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A Study on Some Biological Aspects of Giant Snakehead Fish (*Channa micropeltes*) in Huai Suea Ten Wetland Site in Thailand

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Authors' contributions

This work was carried out in collaboration among all authors. Authors KT and SC designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors BY, SW, ST and PN collected samples and managed the analyses of the study. Author PW managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This research was aimed to study on biological aspects of giant snakehead fish (*Channa micropeltes*) in Huai Suea Ten wetland site, Nam Phong District, Khon Kaen Province in Thailand between April, 2017 and March, 2018. Thirty-six fish species belonging to 17 families were observed at 10 sampling sites. Three Channidae fishes, namely snakehead fish (*Channa striata*), giant snakehead fish (*Channa micropeltes*), and forest snakehead fish (*Channa lucius*), belonging to the family Channidae were reported. A total of 230 giant snakehead fish were found in this survey which consisted of 118 males and 112 females. The sex ratio (male: female) was 1:0.95. The gonadosomatic index value of the female (0.79±0.05%) was higher than that of the male (0.25±0.08%). The body length and body weight of a total of 230 giant snakehead fish observed in

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this study showed the average of a total body length was 43.71±11.72 cm; and the average of the body weight was 448±173 g/fish. The condition factor of giant snakehead fish observed in 12 months were in a range of 0.45-0.74 for the male and 0.39-0.70 for the female. The ratio of the body and intestinal length of giant snakehead fish was as 1: 0.70. The stomach digesta components, expressed as the percentages of a whole stomach content weight of this fish species consisted of 51.8% of fish fillet, 30.3% of small fish and 17.9% of digested digesta.

Keywords: Snakehead fish; body length; body weight; fish species.

1. INTRODUCTION

Huai Suea Ten wetland site is located in Nam Phong District, Khon Kaen Province where is in the northeast of Thailand. Huai Suea Ten wetland is considered as the aquaculture areas that are the main animal protein source for people who live in Khon Kaen province. Therefore, this wetland has been paid attention by researchers. Sri and Pornpongrungrueng [1] studied Huai Suea Ten wetland was abundant in both plants and aquatic plant along the water-course bank. However, the native fish species; especially giant snakehead fish, and their biological aspects have not studied yet.

Giant snakehead fish (*Channa micropeltes*) belongs to Channidae family together with *Channa striata,* which are fresh water, air breathing, carnivorous fish, which are a valuable source of protein throughout the Asia Pacific region and they are indigenous to many tropical and sub-tropical countries including Thailand [2]. In terms of the ecology system, the snakehead fish is on the top of the food chain. In Thailand, it is one of the major fish species caught by the local fisherman because it is a high value fish species in the markets. In addition, the juvenile of giant snakehead fish has become highly demanded as the small-scale farmers still count on the traditional fish culture by catching the fish juvenile from the nature. Consequently, the invasion of the ecology system in Huai Suea Ten wetland by those farmers takes placed and become an issue recently. The overfishing is able to cause the imbalance of the ecology system in Huai Suea Ten wetland. Nevertheless, the information is limited.

It was necessary to understand the biological aspects of giant snakehead fish as a fundamental information for both of the conservation of snakehead fish and the researches to develop the snakehead fish culture. This research was aimed to study certain biological aspects, including sex ratio, relationship between body weight and length, gonadosomatic index, condition factor, and stomach content of Giant snakehead fish (*Channa micropeltes*) in Huai Suea Ten wetland site in Thailand.

2. MATERIALS AND METHODS

2.1 Study Area

Huai Suea Ten wetland site is located in Nam Phong District, Khon Kaen Province where is in the northeast of Thailand. It lies between latitude 16°46'5" N and longitudes 102°46"9" E. It covers approximately 7,000 km^3 and this area is considered to be economically important for people who live in Nam Phong District, Khon Kaen Province. There are three seasons namely, raining, and winter and summer. The annual averages of temperature, humidity and raining volume are approximately 27.5°C, 74%, and 1,500 mm., respectively. The sampling site was divided into 10 sites such as A, B, C, D, E, F, G, H, I, and J (Fig.1) based on the local fishing pier in Huai Suea Ten wetland.

