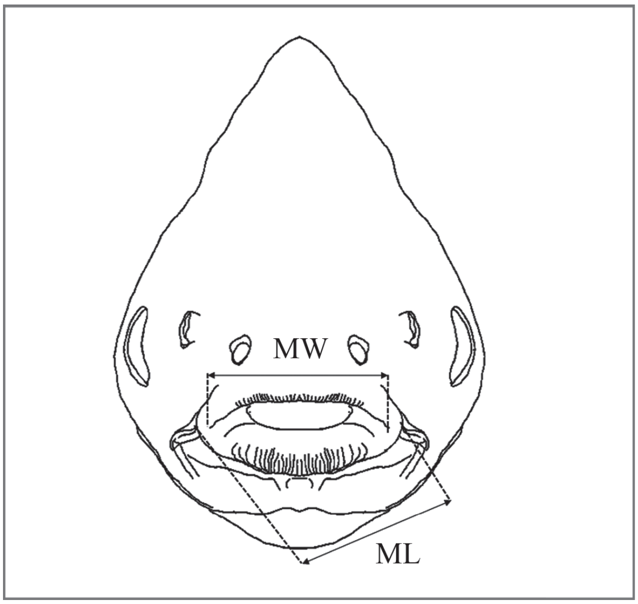


Figure 2. Measurement for dimension of mouth, *Helicophagus leptorhynchus*.

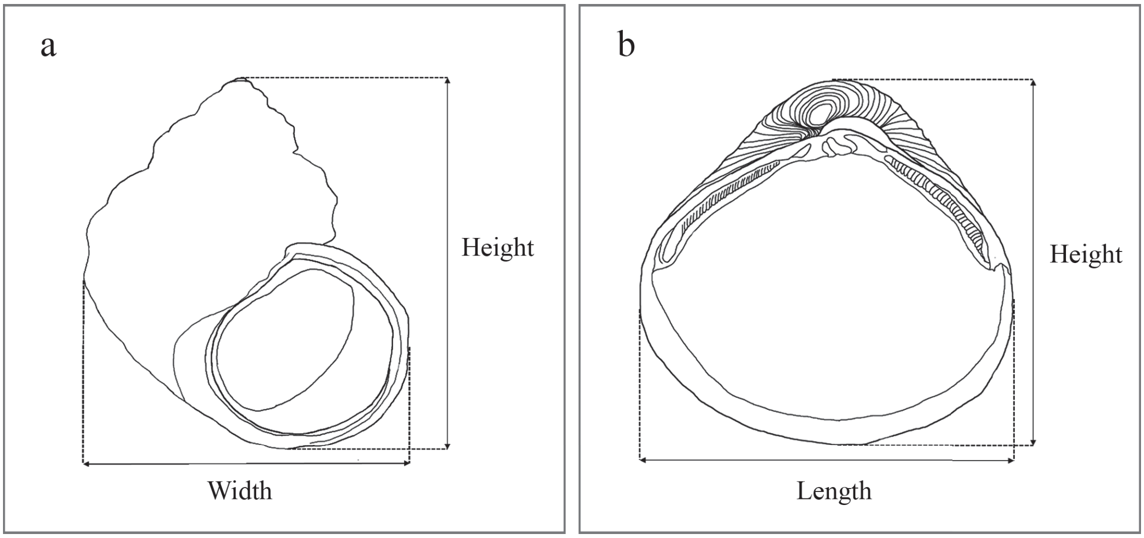


Figure 3. Measurement for dimension of Mollusk's shell (gastropod and bivalves).

**Data analysis**

Importance of each individual i$^{th}$ food item was analyzed by mean of index of relative importance (IRI%: Hyslop, 1980) as

$$IRI_i = \%number \times \%occurrence \text{ ------------- } (1)$$

and

$$\%IRI_i = \left(\frac{IRI_i}{\sum_{i=1}^{n} IRI_i}\right) \times 100 \text{ ------- } (2)$$

% IRI was calculated for both the spatio-temporal and life stage approaches. The hierarchical Ward agglomerative clustering analysis (Ward, 1963) was applied to % occurrence data of the food items to characterize the similarity of consumed items for each sample, i.e. combinations between sampling sites and months. Differences among clusters were tested statistically with analysis of similarities (ANOSIM) with 999 permutations.

