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Diet Composition of *Pristolepis fasciata* (Bleeker, 1851) (Family Nandidae) and *Puntius brevis* (Bleeker, 1849) (Family Cyprinidae) in Kaeng Lawa, Thailand.

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ABSTRACT

Objectives of this study were to examine seasonal diet composition and to investigate the length-weight relationships and condition of *Pristolepis fasciata* (Bleeker, 1851) (family Nandidae) and *Puntius brevis* (Bleeker**,** 1849) (family Cyprinidae) in Kaeng Lawa, Khon Kaen Province, northeastern Thailand. The types of food consumed varied with season (Chi-square test, $P<0.05$). Food items consumed in all seasons consisted of chironomid larvae (O. Diptera), baetid and caenid mayflies (O. Ephemeroptera), O. Hemiptera, hydroptilid larvae (O. Trichoptera), and insect fragments. The length-weight relationship of fish from the 3 seasons showed an allometric growth pattern. Their coefficient of condition factors were greater than 1, which indicated that they were in a good condition. The results of diet composition and relative gut length indicated that *Pr. fasciata* is a carnivore and *P. brevis* is an omnivore.

Keywords: diet composition, *Pristolepis fasciata*, *Puntius brevis*, Kaeng Lawa

1. INTRODUCTION

Kaeng Lawa is one of the most important freshwater wetlands of Thailand and is located in the Mekong River Basin. Specifically, it is situated in Ban Pai District, Khon Kaen Province of northeastern Thailand. Kaeng Lawa is a large permanent semi-natural pond and floodplain covering an area of approximately 11.2 km^2 and is located at 160 m above mean sea level [1]. This area is rich in biodiversity including fauna consisting of benthic macroinvertebrates (molluscs, arthropods included shrimps, crabs and aquatic insect larvae), fish, amphibians, reptiles, and mammals [2]. The flora consisted of water chestnut (*Eleocharis spiralis*), giant sedge (*Scirpus grossus*), sedge (*S. mucronatus*), knotweeds (*Polygonum tomentosum*, *Limnocharis flava*, *Potamogeton cripus*), floating stag's horn fern (*Ceratopteris thalictroides*), water hyacinth (*Eichhornia crassipes*), swamp morning glory (*Ipomoea aquatic*), water primrose (*Jussiaea repens*), floating water fern (*Salvinia cucullata*) and water lily (*Nymphaea lotus*) [1].

Adjacent communities rely on Kaeng Lawa for agriculture, irrigation, and fisheries. Kaeng Lawa is also an economically important resource for the local community because the local people can harvest fish, other animals (such as molluscs, aquatic insects and frogs) and aquatic plants, including water chestnut and water lily, for their consumption and to sell for income (personal communication). In addition, it is a potential recreation site where tourists can enjoy rafting and game fishing [1].

Pristolepis fasciata (Bleeker, 1851), belonging to the Asian leaffish family Nandidae, is a native fish to the Chao Praya River in Thailand [3]. It occurs with aquatic or emergent plants and inhabits slow running or still waters in reservoirs, marshes, swamps and rivers. This species is distributed widely from Burma to Indonesia and also inhabits the Mekong River in Cambodia [4].

Puntius brevis (Bleeker**,** 1849), belonging to the minnow family Cyprinidae is a native freshwater species in the Chao Praya River basin. It is generally found in floodplains, canals, ditches and small sluggish streams from Indonesia to Thailand [4].

Both *Pr. fasciata* and *P. brevis* are harvested from Kaeng Lawa [5]. *Pr. fasciata* is a delicacy dish in local communities, where it is fresh cooked, dried or fermented, and is also a good aquarium fish because of its beautiful color [6]. *P. brevis* were often caught daily all year around and is always raw or in uncooked products (personal communication).

Studies on diet composition have been done on *Pr. fasciata* and *P. brevis* from different rivers in Thailand [7-8] but almost no work has examined diet composition of these 2 species in Kaeng Lawa. Therefore, the objective of the present study is to examine seasonal diet composition of *Pr. fasciata* and *P. brevis* in Kaeng Lawa and to investigate the length-weight relationship (LWR), condition factor (K), relative length of gut (RLG) and gut fullness.