2.2 Sample Collection

This research period was 12 months (an annual survey study) which started from April, 2017 to March, 2018. The samples such as Channidae fish and other fish species, water were collected monthly (sampling frequency). The depth and fish habitat in each sampling site were observed and recorded. The fishes were caught by our research team using the fish nets and also obtained from the local fishermen of each sampling site. The fishes were identified and unknown species were collected to be identified later. The giant snakehead fish was collected to be used for the other studies in the aquaculture laboratory in Khon Kaen University, Thailand. The collected fish samples were fixed in the 10% formaldehyde solution.

2.3 Water Collection and Analysis

The water samples (100 ml) were randomly collected at each sampling site with triplicates.

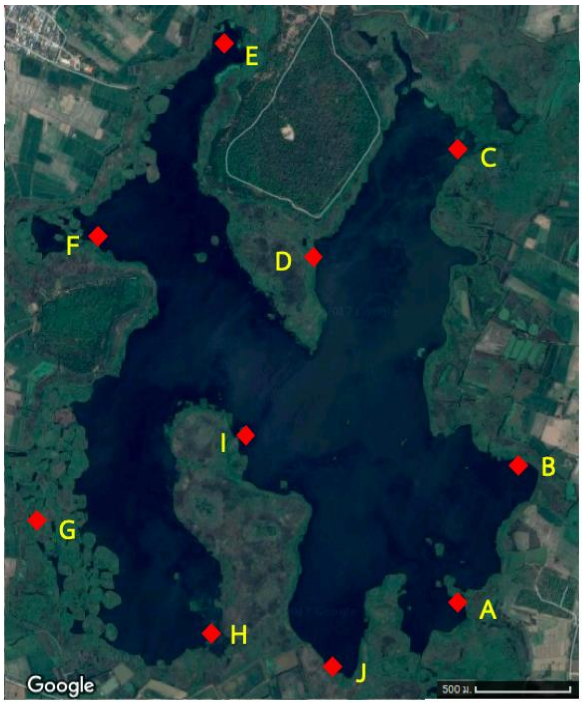

Fig. 1. Ten sampling sites (10 sites) where the samples were collected in Huai Suea Ten wetland, Nam Phong District, Khon Kaen Province

The samples were kept in 4°C until analysed. Water quality parameters such as temperature, dissolve oxygen (DO), and pH were measured in each site using Multi meter (YSI model 30 A, YSI incorporate, Ohio, USA) and turbidity was measured using secchi disk. In addition to those parameters, the water samples were collected to store in the glass bottles for the hardness and alkalinity measurements in the laboratory of aquaculture, Faculty of Agriculture, Khon Kean University, Thailand. The hardness and alkalinity measurements of the collected water were conducted according to the method of [3].

2.4 The Experimental Procedure

Species identification: All fishes collected from the all sampling sites were identified for the species according to Nelson [4]. The collected snakehead fish with perfectly physical appearance were measured for the average of the total body length and body depth ratio according to the method of [5].

The gender identity and sex ratio (male:female): The fish collected from each month were identified the gender by examining the external and internal sexual organs. The external sex appearance in Giant snakehead fish of male and female seemed similar; however, the body size of the male was generally bigger than the female. The pelvic and anal fins of the female were slightly shorter than that of the male. During the pairing season, the abdomen of female was wider than that of male. Additionally, the urogenital pore of female turn pink, the body color of the male became darker than usual. The internal sex appearance, two lobes of ovary were found in the body cavity of female and two spermatic tubes were found the body cavity of the male. The number of all identified fish were calculated for the sex ratio and tested for the statistical difference using Chi-square test [6]. The hypothesis of this study was that the sex ratio (male: female) was assumed as 1:1. The data would be expressed as a monthly average and an annual average of the sex ratio. Lastly, the sex ratio of each month would be compared in order to be determined whether the sex ratio varied with the specific seasons and areas. The equation used in this study:

$$X^2 = \frac{\sum_{(O-E)}{}^2}{E}$$

where: X^2 = Chi – square of the sex ration (male: female)

O = The number of male or female was observed (Observed frequency).
E = The number of male or female which was expected to be observed (Expected frequency).