The relationship between mouth shapes and dimensions of the mollusk-shell was estimated by the coefficient of correlation ($r$). The prediction models between the shapes of mouth and mollusk, which showed the highest $r$ value for each mouth dimension, were also estimated by simple linear regression. All statistical analyses were done by Program R (R Development Core Team, 2012).

## RESULTS

There were 822 *H. leptorhynchus* collected throughout the study period, with sizes ranging from 5.2 to 56.7 cm. for SL and from 1 to 2,200 g for weight (Table 1).

Table 1. Summary information of *H. leptorhynchus* collected throughout the study.

| Sample | Date | Site | Number | Length (cm.SL.) | | Weight (g.) | |
|---|---|---|---|---|---|---|---|
| | | | | Range | Mean ± SD | Range | Mean ± SD |
| 1 | Feb. 2008 | Tha-Ngoi | 46 | 11.0 - 17.6 | 14.2 ± 1.4 | 10 - 48 | 24.9 ± 7.5 |
| 2 | Feb. 2008 | Khong-Chiam | 24 | 13.6 - 27.4 | 14.5 ± 4.0 | 33 - 181 | 107.3 ± 41.4 |
| 3 | Apr. 2008 | Khong-Chiam | 76 | 10.1 - 28.3 | 14.5 ±4.0 | 8 - 169 | 37.7 ± 33.0 |
| 4 | May 2008 | Tha-Ngoi | 9 | 21.2 – 46.0 | 25.5 ± 3.2 | 86 - 298 | 169.2 ± 75.6 |
| 5 | Jun. 2008 | Tha-Ngoi | 78 | 9.0 - 24.2 | 14.6 ± 5.4 | 5 - 129 | 40.0 ± 44.5 |
| 6 | Jun. 2008 | Khong-Chiam | 19 | 22.5 - 41.0 | 30.2 ± 4.3 | 110 - 730 | 302.4 ± 137.3 |
| 7 | Jul. 2008 | Tha-Ngoi | 126 | 6.4 - 26.2 | 12.3 ± 3.8 | 3 - 125 | 21.5 ± 25.0 |
| 8 | Jul. 2008 | Khong-Chiam | 34 | 5.2 - 16.3 | 11.9 ± 3.4 | 1 - 50 | 23.1 ± 15.4 |
| 9 | Aug. 2008 | Tha-Ngoi | 37 | 5.3 - 19.7 | 12.5 ± 4.0 | 1 - 92 | 29.1 ± 23.43 |
| 10 | Sep. 2008 | Tha-Ngoi | 39 | 9.3 - 56.7 | 17.9 ± 10.4 | 6 - 2,200 | 151.6 ± 405.4 |
| 11 | Oct. 2008 | Tha-Ngoi | 105 | 14.9 - 28.9 | 20.8 ± 2.8 | 28 - 269 | 92.6 ± 46.7 |
| 12 | Nov. 2008 | Tha-Ngoi | 104 | 11.8 - 22.3 | 15.7 ± 1.9 | 18 - 102 | 39.0 ± 15.3 |
| 13 | Dec. 2008 | Tha-Ngoi | 32 | 12.3 - 26.7 | 16.6 ± 2.8 | 18 - 198 | 54.8 ± 33.0 |
| 14 | Dec. 2008 | Khong-Chiam | 33 | 24.3 - 44.5 | 33.1 ± 4.2 | 128 - 1,000 | 343.8 ± 168.0 |
| 15 | Jan. 2009 | Khong-Chiam | 15 | 27.4 - 34.3 | 31.2 ± 2.0 | 201 - 399 | 299.4 ± 55.2 |
| 16 | Feb. 2009 | Tha-Ngoi | 29 | 11.9 - 24.9 | 15.6 ± 2.1 | 11 - 137 | 36.8 ± 21.2 |
| 17 | Feb. 2009 | Khong-Chiam | 16 | 13.4 - 28.6 | 21.2 ± 4.2 | 2 - 216 | 86.3 ± 50.5 |

The highest number of fish was obtained in October 2008 at Tha Ngoi, whereas none was collected in March 2008. The major food item of *H. leptorhynchus* was mollusks, with non-mollusks occasionally found in the guts (Table 2). Of the 20 species of mollusks found in the guts, 11 were gastropods and 9 were bivalves (Table 3).

