Faculty of Resource Science and Technology

FEEDING HABIT OF YELLOW PUFFER *(XENOPTERUS NARITUS)* AT BATANG SARIBAS

Tan Siang Na

Bachelor of Science With Honours
(Aquatic Resource Science and Management)
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This project is submitted in partial fulfillment of
the requirements for the degree of Bachelor of Science with Honours
(Aquatic Resource Science and Management)

Faculty of Resource Science and Technology
UNIVERSITY MALAYSIA SARAWAK
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ABSTRACT

The food choice of yellow puffer, *Xenopterus naritus* and the influence of physico-chemical water parameters and availability of zooplankton upon its high congregation in Batang Saribas near Kampung Manggut during certain month in a year was investigated. Thirty one stomachs were observed and 13 taxa food items were identified in the fish guts. The food preference of yellow puffer revolved around juvenile gastropod, adult gastropod, nematode, amphipod and calanoid copepod. Meio-macrobenthos was an important prey of the yellow puffer. This species is omnivore, relying primarily on benthic invertebrates as their food. Congregation of this fish in the estuary of Btg. Saribas is due to the spawning activities. It is believed that the physico-chemical of the water and food availability is also influence the congregation of the fish in the area.

Key words: Gut content analysis, feeding habit and zooplankton.

ABSTRAK

Makanan pemilihan ikan buntal kuning, Xenopterus naritus dan pengaruhan fizikal-kimia parameter air serta kehadiran zooplankton terhadap pegumpulannya secara banyak di Batang Saribas yang berdekatan dengan Kampung Manggut telah dikaji. Sebanyak tiga puluh satu perut telah dikajikan dan 13 taxa telah dikenalpasti dalam perut ikan. Pemakanan kesukaan ikan buntal kuning adalah juvenile gastropod, gastropod, nematode, amphipod dan kopepod kalanoid. Meio-macroinvertebrata merupakan makanan yang penting bagi ikan buntal kuning. Spesies ini adalah omnivor yang bergantung terutamanya kepada inveterbrata bentik sebagai makanannya. Pengumpulan ikan ini secara banyak di muara sungai Btg. Saribas disebabkan oleh aktiviti peneluran. Faktor fiziko-kimia air dan kehadiran makanan dipercayai turut mempengaruhi pengumpulan ikan buntal di kawasan kajian.

Kata kunci: Analisis kandungan perut, cara pemakanan dan zooplankton.

1.0 INTRODUCTION

1.1 The biological background

Puffer fish is classified in the family of Tetraodontidae. According to Al-Baharna (1986), the shapes of their teeth give them the name of "Tetraodontidae". Tetraodon means four teeth, 2 in each jaw. Morphologically, puffer fish has short body with small embedded spines covered especially at abdomen part. Some of the puffers are naked without the spines. Its body shape is flattened on the underside, rounded above with a large head and large eyes. It has a pointed nose and two nostrils on each size. No pelvic fin and no spines in the fins. Caudal fin rounded, truncate or emarginated. Pectoral fins small and rounded. One interesting characteristics of puffers, it's their ability to inflate themselves as its prey detection (Helfman *et al.*, 1997; Nelson, 1994; Axelrod & Burges, 1983; Bender, 1989). The pumping of water or air into the stomach enlarges their body and erects their spines, making them spiny and large objects that hard to swallow by their prey (Axelrod & Burges, 1983). The other special characteristic of puffers is that parts of their body carry toxin which are poisonous to eat (Kottelat *et al.*, 1993). The toxin is known as "tetrodotoxin" (TTX) which concentrated in liver, reproductive organs, intestine, skin and muscle tissue (Isbister *et al.*, 2002; Al-Baharna, 1986). It is a neurotoxin causing rapid and severe side effect by destructing the nerve system (Isbister *et al.*, 2002). However, Al-Baharna (1986) stated that only some of the species carry this poison and only parts of the body. Besides that, puffer can made sounds by grinding the teeth or the pharyngeal teeth or vibrating the swim bladder (Nelson, 1994).