The relationship between body weight and body length: The individual male and female fish were measured for the body weight and total body length. The values of the body and total body length would be calculated for the relationship between body weight and length that was expressed as the quadratic equation and the coefficient of determination (R^2), based the method of [7].

$$W = aL^b$$

or $\log W = \log a + b\, l$

where: W = body weight

The equation of logarithm was performed:

$$\log W = \log a + b \log L$$

where W = Body weight (g/fish),
L = Total body length (cm/fish),
a and b are the constant value

After the quadratic equation and the coefficient of determination (R^2) were calculated, these were examined whether they were able to describe the dependent variable values (Y) properly, according to the t equation.

$$t = \sqrt{\frac{(n-2)R^2}{1-R^2}}$$

The calculated value of t would be compared to the t value in the t-distribution Table at $t_{0.05}$ (n-2). In case, the calculated value of t was higher than that of t in the t-distribution Table, it indicated that there was significant relationship between the body weight and body length.

Gonadosomatic index (GSI): The fish were dissected to collect to gonadal organ which was then weighed using a balance (Sartorius ED124S analytical balance, Goettingen, Germany). The weight of gonad organ was calculated for GSI, according to Benfey and Sutterlin [8]:

GSI = (Gonadal weight of fish x 100 / Fish body weight)

The average of a monthly GSI value collected monthly would be calculated to compared to the average of an annual GSI value in order to estimate the highest development of the gonad in a year (a year-round range).

The condition factor: The body weight and total body length of fish sampled from each month were calculated as the condition factor which is expressed as expressed as a mean value ± standard deviation, according to Swingle and Shell [9].

$$K = 100\ W/L^3$$

where: K = The condition factor
W = The fish body weight (g/fish)
L = The total length (cm/fish)

The relationship between the body and intestinal lengths and stomach content index: The fish samples were dissected to collect both the tissue and the content/digesta in a whole digestive tract including stomach and intestinal contents. The length of intestine was measured for a ratio and relationship between the length of digestive tract and the total body length of fish [10]. The value is expressed as expressed as a mean value ± standard deviation. The digesta was examined for the feed components under the microscope with (5x) using the occurrence method, based on [11], so as to sort the type and number of feed components, of which values were expressed as percentage (%) of a whole stomach digesta (100%) as the digesta weight.

$$Li = a\, Lt^b$$

or $\log Li = \log a + b \log L$

where: Li =Length of intestine (cm)
Lt = total body length (cm)
a and b are the constant values.

3. RESULTS AND DISCUSSION

3.1 The Observation of Study Area and Water Quality

The water-course bank of Huai Suea Ten wetland was brooked and there was the abundance of both plants and aquatic plant along the water-course bank. The ranges of water quality (DO = 2.5-5.0 mg/L; pH = 5.5-5.7; temperature = 23-32°C; alkalinity = 54-66 mg/L; hardness = 57-59 mg/L; and turbidity = 30-130 mg/L) measured in all sampling sites in Huai Suea Ten wetland was considered in the normal range for the natural fishes.

3.2 Fish Species Identification and Diversity

A study on the general characteristics and taxonomy of fishes is used as the significantly important indicators of the fish habitats, fish existence and fish behaviors [12] that is a fundamental information for both of the conservation of certain invaded species and the researches to develop the aquaculture industries.