The dominant food items in each sample (i.e. the combinations between sampling sites and months) were determined through the % IRI (Table 4). The bivalve CMO (see Table 3 for abbreviations) dominated, i.e. the highest % IRI in 9 out of 17 samples, and constituted over 90% of % IRI in Khong Chiam in February 2008 and 2009, April 2008 and July 2008, as well as August 2008 in Tha Ngoi. Meanwhile the gastropod PZI showed the highest % IRI in May, June, September and November from Tha Ngoi. The bivalve LMU had high % IRI values during December 2008 and January 2009 in Khong Chiam, meanwhile the gastropod MTU and bivalve LSI each dominated once in the gut contents in July 2008 and December 2008, respectively, in Tha Ngoi. It is also worthy to note that, between the two sampling sites, the gut contents in fish from Tha Ngoi were composed of more than one species meanwhile only a single food item was observed in the fish from Khong Chiam.

The cluster analysis of the gut contents produced four clusters of samples (Fig. 4),

Table 2. List of food items found in the gut of *H. leptorhynchus* collected throughout the study (0 = absence; 1 = presence). Refer to Table 3 for the full names of the abbreviations.

| **Sample (as in Table 1)** | **Gastropods** | | | | | | | | | | | **Bivalves** | | | | | | | | | **Non mollusks** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **ALA** | **MSP** | **PZI** | **PCR** | **LMU** | **SBA** | **SOV** | **MTU** | **CHE** | **CSP** | **CSP2** | **LSI** | **SPI** | **PSP** | **SCR** | **HMU** | **EIN** | **TSP** | **CMO** | **CLE** | **insect** | **fish** | **shrimp** | **parasite** | **debris** |
| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 6 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 7 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 10 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| 11 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 12 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 13 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 14 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 15 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 16 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 17 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |

Table 3. List of the mollusks found in gut of *H. leptorhynchus* and their abbreviations (Abb.) as shown in Table 2.

| **No** | **Scientific names** | **Abb.** | **No** | **Scientific names** | **Abb.** |
|---|---|---|---|---|---|
| | **Gastropod** | | | **Bivalve** | |
| 1 | *Anulotaia lagrandierei* | ALA | 1 | *Corbicula leviuscula* | CLE |
| 2 | *Clea helena* | CHE | 2 | *Corbicula moreletiana* | CMO |
| 3 | *Clea* sp. | CSP2 | 3 | *Ensidens ingallsianus* | EIN |
| 4 | *Clea spinosa* | CSP | 4 | *Harmandia munensis* | HMU |
| 5 | *Lacunopsis munensis* | LMU | 5 | *Physunio* sp. | PSP |
| 6 | *Mekongia sphaericula sphaericula* | MSP | 6 | *Limnoperna siamensis* | LSI |
| 7 | *Melanoides tuberculata* | MTU | 7 | *Scabies crispata* | SCR |
| 8 | *Pachydrobia crooki* | PCR | 8 | *Scaphula pinna* | SPI |
| 9 | *Pachydrobia zilchi reducta* | PZI | 9 | *Trapezoideus* sp. | TSP |
| 10 | *Stenothyra basisculpta* | SBA | | | |
| 11 | *Stenothyra ovalis* | SOV | | | |

Table 4. Percentage of the index of relative importance (% IRI) of the top three food items in the gut of *H. leptorhynchus* (T = Tha Ngoi; K = Khong Chiam).

| **Feb. 2008 (T)** | | **Feb. 2008 (K)** | | **Apr. 2008 (K)** | | **May 2008 (T)** | | **Jun. 2008 (T)** | | **Jun. 2008 (K)** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** |
| CMO | 66.91 | CMO | 96.48 | CMO | 98.79 | PZI | 93.42 | PZI | 45.49 | CMO | 83.35 |
| PZI | 31.95 | CLE | 3.45 | CLE | 1.2 | CMO | 5.85 | MTU | 44.19 | LSI | 11.33 |
| MSP | 0.99 | LSI | 0.07 | CHE | 0.01 | CHE | 0.57 | CMO | 7.3 | CLE | 3.49 |

| **Jul. 2008 (T)** | | **Jul. 2008 (K)** | | **Aug. 2008 (T)** | | **Sep. 2008 (T)** | | **Oct. 2008 (T)** | | **Nov. 2008 (T)** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** |
| MTU | 97.03 | CMO | 99.99 | CMO | 99.94 | PZI | 57.54 | CMO | 77.64 | PZI | 53.39 |
| PZI | 0.88 | LSI | 0.01 | LSI | 0.06 | MTU | 21.74 | PZI | 20.65 | MSP | 19.74 |
| CMO | 0.8 | | | | | CMO | 13.71 | CLE | 0.98 | CMO | 14.52 |

