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Full Length Research Paper

Gut contents of *Osteochilus hasselti* (Valenciennes, 1842) and *Thynnichthys thynnoides* (Bleeker, 1852) from Kaeng Lawa, Khon Kaen Province, Northeastern Thailand

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Gut contents of the hard-lipped barb (*Osteochilus hasselti* (Valenciennes, 1842)) and the tiny scale barb (*Thynnichthys thynnoides* (Bleeker, 1852)) were analyzed. Fish samples were collected from Kaeng Lawa, Khon Kaen Province, northeastern Thailand during the hot season (April and May 2009) and the late rainy season (September 2009). The percentage of frequency of occurrences (%F) and percentage of proportions (%P) of food items were evaluated. *O. hasselti* consumed 11 food items, only 7 categories were found in both seasons which consisted of detritus (66.67%, 42.00%P), plant parts (21.34%, 35.00%P), algae (4.00%, 9.00%P), unidentified items (5.34%, 4.00%P), protozoa (1.06%, 2.00%P), aquatic insect fragments (0.53%, 2.00%P) and diatoms (1.06%, 0.30%P), respectively. Whereas, *T. thynnoides* consumed 7 food items and only 5 food catergories were found in both seasons consisting of detritus (87.36%, 70.00%P), rotifers (7.37%, 6.00%P), unidentified items (2.11%, 3.00%P), plant parts (2.11%, 1.00%P) and aquatic insect fragments (1.05%, 3.00%P). From Chi-Square test for independence, it was found that %P of food items depended on season and fish species ($p < 0.05$). The result of present study, it was concluded that *O. hasselti* and *T. thynnoides* are omnivores.

Key words: Gut content, *Osteochilus hasselti*, *Thynnichthys thynnoides*, Kaeng Lawa, northeastern Thailand.

INTRODUCTION

Kaeng Lawa, a natural freshwater wetland is located in Khon Kaen Province, northeastern Thailand. It is situated at the latitude 16°05' 11' N, longitude 102°40' to 43' E, altiude 160 m above sea level, with a length of 10 km, maximum width of 4 km, and a surface area of 11.2 km^2. It is a major water source providing water for agriculture, fishery and aquaculture for local people, and it is also a source of household income, ecotourism and recreational activities (Office of Natural Resource and Environmental Policy and Planning, 1999).

In addition, Kaeng Lawa serves as an important wetland of conservation and ecological significance since it provides feeding and breeding sites, shelter and residence for numerous animals and plants. It is a source of biodiversity and supports benthic macroinvertebrates which dominated by arthropods and mollusks, 45 species of fishes, 7 species of amphibians, 5 species of reptiles, 43 species of birds and 3 species of mammals (Sangpradub et al., 2010). Fish are an especially important food resource for local people as they provide subsistence as a natural source of protein for local consumption.

Hard-lipped barb, *Osteochilus hasselti* (Valenciennes, 1842) and tiny scale barb, *Thynnichthys thynnoides* (Bleeker, 1852) (Family Cyprinidae) were also collected from Kaeng Lawa (Chumnaure and Hanjavanit, 2010). As