Based on the results of the annual survey from April, 2017 to March, 2018 in Huai Suea Ten wetland site is located in Nam Phong District, Khon Kaen Province, 36 fish species belonging to 17 families were observed in 10 sampling sites (Table 1). The family Channidae, three fishes such as snakehead fish (*Channa striata*), giant snakehead fish (*Channa micropeltes*) (Fig. 2), and forest snakehead fish (*Channa lucius*), were observed in this survey. In addition to the giant snakehead fish which was the target fish found in this survey, the Cyprinid fishes were the most diverse among fishes that was counted as 11 species. Three of them belonged to the subfamily Rasborinae; and the others (8 fishes) belonged to subfamily Cyprininae. The family of Anabantidae fishes was in the 2nd place which was surpassed by the group of Cyprinid fishes. There were five species found in this survey. Further, two families of fishes, namely Siluridae and Cobitidae, consisted of two species of each family were found. The others families including Clariidae, Notopteridae, Pristolepidae, Cichlidae, Eleotidae, Belonidae, Tetrodontidae, Mastacembelidae, Symbranchidae, Parmbassidae and Nandidae, which composed of only one species of each family. In Thailand, 10 fish species belonging to family Channidae; and the giant snakehead fish is the biggest snakehead fish in this family.

3.3 The Sex Ratio (Male: Female) of Giant Snakehead Fish

According to the annual sampling of giant snakehead fish, a total of 230 giant snakehead fish were found in this survey which consisted of 118 males and 112 females. The sex ratio (male: female) was 1: 0.95 (Table 2). The sex ratio was hypothesized that the ratio of the male was equal the female as 1: 1 at 95% of the confident interval. As a result of Chi-square test in the annual survey, the calculated value of Chi-square (9.465) was lower that the table value of Chi-square (19.68; df = 11), indicating there was no a significant difference in the sex ratio of giant snakehead fish ($p>0.05$). Based on the result of the monthly survey, the calculated values of Chi-square were lower that the table value of Chi-square (3.84; df = 1), indicating there was no a significant difference in the sex ratio of giant snakehead fish ($p>0.05$).

3.4 The Relationship between Body Weight and Body Length

There was a significantly positive relationship between the body length and body weight of 230 giant snakehead fish ($R^2 = 0.696$) collected from April, 2017 to March, 2018 in Huai Suea Ten wetland (Fig. 6).

3.5 Gonadosomatic Index (GSI)

The gonadosomatic index (GSI) of each gender collected monthly was used to indicate the maturity period of giant snakehead fish in a year by comparing the value in each month. The GSI of a total of 230 giant snakehead fish observed in 12 months showed that GSI of 118 males was in a range of 0.140-0.361%, and the highest value(0.36%) and lowest of GSI values were found in December, 2017 and April, 2018, respectively (Fig. 4). The GSI of 112 females was in a range of 0.299-1.788%, and the highest value (1.79%) and lowest of GSI values were found in June, 2017 and December, 2018, respectively. In comparison, the GSI value of the female was higher than that of the male that indicates the gonad (ovary) of female is greater level of gonad development, in terms of the weight, than that (sperm) of male.

Fig. 2. Giant snakehead fish (*Channa micropeltes*)

Table 1. The fish species were observed in all sampling site in Huai Suea Ten wetland, Nam Phong District, Khon Kaen Province

Family	Subfamily	Scientific name
Notopteridae		*Notopterus notopterus*
Cyprinidae	Rasborinae	*Esomus metallicus*
		Rasbora rubrodorsalis
		Rasbora borapetensis
	Cyprininae	*Cyclocheilichthys apogon*
		Osteochilus hasselti
		Labiobarbas spilopleura
		Puntioplites proctozysron
		Puntius leiacanthus
		Puntius gonionotus
		Hampala dispar
		Cirrhinus molitorella
Channidae		*Channa striata*
		Channa lucius
		Channa micropeltes
Anabantidae		*Anabas testudineus*
		Trichopsis vittatus
		Trichogaster trichopterus
		Trichopsis pumila
		Betta smaragdina
Cobitidae		*Lepidocephalus hasselti*
		Acanthopsis choirorhynchos
Siluridae		*Ompok bimaculatus*
		Krytopterus bleekeri
Ambassidae		*Parambassis siamensis*
Nandidae		*Nandus nebulosus*
Belonidae		*Xenentodon cancila*
Bagridae		*Mystus vittatus*
		Mystus nemurus
Clariidae		*Clarias batrachus*
Symbranchidae		*Monopterus albus*
Tetrodontidae		*Tetrodo nleiurus*
Mastacembelidae		*Macrognathus siamensis*
Pristolepidae		*Pristolepis fasciatus*
Cichlidae		*Oreochromis niloticus*
Eleotridae		*Oxyeletris marmoratus*
Total = 17 families		36 species