2. MATERIALS AND METHODS

2.1 Fish Examination

Fish samples were purchased seasonally from middlemen at the landing site, Ban Don Po Daeng (latitude 16° 9' 22.18" N, longitude 102° 41' 42.61" E) and Ban Kog Sam Ran (latitude 16° 10' 23.24" N, longitude 102° 41' 30.39" E), which surround Kaeng Lawa, Khon Kaen Province, northeastern Thailand. Total length (TL) of individual fish was measured. Body weight (BW) of fish was also weighed, and the samples of fish were fixed in 10% formalin. The gut of individual fish was removed, measured (cm) and weighed (g).

2.2 Analysis of Gut Content

Semi-permanent slides of gut contents were prepared according to Somnark *et al.* [9]. The diet contents were identified to the lowest taxon as possible based on Koannuntagul *et al.* [10], Sangpradub and Boonsoong [11], and Chittapalapong and Somchun [12]. The diet contents were quantified as percentage of numerical composition (%N), and percentage of frequency of occurrence (%F) of given prey category [13]. The chi-squared test (χ^2) for independence was calculated to test significantly difference of the relationships among %N, %F and the season [14].

2.3 Data Analysis

The LWR was calculated by using the equation: $W = aL^b$, where W = weight (g), L = total length (cm), a = constant, b = growth exponent [15-17]. Slopes of length-weight regressions were compared to 3 (Cube law) using student's t-test [14] to investigate whether species had isometric growth. Values of the growth exponent were tested for the estimation of K by using the equation: $K = 100W/L^b$, where K = condition factor, W = total body weight (g), L = total length (cm), b = growth exponent [16, 18]. The relative length of gut (RLG) was determined as a possible indicator of major diet by using the equation: RLG = GL/TL, where GL = gut length (cm) and TL = total length (cm) [19]. Stomach fullness was scored from 0 to 4 as follows: 0 = empty stomach; 1 = ¼ full stomach; 2 = ½ full stomach; 3 = ¾ full stomach; 4 = full stomach [20].

3. Results and Discussion

3.1 Diet Composition

Data on gut contents from the seasonal samples were pooled to assess their overall composition for each fish is summarized in Table 1. A total of 15 different prey taxa belonging to 6 major groups: arthropoda, mollusca, plant, algae, euglenozoa and unidentified items were identified from stomach of *Pr. fasciata*. The most main prey item was chironomid larvae (29.4%N), followed by baetid larvae (21.7%N), Hemiptera (13.8%N), and insect fragments (12.1%N). While plant parts, hydroptilid larvae, caenid larvae, algae, gastropods, cladocerans, odonate larvae, *Euglena*, leptocerid larvae, Araneae and unidentified items were of minor importance, each less than 10%N. The results of food items agree with the report of Rainboth [4] on *Pr. fasciata* inhabiting the Mekong River of Cambodia fed on aquatic insects, crustaceans, filamentous algae and submerged plants. In addition, Uk-katawewat [7] reported that *Pr. fasciata* fed on shrimp, fish fry and aquatic insects, and Vidthayanon [8] reported that the food items consumed by *Pr. fasciata* in Thailand consisted of shrimp and molluscs.

A total of 12 different prey taxa belonging to 5 groups: arthropoda, rotifera, plants, algae, and unidentified items were found from stomach contents of *P. brevis*. Plant materials were the most consumed item (24.2%N), followed by cladocerans (19.7%N), algae and insect fragments (15.2%N each), and ostracods (10.0%N). Unidentified items, copepods, rotifers, Hemiptera, Hydracarina, chironomid larvae and caenid larvae were of minor importance, each being less than 10.0%N. These results are similar to Akkathewatt [7] and Vidthayanon [8], who reported that *P. brevis* inhabiting many rivers of Thailand fed on aquatic plants, aquatic insects, small benthic organisms, and zooplankton. It is also in agreement with the finding of Rainboth [4], who reported that *P. brevis* from the Mekong River in Cambodia fed on crustaceans, tubuficid worms, algae, and zooplankton. In Kaeng Lawa, *Pr. fasciata* and *P. brevis* consumed more varieties of food than found elsewhere, which may be due to the difference in locality or with level of identification of the food items.