| **Dec. 2008 (T)** | | **Dec. 2008 (K)** | | **Jan. 2009 (K)** | | **Feb. 2009 (T)** | | **Feb. 2009 (K)** | |
|---|---|---|---|---|---|---|---|---|---|
| **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** | **Species** | **%IRI** |
| LSI | 89.72 | LMU | 91.58 | LMU | 89.66 | CMO | 49.35 | CMO | 99.2 |
| SPI | 4.77 | CLE | 3.25 | SBA | 9.49 | LSI | 46.41 | CLE | 0.75 |
| PZI | 4.53 | CSP | 2.59 | CHE | 0.49 | MSP | 3.03 | LMU | 0.03 |

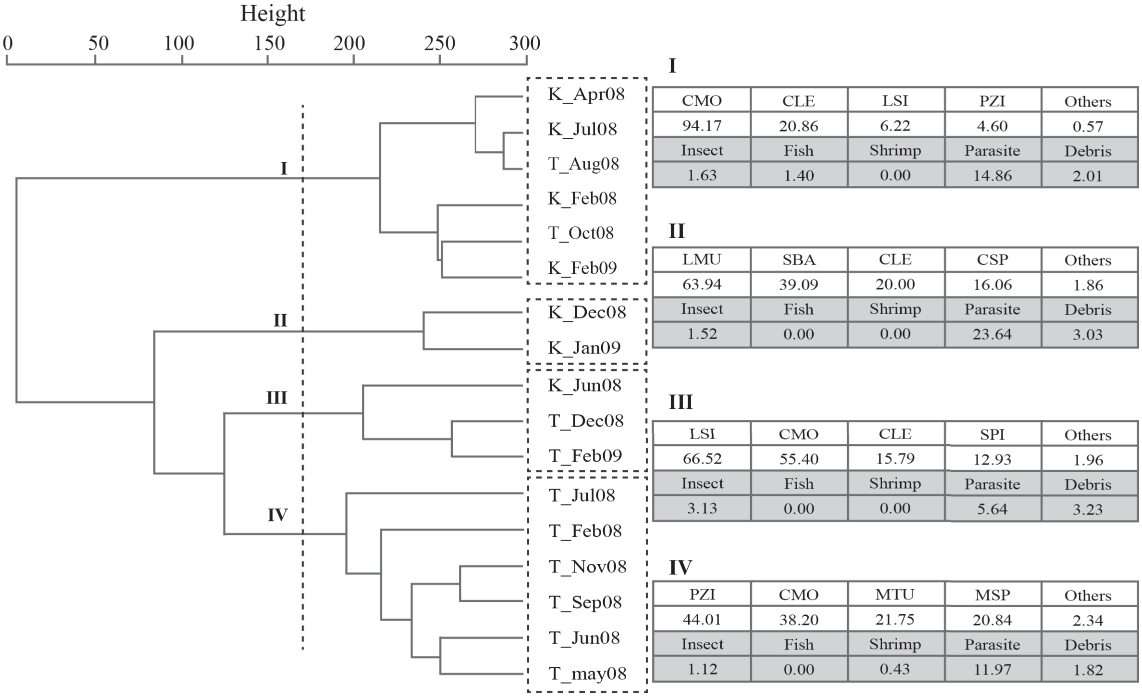


Figure 4. Dendrogram of the cluster analysis results corresponding to the combination of sites and months of sampling by using % occurrence.

with different structures of gut contents, in terms of % occurrence (ANOSIM test, *P-value < 0.05*). Cluster I included the samples from both sampling sites, with the bivalve CMO showing the highest % occurrence in this cluster, followed by the bivalve CLE. The preyed fish in the gut was found only in this cluster. Cluster II contained only two samples from Khong Chiam in December 2008 and January 2009. The food items in this cluster with high % occurrence were the gastropods LMU (63.94%), SBA (39.09%) and the bivalve CLE (20.00%). The % occurrence of parasites was highest in this cluster. Cluster III showed high % occurrences only with the bivalves, i.e. LSI (66.52%), CMO (55.40%), CLE (15.79) and SPI (12.93%). Cluster IV contained samples exclusively from Tha Ngoi. High % occurrence food items in this cluster included a mixture of gastropods, i.e. PZI (44.01%), MTU (21.75%) and MSP (20.84%), and bivalve CMO (38.20%).