3.6 The Condition Factor

The condition factor is an indicator of the health status and maturity which are commonly varied with the season and several factors such as fish species, fish body size, fish gender, food availability and the quality of environment [10]. The body length and body weight of a total of 230 giant snakehead fish observed in this study showed that the longest and shortest body lengths of fish were 14.3 and 73.3 cm, respectively; and the average of a total body length was 43.71±11.72 cm. The heaviest and lightest body weights of fish were 125 and 1,254 g/fish, respectively; and the average of the body weight was 448±173 g/fish (Table 3). The condition factor (K) of a total of 230 giant snakehead fish observed in 12 months showed that the condition factor of the male was in a range of 0.45-0.74, and the highest value and lowest of condition factor values were found in June, 2017 and April, 2018, respectively. The

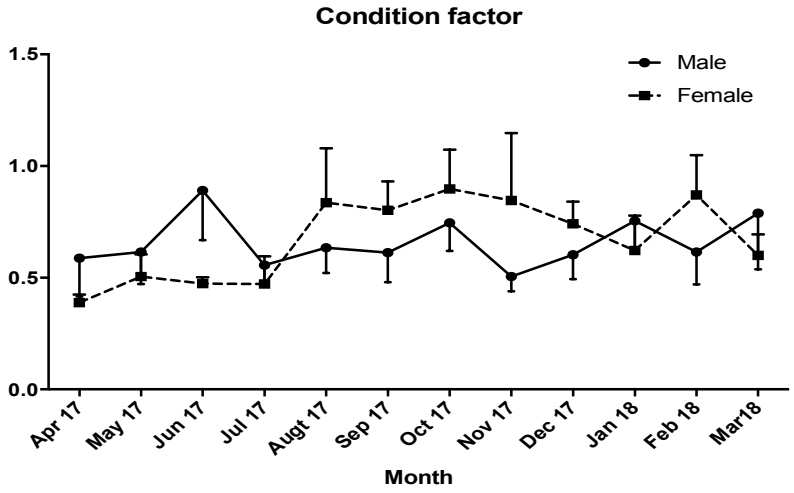

Fig. 3. The tendency of the condition factor (K) of the giant snakehead fish of male and female in Huai Suea Ten wetland, Nam Phong District, Khon Kaen Province from April, 2017 – March, 2018 (The error bars are the standard deviation)

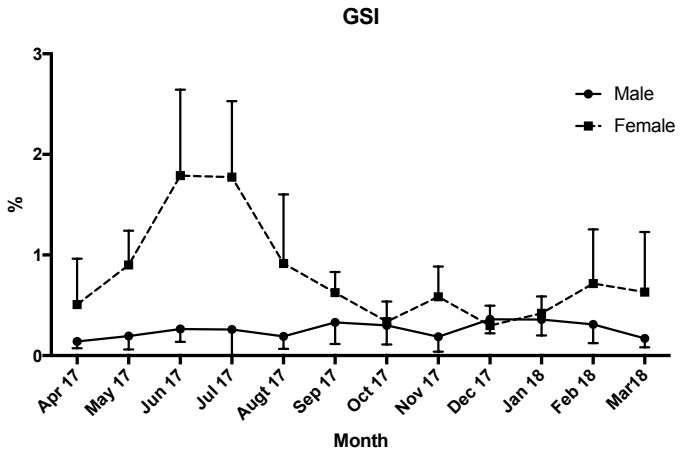

Fig. 4. Gonadosomaic index (%) of the giant snakehead fish of male (n = 118) and female (n = 112) in Huai Suea Ten wetland, Nam Phong District, Khon Kaen Province from April, 2017 – March, 2018 (The error bars are the standard deviation)

Fig. 5. The difference of urogenital pore of giant snakehead fish collected during the pairing season in Huai Suea Ten wetland, Nam Phong District, Khon Kaen Province (left = male; right = female)