For both fish species, diet (%N of each food item eaten) varied with season (*Pr. fasciata*: χ^2 = 62.479, df = 30, P<0.05; *P. brevis*: χ^2 = 59.139, df = 22, P<0.05) as did %F of each food item (*Pr. fasciata*: χ^2 =109.151, df = 30, P<0.05; *P. brevis*: χ^2 = 82.441, df = 22, P<0.05). Considering all differences and similarities of prey items in the diet of *Pr. fasciata* and *P. brevis* in Kaeng Lawa and other localities, it may be concluded that these 2 species showed flexible feeding strategies, allowing them to use locally available food resources [21]. From statistically analysis, there are significant relationships among %N and season and %F and season (P<0.05). These results indicated that the dietary composition of these 2 species is variable among seasons, which may be related to the availability of the different food sources among habitat type and season [22]. According to Ayoade and Ikulala [17], the availability of food items is often cyclical due to climatic condition or other environmental factors, or their life cycles.

3.2 Length Weight Relationship (LWR) and Condition Factor (K)

Table 2 shows the LWR and K of *Pr. fasciata* and *P. brevis*. The values of b in LWR of *Pr. fasciata* and *P. brevis* were significantly less than 3 (Cube law) (P<0.05) showing negative allometric growth pattern, which means fish gets thinner throughout the study periods. The exception was the b value of *P. brevis* in the hot season, which was significantly greater than 3 (P<0.05) indicating a positive allometric growth

Table 1. Seasonal variation of percentage of numerical composition (%N) and percentage of frequency of occurrence (%F) of various food items in the stomach of *Pr. fasciata* and *P. brevis* from Kaeng Lawa, northeastern Thailand (- = not found).

	hot				rainy				cool				Average			
Food items	***Pr. fasciata* (n = 30)**		***P. brevis* (n = 32)**		***Pr. fasciata* (n = 33)**		***P. brevis* (n = 34)**		***Pr. fasciata* (n = 34)**		***P. brevis* (n = 30)**		***Pr. fasciata* (n = 97)**		***P. brevis* (n = 96)**	
	%N	**%F**	**%N**	**%F**	**%N**	**%F**	**%N**	**%F**	**%N**	**%F**	**%N**	**%F**	**%N**	**%F**	**%N**	**%F**
Phylum Arthropoda O. Diptera																
Chironomid larvae	36.7	60.0	0.3	3.1	18.0	66.6	-	-	33.6	52.9	0.5	10.0	29.4	59.8	0.3	4.3
O. Ephemeroptera																
Baetidae	17.0	46.7	-	-	22.0	63.6	-	-	25.7	44.1	-	-	21.7	51.4	-	-
Caenidae	5.3	20.0	-	-	5.3	21.2	-	-	2.7	8.8	0.1	0.3	4.4	16.7	0.03	0.1
O. Hemiptera	8.0	26.7	0.9	9.4	20.9	60.6	-	-	12.4	29.4	0.7	16.6	13.8	38.9	0.5	8.7
O. Odonata	-	-	-	-	1.9	3.0	-	-	-	-	-	-	0.6	1.0	-	-
O. Trichoptera																
Hydroptilidae	1.3	6.7	-	-	11.4	42.4	-	-	0.9	2.9	-	-	4.5	17.3	-	-
Leptoceridae	0.7	3.3	-	-	-	-	-	-	-	-	-	-	0.2	1.1	-	-
Insect fragments	18.8	60.0	16.2	40.6	10.5	84.9	14.8	23.5	7.1	23.5	14.5	66.7	12.1	56.1	15.2	43.6
Cladocera	-	-	10.3	25.0	4.5	9.0	35.6	29.4	0.8	2.9	13.1	76.7	1.8	3.9	19.7	43.7
Copepods	-	-	7.4	37.5	-	-	3.7	11.7	-	-	6.5	56.6	-	-	5.9	35.3