In terms of life stages, as classified here by five size classes with 10 cm SL interval (Table 5), the results showed that the juveniles, i.e. size less than 10 cm.SL., fed exclusively on the gastropod MTU (%IRI = 79.53%). The major food item was then shifted to the bivalve CMO, i.e. accounted for about 65 % IRI, for *H. leptorhynchus* when they grew larger up to 30 cm. SL. At mature stages, i.e. size beyond 30 cm. SL., *H. leptorhynchus* fed on a wide-variety of mollusks and implied that the larger fish are less selective of their prey.

The relationships between mouth of *H. leptorhynchus* (length and width) and dimension of the mollusks (height, width and length) were retrieved by means of coefficient of correlation (Table 6). The highest correlation of the mouth to gastropod was found between mouth-length and average width of the shell ($r = 0.63$); whereas, it was the relationship between mouth width and height of the shell for the bivalve ($r = 0.61$). The regression equations that showed the predictions to both relationships were:

Gastropods: *gastropod width = 0.253 + 0.603 mouth length ----- (3)*

Bivalves: *bivalve height = 0.530 + 0.802 mouth widt ------ (4)*

Table 5. List of the top five food items, as ranked by %IRI, of *H. leptorhynchus* at each size class.

| Rank | Size range (cm.SL.) | | | | |
|---|---|---|---|---|---|
| | **0.5 – 10.5 (n = 90)** | **10.5 – 20.5 (n = 526)** | **20.5 – 30.5 (n = 157)** | **30.5 – 40.5 (n = 43)** | **40.5 – 50.5 (n = 5)** |
| 1 | MTU (79.53) | CMO (60.78) | CMO (73.37) | LMU (55.40) | MSP (60.83) |
| 2 | CMO (18.35) | PZI (22.22) | PZI (21.38) | CMO (24.39) | LMU (21.20) |
| 3 | CLE (0.89) | MTU (8.61) | LMU (2.22) | CLE (9.00) | CSP (13.36) |
| 4 | MSP (0.38) | LSI (4.17) | CLE (2.21) | SBA (6.00) | CMO (1.84) |
| 5 | LSI (0.24) | MSP (3.82) | LSI (0.34) | LSI (2.69) | CLB (0.92) |

Table 6. The matrix of correlation coefficient (r) between mouth of *H. leptorhynchus* (length and width) and dimension of the mollusks (height, width and length).

**(a) Gastropods**

| Mouth | Shell dimensions | | | |
|---|---|---|---|---|
| | Average Height | Maximum Height | Average Width | Maximum Width |
| Length | 0.35 | 0.35 | 0.63 | 0.62 |
| Width | 0.17 | 0.15 | 0.39 | 0.41 |

**(b) Bivalves**

| Mouth | Shell dimensions | | | |
|---|---|---|---|---|
| | Average Length | Maximum Length | Average Height | Maximum Height |
| Length | 0.47 | 0.50 | 0.45 | 0.49 |
| Width | 0.47 | 0.59 | 0.47 | 0.61 |

## DISCUSSION

The Indochinese molluscivorous catfish *H. leptorhynchus*, in this study, had shown a variation and selection on food items. The results are contrary to previous reports, which indicated that this fish feeds exclusively on bivalves (e.g. Roberts and Vidthayanon, 1991; Ng and Kottelat, 2000; Jiwyam and Tippayadara, 2009; Kulabtong *et. al*., 2012). The findings show also remarkable relationships between the food items with geographical areas, seasonal changes and life stages. The results also support the assumption on flexibility in diets of the riverine fish species (Pusey *et. al*., 1995).

Tha Ngoi sampling site is characterized as a lowland flooding area of the Mun River and connects to the confluences of her major tributaries, i.e. Chi and Sae Bai Rivers. The high nutrient load flow to the area and the muddy and sandy bottom make the area a suitable sanctuary for mollusks (Harman, 1972). The presence and domination of gastropod PZI in the guts of *H. leptorhynchus*, collected in Tha Ngoi, could be explained by habitat preference since this tiny snail is restrictedly distributed in the sandy ground of rivers with slow-flowing water (Köhler & Richter, 2012). This also explained why PZI was less abundant and scarcely found in the Khong Chiam site, where the water is relatively strong and turbulent (Jutagate *et. al*., 2007). It is also worthy to note that PZI is considered an endangered species by the IUCN red list (Köhler & Richter, 2012).