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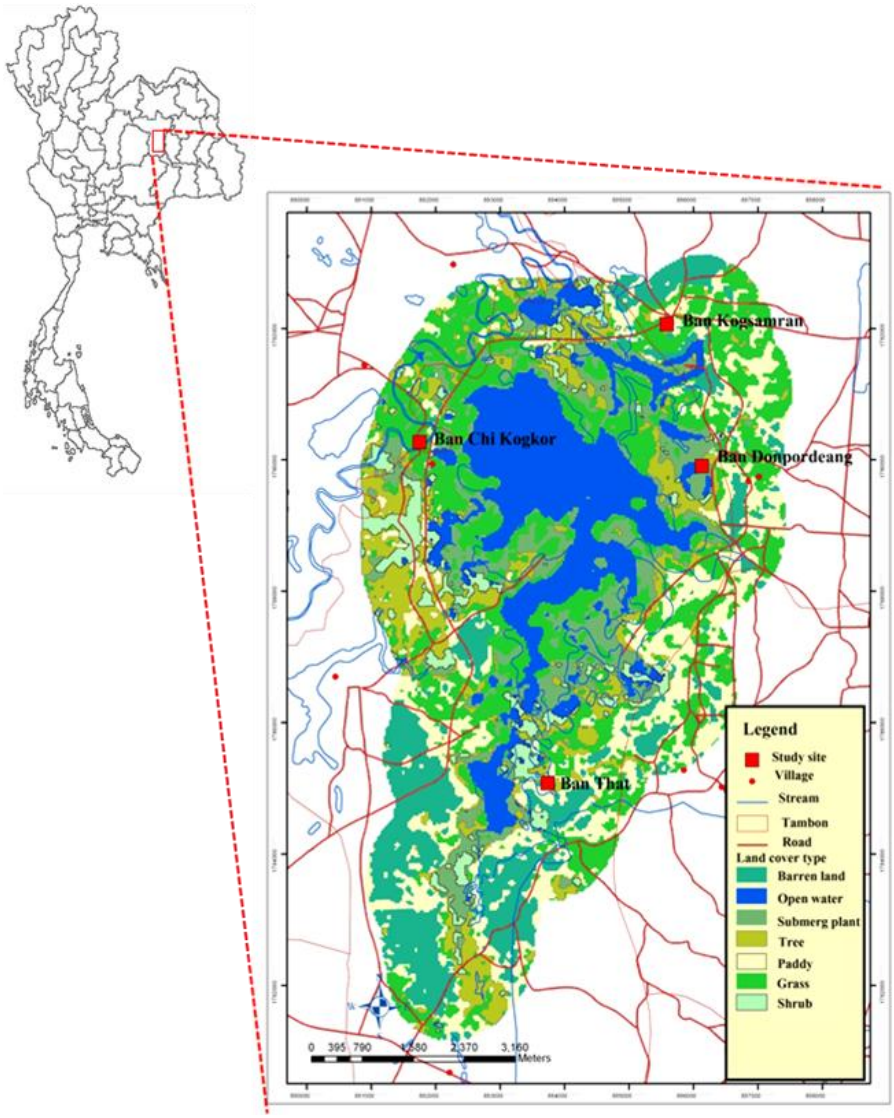

Figure 1. Map showing location of 4 sampling sites surrounded Kaeng Lawa, Khon Kaen Province, northeastern Thailand.

As stated by Hyslop (1980) the analysis of stomach contents of fish could provide information about the niche of particular fish occupy in the ecosystem and this has become a standard practice in fish ecology research. The knowledge of food and feeding habits helps to select specific species of fish for aquaculture so as to produce optimum yield by utilizing all available potential food of the water bodies efficiently without any competition (Mondol et al., 2005). Presently, very little information is available on the food and feeding habits of *O. hasselti* and *T. thynnoides* in Kaeng Lawa. The purpose of our study was to analyze diet composition, to determine seasonal variations in the diet of *O. hasselti* and *T. thynnoides* and to find the relationship between percentage proportion of food items and season and fish species in Kaeng Lawa.

MATERIALS AND METHODS

Study areas

Fish samples were collected at four sites: Ban Don Po Daeng (latitude 16° 9' 22.18'' N, longitude 102° 41' 42.61'' E), Ban Kog Sam Ran (latitude 16° 10' 23.24'' N, longitude 102° 41' 30.39'' E), Ban Chi Kogkor (latitude 16° 9' 28.75'' N, longitude 102° 39' 49.03'' E) and Ban That (latitude 16° 7' 45.53'' N, longitude 102° 41' 30.22'' E). These sites surround Kaeng Lawa, Khon Kaen Province, northeastern Thailand (Figure 1). Fish were collected during the hot season (April-May 2009) and the late rainy season (September

Table 1. Total number of gut examined, number of empty gut, total length and weight of *O. hasselti* and *T. thynnoides.*

	O. hasselti		*T. thynnoides*	
	Hot season	**Late rainy season**	**Hot season**	**Late rainy season**
Total number of gut examined	24	29	20	10
Empty gut	3	12	3	1
Range of total length (Mean±SD) (cm)	11.3-17.7 (15.4±4.5)	13.0-17.0 (15.2±1.5)	10.3-16.2 (16.3±4.6)	15.5-17.0 (16.2±0.7)
Range of weight (Mean±SD) (g)	20.0-70.0 (59.4±39.9)	25.0-80.0 (54.1±19.3)	18.0-45.0 (74.7±38.6)	30.0-60.0 (46.0±9.9)

2009). Total length of the fishes were measured and weighed in freshly caught condition to the nearest 0.1 mm and 0.1 g, respectively. Fish samples were preserved in 10% formalin and abdominal cavities were first opened to facilitate penetration of the preservative. The fish samples were transported to the Department of Biology, Faculty of Science, Khon Kaen University, Thailand for identification based on Rainboth (1996); Vidthayanon (2004).