Table 1. Continued.

	hot				rainy				cool				Average			
Food items	*Pr. fasciata* (n = 30)		*P. brevis* (n = 32)		*Pr. fasciata* (n = 33)		*P. brevis* (n = 34)		*Pr. fasciata* (n = 34)		*P. brevis* (n = 30)		*Pr. fasciata* (n = 97)		*P. brevis* (n = 96)	
	%N	%F	%N	%F	%N	%F	%N	%F	%N	%F	%N	%F	%N	%F	%N	%F
Ostracods	-	-	15.9	43.8	-	-	2.2	2.9	-	-	11.8	73.3	-	-	10.0	40.0
Hydracarina	-	-	0.2	3.1	-	-	0.7	3.1	-	-	-	-	-	-	0.3	2.0
Araneae	-	-	-	-	0.3	3.0	-	-	-	-	-	-	0.1	1.0	-	-
Phylum Rotifera Rotifers	-	-	1.9	12.5	-	-	-	-	-	-	0.6	10.0	-	-	0.8	7.5
Phylum Mollusca Gastropods	-	-	-	-	0.7	3.0	-	-	6.2	8.8	-	-	2.3	3.9	-	-
Phylum Euglenozoa Euglena	1.3	3.3	-	-	-	-	-	-	-	-	-	-	0.4	1.1	-	-
Algae	2.6	6.7	16.5	59.4	1.9	6.0	5.9	8.8	3.5	8.8	23.2	53.3	2.7	7.2	15.2	40.5
Plant parts	8.0	36.7	26.1	65.6	2.4	36.3	22.3	26.4	7.1	23.5	24.5	56.6	5.8	32.2	24.3	49.5
Unidentified items	-	-	4.3	25.0	0.2	3.0	14.8	14.7	-	-	4.5	46.7	0.1	1.0	7.9	28.8

Table 2. Seasonal variation in length-weight relationship, (LWR), condition factor (K) and relative length of gut (RLG) of *Pr. fasciata* and *P. brevis* from Kaeng Lawa, northeastern Thailand (a = constant b = growth exponent, SE (b) = standard error of the slope b, r = correlation coefficient, R^2 = coefficient of determination, SD = standard deviation).

Fish species	Season	Wt (g) Min - Max (Mean ± SD)	TL (cm) Min - Max (Mean ± SD)	W = aL^b a	b	SE (b)	r	r^2	*p* value (differrence of b from 3)	K =100W/L^3	RLG ± SD
Pr. fasciata	Hot	13.00 - 35.00 (21.67 ± 5.77)	7.80 - 11.90 (10.02 ± 0.92)	0.123	2.234	0.306	0.810	0.656	<0.05	2.157	0.80 ± 0.11
	Rainy	15.00 - 30.20 (21.69 ± 4.95)	8.00 - 12.70 (10.07 ± 0.91)	0.491	1.633	0.390	0.639	0.408	<0.05	2.130	0.38 ± 0.12
	Cool	10.00 - 60.00 (35.27 ± 12.26)	7.40 - 13.30 (10.58 ± 1.61)	10.120	2.391	0.203	0.901	0.813	<0.05	2.981	0.35 ± 0.19
P. brevis	Hot	10.00 - 20.00 (13.70 ± 2.85)	9.7.00 - 12.00 (10.68 ± 0.45)	0.001	3.604	0.450	0.837	0.70	<0.05	1.120	1.0 ± 0.17
	Rainy	16.00 - 32.00 (22.59 ± 3.67)	10.00 - 12.60 (11.25 ± 0.64)	0.084	1.691	0.298	0.808	0.65	<0.05	1.590	1.09 ± 0.18
	Cool	10.00 - 25.00 (14.33 ± 4.10)	8.50 - 11.40 (9.75 ± 0.73)	0.008	2.835	0.359	0.864	0.75	<0.05	1.550	1.35 ± 0.16

*significant p<0.05

Table 3. Seasonal variation in stomach fullness of *Pr. fasciata* and *P. brevis* from Kaeng Lawa, northeastern Thailand.