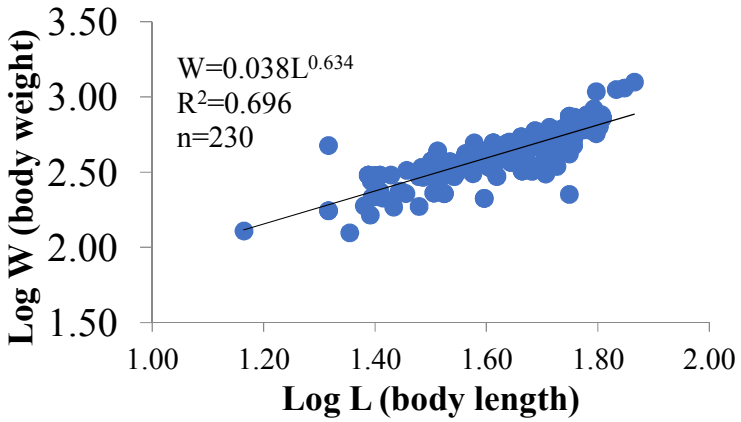

Fig. 6. the relationship between the body length and body weight of giant snakehead fish (R^2 = 0.696) in Huai Suea Ten wetland, Nam Phong District, Khon Kaen Province collected from April, 2017 – March, 2018

Table 2. The sex ratio of giant snakehead fish collected in Huai Suea ten wetland, Nam Phong district, Khon Kaen province from April, 2017 – March, 2018

Month/year	Fish number		Total	Sex ratio		Chi-square	H_o
	Male	Female		Male	Female		
April 17	10	10	20	1	1.00	0.014	accept
May 17	13	8	21	1	0.62	0.945	accept
June 17	10	8	18	1	0.80	0.130	accept
July 27	8	7	15	1	0.86	0.025	accept
August 17	10	7	17	1	0.70	0.385	accept
September 17	9	14	23	1	1.56	1.364	accept
October 17	9	9	18	1	1.00	0.012	accept
November 17	6	12	18	1	2.00	2.327	accept
December 17	9	11	20	1	1.22	0.318	accept
January 18	16	9	25	1	0.56	1.613	accept
February 18	11	6	17	1	0.55	1.222	accept
March 18	7	11	18	1	1.57	1.111	accept
Average				1	0.95	9.465	accept
Total	118	112	230				

Note: Chi-square at the confident 95% df1 = 3.84, df11 = 19.68

condition factor of the female was in a range of 0.39-0.70, and the highest value and lowest of condition factor values were found in October, 2017 and April, 2018, respectively. According to our study, the condition factor in giant snakehead fish slightly changed during an annual observation due to this fish species generally live in the wetland all years long.

3.7 The Relationship between the Body and Intestinal Lengths and Stomach Content Index

The longest and shortest intestinal length of fish were 16.95 and 48.00 cm, respectively; and average of intestinal length was 30.16±12.04 cm. The ratio of the body and intestinal length of giant snakehead fish was 1:0.70 (Table 4). The type of stomach content examined in 230 fish displayed that only 24 fish of which stomach contained the digesta; and the stomach of the other 206 fish contained no digesta. The components of stomach content included fish fillet, small fish and digested content which was not able to be identified due to the complete digestion. The portion of a total stomach content, counted as 100%, comprised of 51.8% of fish fillet, 30.3% of small fish and 17.9% of digested content (Fig. 7). The ratio of the body and intestinal length (1: 0.70) of giant snakehead fish was in a range of the carnivore fish. Likewise, the stomach digesta components found in this study indicates that the feeding behavior of giant snakehead fish has not changed which is carnivore fish.