Analysis of gut content

The samples of fish were rinsed with tap water many times until the odor of formalin disappeared. Tempory slides of the guts were prepared following the method of Somnark et al. (2011) by removing the gut and immersing in 70% ethyl alcohol. Subsequently, each gut was open and divided into anterior, middle and posterior parts. The content of each part of gut was poured into a separate petri-dish and mixed with one drop of 70% ethyl alcohol. One drop of a random sample of gut was taken placed and dropped on a slide and mixed well with one drop of glycerin. Each slide was covered with a cover glass and sealed with nail varnish between the edge of cover glass and slide to prevent water evaporation. Three temporary slides of gut content from each fish were prepared. The diet composition of each individual fish was observed under the light microscope (Olympus CH 30). Food items were identified to the lowest possible taxonomic level based on Pennak (1978); Sangpradub and Boonsoong (2006). The diet contents were quantified as percentage frequency of occurrence (%F) and the percentage proportion (%P) of given prey category (Hyslop, 1980). Chi-Square test for independence (Zar, 1999) was used for testing the significance of the relationships between %P and season and fish species.

RESULTS

Sizes of fishes

A total of 53 specimens of *O. hasselti* and 30 of *T. thynnoides* were examined of which 15 (26.42%) and 4 (13.33%) were empty guts. A summary of the number samples examined, size range and weight is shown in Table 1.

Percentage frequency of occurrence of diet

Table 2 shows a summary of the percentage frequency of occurrence and the percentage proportion of various food items from the guts of *O. hasselti* and *T. thynnoides*. Detritus had the highest frequentcy of occurrence (100%), followed by plant parts (80.95%), algae such as *Euglena* sp. (33.33%), unidentified items (19.05%), diatoms such as *Gyrosigma* sp. (9.52%), protozoa such as *Centropyxis* sp. (4.76%) and fragments of aquatic insects (4.76%) from gut contents of *O. hasselti* in the hot season. While in the late rainy season, detritus was also the highest occurrence (94.12%), followed by plant parts (82.35%), algae (58.82%) consisting of *Blennothrix* sp., *Cosmarium* sp., *Phacus* sp. and *Volvox* sp., fragments of aquatic insects (52.94%), unidentified items (23.53%), cladocerans such as *Bosminopsis deitersi* (17.65%), protozoa (11.76%) consisting of *Centropyxis aculeata*, *C. ecornis*, diatoms (5.88%) such as *Navicula* sp., rotifers (5.88%) consisting of *Keratella* sp., *Lecane* sp., bryozoa (5.88%), and copepods (5.88%).

For *T. thynnoides*, detritus was also the highest occurrence (94.12%), followed by unidentified items (41.18%), rotifers (29.41%) such as *K. tropica*, plant parts (17.65%) and fragments of aquatic insects (5.88%) in the hot season. Additionally, in the late rainy season, detritus occurred at the highest frequentcy (100%), followed by algae (55.56%) consisting of *Closterium* sp., *Euglena* sp., *Phacus* sp., *Tetraedron* sp. and *Volvox* sp., rotifers (44.44%) consisting of *K. cochlearis*, *K. tropica* and *Lecane* sp., cladocerans (33.33%), fragments of aquatic insects (22.22%) and plant parts (11.11%), respectively.

Percentage proportion of diet

As shown in Table 2, 7 of food items were found from the gut contents of *O. hasselti* in the hot season. Detritus was the highest proportion of food items (66.67%), followed by plant parts (21.34%), unidentified items (5.34%), algae (4.00%), diatoms (1.06%), protozoa (1.06%) and aquatic insect fragments (0.53%). In the late rainy season, 11 food categories were found, and *O. hasselti* also fed predominantly on detritus (42.00%), followed by plant parts (35.00%), algae (9.00%), unidentified items

Table 2. Percentage of frequency of occurrence (%F) and percentage of proportion (%P) of various food categories in the guts of *O. hasselti* and *T. thynnoides* from Kaeng Lawa, Khon Kaen Province, Thailand (X=present).