Fish species	Season	N	score: 0 empty (%)	1 ¼ (%)	2 ½ (%)	3 ¾ (%)	4 full (%)	Average of the stomach fullness score
Pr. fasciata	Hot	30	0 (0.00)	11 (36.67)	14 (46.67)	3 (10.00)	2 (6.66)	1.87
	Rainy	33	4 (12.12)	9 (27.27)	10 (30.30)	8 (24.24)	2 (6.06)	1.85
	Cool	34	8 (23.53)	14 (41.18)	6 (17.65)	5 (14.70)	1 (2.94)	1.32
P. brevis	Hot	32	8 (25.00)	10 (31.25)	8 (25.00)	4 (12.50)	2 (6.25)	1.44
	Rainy	34	16 (47.05)	12 (35.29)	4 (11.76)	2 (5.88)	0 (0.00)	0.76
	Cool	30	6 (20.00)	18 (60.00)	3 (10.00)	3 (10.00)	0 (0.00)	1.10

pattern, which meant that the fish were getting plumper. The b value from the LWR of fish can indicate food intake and growth pattern, and can be affected by such abiotic and biotic factors as water temperature, habitat type, and food availability [16].

In the current study, average K (or condition; 16, 18) values for *Pr. fasciata* and *P. brevis* for all seasons were greater than 1, which implies that populations of these 2 species were in better than average condition throughout the study period. A K value greater than 1 means above average condition and that the fish receives sufficient natural food for growth. In the case of a K value less than 1, the fish is in below average condition [18]. According to Lagler [15] and Parihar and Saksena [23], K values are influenced by several factors, such as fish age, sex, season, state of maturation, gut fullness, type of prey consumed, amount of fat deposit, and the degree of muscular development.

3.3 Relative Length of Gut (RLG) and Stomach Fullness

As shown in Table 2*,* the mean RLG values for *Pr. fasciata* were less than 1 for all seasons (0.80 ± 0.11, 0.38 ± 0.12, and 0.35 ± 0.16), which indicates that this species is carnivorous. In contrast, *P. brevis* had greater mean RLG values than 1 as follows: 1.05 ± 0.17, 1.09 ± 0.18 and 1.35 ± 0.16 in the hot, rainy and cool seasons, respectively, which indicates that *P. brevis* is omnivorous. Yamagishi *et al.* [19] stated that RLG less than 1 indicates that a fish is carnivorous, whereas RLG greater than 1 indicates that the fish is omnivorous or herbivorous. In this study, another unusual finding was plant materials in the stomach of the carnivorous *Pr. fasciata*, which may be due incidental consumption while feeding on aquatic insects, especially chironomid larvae, which are often abundant near vegetation or dwell on sandy bottoms [24]. Algae also occurred incidentally and may have been picked up while foraging on other food items. Therefore, *Pr. fasciata* likely consumed the plant parts and algae by accident. Chironomid larvae and ostracods inhabited along the sandy bottom, whereas hemipterans, cladocerans and algae are distributed more often in the water column. From the diet composition, *Pr. fasciata* and *P. brevis* may be regarded as demersal fish and benthopelagic fish, respectively, which agrees with the findings of Froese and Pauly [3, 25].

From the feeding activity as shown in Table 3, it was revealed that *Pr. fasciata* had high to low average scores of stomach fullness (1.87, 1.85, 1.32) in the hot, rainy seasons and cool season, respectively. In contrast, *P. brevis* had high average scores of stomach fullness (1.44, 1.10) in the hot and cool seasons and the lowest average score of stomach fullness (0.76) in the rainy season. These results show the fluctuation of feeding intensity varies with season, which could be explained by the food availability in the environment where fish live at any particular time [26].

In conclusion, this study provides information about feeding ecology of *Pr. fasciata* and *P. brevis* in Kaeng Lawa, and this information could be useful for managing these and other commercially important fishes in the future. Kaeng Lawa retains a high diversity of phytoplankton, zooplankton, macroinvertebrates and fish – diversity that if conserved will continue to support a remarkable wetland that benefits both people and the environment.

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