In Tha Ngoi, the extremophile gastropod MTU became prevalent during the starting of rainy season, i.e. between June and July. During the period, more organic and inorganic matters flowed down from upstream through the communities and agricultural fields that has suddenly negative effect with many mollusks species explored in substratum but MTU, which can be resistant in low oxygen condition and survive in the harsh condition aquatic habitats, impacted by human activities e.g. eutrophic lakes, chemical rice fields or polluted canals (Wingard *et. al*. 2008; Van Damme, 2014). The extensive of the bivalve LSI in gut content during the winter could be caused by their reproductive biology, in which the peak of spawning occurs when the water temperature is around 16 – 21$^{o}$C (Ricciardi, 1998).

Unlike the other major mollusks found in the gut of *H. leptorhynchus*, the bivalve CMO also dominated in Tha Ngoi and Khong Chiam sites. The characteristics of large plain with a mixture of sand and clay, connected with strong current and rocky rapids and deep pool bed rock substratum (*personal observation*), at the mouth of Mun River of Khong Chiam site, make the area a suitable habitat for bivalves, in particular CMO, which dominated in the gut of *H. leptorhynchus* almost all year round. Unfortunately, although this bivalve is native and abundant in the Lower Mekong Basin (Bogan, 2011), there are no reports or studies on the ecology of this bivalve to elucidate its relationship to the feeding behavior of *H. leptorhynchus*. However, it is reported that CMO can survive in all types of freshwater habitats, although they inhabit primarily on sand-muddy bottom, causing a high abundance of this bivalve (Jivaluck *et. al*., 2007). Moreover, it is also known that bivalves of the genus Corbicula have high potential for filtration, i.e. feeding (Musig *et. al*., 2012) and reproduction, based on the hermaphroditic *C. fluminea*, which can self-fertilize, releasing up to 2000 juveniles per day, with an average annual fecundity of > 68,000 (Williams and McMahon 1989).

The gastropod LMU replaced the bivalve CMO as a major food item of *H. leptorhynchus* from Khong Chiam site during winter between December and January. During this period, water level is at its lowest because of the hydrological cycle as well as water manipulation by the Pak Mun Dam, just 5 km upstream. This gastropod inhabits the rapids, are attached to rocks, and have been reported to be restricted in their distribution from Khong Chiam down to Strung Treng in Cambodia. They are listed as vulnerable by the IUCN red list (Brandt, 1974; Simonis *et. al*. 2011). The spatial effect on food items was also confirmed by the presence of LMU, SBA and CSP exclusively from Khong Chiam samples because these gastropods are found only in rocky rapids in the restricted area of the Mekong mainstream (Brandt, 1974). *H. leptorhynchus* was reported to spend time in the dry season refuges associated with deep pools in the Mekong mainstream (Poulsen *et. al*., 2004). This is the remarkable reason between the restricted range of gastropod LMU and feeding ground in dry season of *H. leptorhynchus* as they share the same place and time with the relationship between predator and its prey in this sampling site.

Our results showed that the differences in feeding grounds and availability of mollusks during any certain period of the year are the main reasons for *H. leptorhynchus* to feed on a variety of food items, such as the 4 clusters of the prevalence of food items. Moreover, the ontogenic shift in food preference would contribute also to the similarity of food items in the gut of *H. leptorhynchus*. With Tha Ngoi an important nursery ground for *H. leptorhynchus* in the Mun River (Jutagate *et al*, 2007), the younger *H. leptorhynchus*, therefore, tend to feed on gastropods PZI and MTU, which are up to 15 mm in size (Davis, 1979). The high correlation coefficients of mouth size to the shell dimension is also implied in food selection and adaption on prey size of *H. leptorhynchus*, which is similar to other fish, both freshwater and marine species (Delariva and Agostinho, 2001; Karpouzi *et. al*., 2003).

In conclusion, this study shows the influence of space and time as well as life stage on food preference and gut contents of *H. leptorhynchus*. This finding leads to the clear understanding on prey selection of *H. leptorhynchus*. Further studies on niche overlap of this fish with other species in the same community are recommended to understand how food resources in the habitats are used.

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