Food item	*O. hasselti*				*T. thynnoides*			
	Hot season		Late rainy season		Hot season		Late rainy season	
	%F	%P	%F	%P	%F	%P	%F	%P
Algae	33.33	4.00	58.82	9.00	0.00	0.00	55.56	8.00
Blennothrix sp.			X					
Closterium sp.							X	
Cosmarium sp.			X					
Euglena sp.	X						X	
Phacus sp.			X				X	
Tetraedron sp.							X	
Volvox sp.			X				X	
Diatom	9.52	1.06	5.88	0.30	0.00	0.00	0.00	0.00
Gyrosigma sp.	X							
Navicula sp.			X					
Protozoa	4.76	1.06	11.76	2.00	0.00	0.00	0.00	0.00
Centropyxis sp.	X							
C. aculeata			X					
C. ecornis			X					
Plant parts	80.95	21.34	82.35	35.00	17.65	2.11	11.11	1.00
Rotifer	0.00	0.00	5.88	1.00	29.41	7.37	44.44	6.00
Keratella sp.			X					
K. cochlearis							X	
K. tropica					X		X	
Lecane sp.			X				X	
Bryozoa	0.00	0.00	5.88	0.70	0.00	0.00	0.00	0.00
Cladocera	0.00	0.00	17.65	2.00	0.00	0.00	33.33	9.00
Bosminopsis deitersi			X					
Copepod	0.00	0.00	5.88	2.00	0.00	0.00	0.00	0.00
Fragments of aquatic insects	4.76	0.53	52.94	2.00	5.88	1.05	22.22	3.00
Detritus	100.00	66.67	94.12	42.00	94.12	87.36	100.00	70.00
Unidentified items	19.05	5.34	23.53	4.00	41.18	2.11	55.55	3.00

(4.00%), protozoa (2.00%), aquatic insect fragments (2.00%), cladocerans (2.00%), copepods (2.00%), rotifers (1.00%), bryozoa (0.70%) and diatoms (0.3%). From the gut analyses, they showed that *O. hasselti* fed on the same 7 categories of food items, namely detritus, plant parts, algae, unidentified items, aquatic insect fragments, protozoa and diatoms in both seasons. Sand was found in the hot season, whereas bryozoa, cladocerans, copepods and rotifers were found in the late rainy season.

In the case of *T. thynnoides*, 5 of food categories were found in their gut contents in the hot season. Detritus was the highest percentage (87.36%) followed by rotifers (7.37%), plant parts (2.11%), unidentified items (2.11%) and aquatic insect fragments (1.05%). While 7 of food items were found in the late rainy season. Detritus was also the highest dominant group (70.00%), followed by cladocerans (9.00%), algae (8.00%), rotifers (6.00%), aquatic insect fragments (3.00%), unidentified items (3.00%) and plant parts (1.00%). It was found that *T. thynnoides* consumed the same 5 categories of food items, included detritus, plant parts, rotifers, unidentified items and aquatic insect fragments in both seasons. Sand was found in the hot season, whereas algae and cladocerans were found in the late rainy season. From the Chi-Square test, it showed that %P was depended on season and fish species ($p < 0.05$) as shown in Table 3.

DISCUSSION

The results of gut content analyses showed that *O. hasselti* and *T. thynnoides* are omnivorous as they were shown to consume both plant and animal materials as

Table 3. Pearson Chi-Square test for significance of the relationships between (a) %P and season, and (b) %P and fish species.

Catergory	Chi-Square	df	*p*
O. hasselti	18.935	10	0.041
T. thynnoides	20.447	10	0.002
Hot season	32.575	7	0.000
Late rainy season	52.539	7	0.000

their source of food. It was found that *O. hasselti* fed on a wider range of food items which agreed with the study by Kakkaeo et al. (2004) who reported that *O. hasselti* from Ubolratana Reservoir, Thailand consumed detritus, macrophytes, epiphytic algae, zooplankton, insect larvae, phytoplankton and microbenthos. It was also similar to a study by Chittapalapong et al. (2009) who reported that the diet of *O. hasselti* in the Lower Songkhram River, Thailand consisted of oligochate, aquatic insect larvae, rotifers, bryozoa, hydra, sponges and phytoplankton. Our results differed from Rainboth (1996) who reported that the diet of *O. hasselti* from the Mekong River, Cambodia consisted of periphyton, bottom algae and phytoplankton, whereas Vidthayanon (2004) reported that food items of *O. hasselti* in Thailand consisted of periphyton, algae and organic matter.