Table 3. The condition factor (K) of the giant snakehead fish of male and female collected between April 2017 – March 2018

Month/year	Male				Female			
	Fish number	Length (cm)	weight (g)	K	Fish number	Length (cm)	weight (g)	K
April 17	10	47.2	472.96	0.45	10	47.2	409.49	0.39
May 17	13	46.9	492.01	0.48	8	48.8	518.83	0.45
June 17	10	37.4	387.18	0.74	8	48.0	541.38	0.49
July 17	8	42.9	407.58	0.52	7	53.5	629.81	0.41
August 17	10	46.4	532.15	0.53	7	41.6	449.10	0.62
September 17	9	46.4	500.59	0.50	14	38.7	381.56	0.66
October 17	9	41.2	442.44	0.63	9	36.9	353.81	0.70
November 17	6	45.2	439.77	0.48	12	42.2	426.33	0.57
December 17	9	43.9	436.57	0.51	11	39.3	386.36	0.64
January 18	16	41.7	416.39	0.58	9	45.8	471.16	0.49
February 18	11	46.6	478.70	0.47	6	37.4	362.39	0.69
March 18	7	42.9	423.33	0.54	11	44.9	469.31	0.52
Average		44.05	453.61	0.54±0.08*		43.35	442.84	0.55±0.11*
Total	118				112			

** The mean value ± standard deviation*

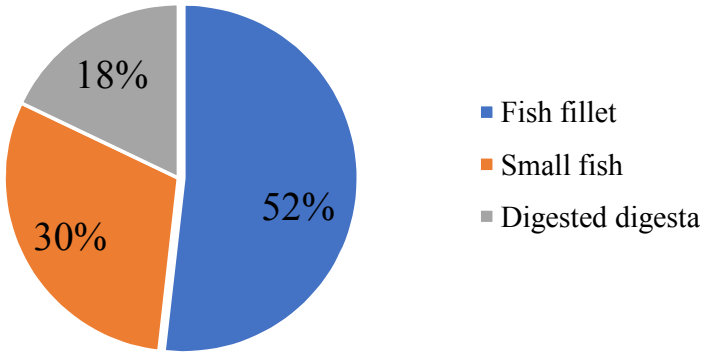

Fig. 7. The type of and amount of stomach content of giant snakehead fish (n = 230); the values are expressed as percentage (%) of a whole stomach digesta as the digesta weight

Table 4. The ratio of body length and intestinal length of giant snakehead fish in Huai Suea Ten wetland, Nam Phong District, Khon Kaen Province collected from April, 2017 – March, 2018

Class interval of length (cm)	Fish number	Body length (cm)	Intestinal length(cm)	Ratio of body and intestinal length
20.0 – 29.9	19	23.90	16.95	1 : 0.71
30.0 - 39.9	58	33.22	22.46	1 : 0.68
40.0 – 49.9	97	44.66	28.31	1 : 0.63
50.0 - 59.9	47	52.86	35.08	1 : 0.66
60.0 – 69.9	9	61.80	48.00	1 : 0.78
Average		43.29±15.11*	30.16±12.04*	1 : 0.70
Total	230			

** The mean value ± standard deviation*

4. CONCLUSION

Based on the results of the annual survey from April, 2017 to March, 2018 in Huai Suea wetland, there were 36 fish species belonging to 17 families were observed in 10 sampling sites. Three Channidae fishes, namely snakehead fish (*Channa striatus*), giant snakehead fish (*Channa lucius*), and forest snakehead fish (*Channa micropeltes*), belonging to the family Channidae were reported. A total of 230 giant snakehead fish were found in this survey which consisted of 118 males and 112 females. The sex ratio (male: female) was 1:0.95. The GSI value of the female was higher than that of the male that indicates the gonad of female is greater level of gonad development than that of male.The body length and body weight of a total of 230 giant snakehead fish observed in this study showed that the longest and shortest body lengths of fish were 14.3 and 73.3 cm, respectively; and the average of a total body length was 43.71±11.72 cm. The heaviest and lightest body weights of fish were 125 and 1,254 g/fish, respectively; and the average of the body weight was 448±173 g/fish. The condition factors of giant snakehead fish observed in 12 months were in a range of 0.45-0.74% for the male and 0.39-0.70% for the female. The ratio of the body and intestinal length of giant snakehead fish was as 1: 0.70. The stomach digesta components of this fish species consisted of 51.8% of fish fillet, 30.3% of small fish and 17.9% of digested digesta.

ETHICAL APPROVAL

As per international standard written ethical approval has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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