From the present study, it was found that *T. thynnoides* consumed similar categories of food items but to a lesser degree than those of *O. hasselti*. It fed mainly on detritus followed by algae, plant parts, rotifers, cladocerans, aquatic insects and unidentified items which differed from those reported by Rainboth (1996), for *T. thynnoides* in the Mekong River, Cambodia which consisted of periphyton, algae, phytoplankton and small zooplankton. In addition, Arkathaweewat (2002) has reported that food items of *T. thynnoides* in Thailand consisted of aquatic insects, aquatic insect larvae and periphyton.

Results from our study, have shown that food items of *O. hasselti* and *T. thynnoides* differed from studies by Rainboth (1996), Vidthayano (2004) and Arkathaweewat (2002) and are likely to be related to the way that fish feed and the prevalence of various food items in the water body during the study period. It was found that both *O. hasselti* and *T. thynnoides* consumed more food items in the late rainy season than those during the hot season, which may be due to change of food habit by fish with the change of seasons. Statistical analyses have shown that there are significance relationships between %P and season and fish species ($p<0.05$). These findings agreed with those of Schafer et al. (2002), who have shown that the feeding habit of fish varies with quantity and type of food items in the habitat where fish live in a particular time. According to Islam et al. (2004), the food and feeding habit of fish vary from season to season, and the fish consume different types of food. Ayoade and Ikulal (2007) have also stated that the food of fish varies for individual species with age, locality where found and with season. Eventhough *O. hasselti* and *T. thynnoides* are classified in the same family, Cyprinidae, and inhabit the same location (Kaeng Lawa), the proportion of food items consumed are not the same, which may be related to the differences of the morphology of the mouth and their feeding behavior. Rainboth (1996) stated that the mouth of genus *Osteochilus*, both upper and lower lips fringe with papillae, while the mouth of genus *Thynnichthys* has no upper lip.

An interesting observation in the present study, was that sand particles were also found in the guts of *O. hasselti* and *T. thynnoides* in only the hot season. This contrasts with diatoms which were found in guts of only *O. hasselti* in both the hot season (1.06%P) and the late rainy season (0.30%P). Currently, no sand grains and diatoms have been reported in the guts of *O. hasselti* and *T. thynnoides* (Rainboth, 1996; Vidthayanon 2004). Amisah and Agbo (2008) stated that the prevalence of sand particle in guts of fish may facilitate digestive breakdown of the food items.

From the analysis of food in the gut contents, it is evident that both *O. hasselti* and *T. thynnoides* are neither true surface feeders nor true bottom feeders. Food substances of *O. hasselti* mainly consisted of detritus, plant parts, algae, unidentified items, aquatic insects, protozoa, cladocerans, copepods, rotifers, diatoms, and bryozoa, respectively, whereas *T. thynnoides* consumed mainly detritus, rotifers, cladocerans, algae, unidentified items, aquatic insects and plant parts, which are distributed throughout the different layers of the water bodies. The knowledge of the kinds and amount of food items of the fish is very important and essential for fish stock enhancement through seedling release. Furthermore, it can become a guideline for determining the environmental capacity which is necessary for the prevention of fish starvation and improvement of their growth after the release (Yamagishi et al, 2005). According to Ferrareze and Nogueira (2007), knowledge about fish sources of feeding could provide data about habitat, feeding availability in the environment, as well as offering an ecological and behavioral understanding of fish species. Therefore, the results from this study can

provide data about food availability in Kaeng Lawa and hence be used better understand the ecology and behavior of fish species.

Conclusions

On the basis of different food items found in the gut contents of *O. hasselti* and *T. thynnoides* can be concluded that they are omnivorous. *O. hasselti* fed on a wider range of food items than those of *T. thynnoides* and their food consumption varies from season to season. From the statistical analysis, it showed that %P was depended on season and fish species (p<0.05).

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