1.2 Distribution of puffer fish

Puffer fish mostly live in marine ecosystem, distributed from tropical to subtropical. It is shallow sea water species and is found in abundance in coral reef (Iversen, 1996; Al-Baharna, 1986; Bone & Marshall, 1982). This fish is found at downstream proximity to the river mouth where the water in brackish and marine condition (Kottelat *et al.*, 1993). A few members of family Tetraodontidae are fresh water species (Bone & Marshall, 1982). Al-Baharna (1986) pointed out that they also can be observed on open sand or sea grass bottoms. In Sarawak, there are 21 puffer species from 3 families have been recorded and large quantity of the fish is observed in coastal, estuaries and brackish water river (Isaka, 2002).

1.3 Diet and feeding behavior

Puffer fish diet includes various types of benthic organisms, live coral and plant materials (Al-Baharna, 1986). Bone & Marshall (1982) said that puffers' feed rely on invertebrates. Many marine fishes have diverse feeding habit for capturing their prey. As for puffers, they use their teeth and powerful jaw to graze the coral polyp, encrusting algae or hidden invertebrate in coral reef (Marshall, 1999).

1.4 Commercial value of puffers

Puffers or genus *Fugu* are considered a delicacy in Japan. The preparation and marketing of puffers are under the governing Japanese government regarding many incidences of puffers poisoning that occurred (Isbister *et al.*, 2002). Thus only the trained and licensed cooks are allowed to prepare it. Besides that, puffers are also kept as aquarium fish especially species from genus *Canthigaster* (Axelrod & Burgess, 1983).

1.5 Gut content analysis

Feeding habit of a particular fish can be examined by stomach content analysis. The analyses were constrained to food items found in the stomach and esophagus to increase the possibility that the food item had been eaten recently and in the habitat where the fish caught (Wennhage & Pihl, 2002). The collected data from the analysis is very useful for stock assessment (Iversen, 1996; Hilborn & Walters, 1992) and investigation of interaction among fish (Grant and Brown, 1998). Andersen (2001) stated that prey composition and the amount of food ingested by the fish are important prerequisite information for the fishes' trophic role study. There are three basic stomach content analysis methods which are numerical, volumetric and gravimetric analysis that are mentioned by Windell & Bowen (1978). Each of the methods has their advantages and limitations. However, the selection of the methods depends on the purpose of the study and the food type to be analyzed (Windell & Bowen, 1978). The degree of fullness gut content for each fish samples are estimated (Grant & Brown, 1998; Pirro *et al.*, 1999) based on of the categories: empty, 0.25 full, 0.5 full, 0.75 full or full (Pirro *et al.*, 1999). The estimation of numerical analysis is not so representative to reveal the fish diet since the small food items have the same importance with the bigger prey (Windell & Bowen, 1978; Hop *et al*, 1993). There is still not much research done on the feeding habit of *X. naritus* in Sarawak.

1.6 Objective

The main objective of this research is to investigate the food choice of *X. naritus* and to find out if the abundance of food (zooplankton) in its habitat influenced upon its congregation at Batang Saribas. Besides that, the study is to observe the influence of physico – chemical water parameters on its congregation at Batang Saribas during certain month in a year.

2.0 MATERIALS AND METHODS

2.1 Study area

This study was carried out at Batang Saribas in Betong district, Sarawak. Btg. Saribas is one of the main rivers in Sarawak. Five stations were selected for zooplankton sampling (Figure 1), which were Kampung Supa (01°30.645'N and 111°18.126'E), Tanjung Keranji (01°30.529'N and 111°19.898'E), Kampung Manggut (1°30.50'N and 111°21.37'E), Tanjung Baring (01°30.315'N and 111°22.568'E) and Kampung Serembang (01°28.817'N and 111°23.643'E). Distance from the river mouth to the study areas was about 80 km (Figure 1). There are a few villages along the river bank. It is an estuary with brackish water condition that it is a mixture of freshwater and seawater having salinity values ranging from approximately 0.50 to 17.00 psu (Iversen, 1996). Palm (*Nypa fruticans*) was the dominant plant found along the riverbank in this study. However, the yellow puffers (*X. naritus*) sampling were conducted in between the five stations. The most popular fishing area for this species was between Tanjung Matu (near Kampung Manggut) and Tanjung Nangka (near Kampung Supa), Spaoh. The study areas were chosen based on its high congregation there during certain month of the year.

Global Positioning System GPS, model Garmin GPS S-28 was used to locate the position of the studies area.

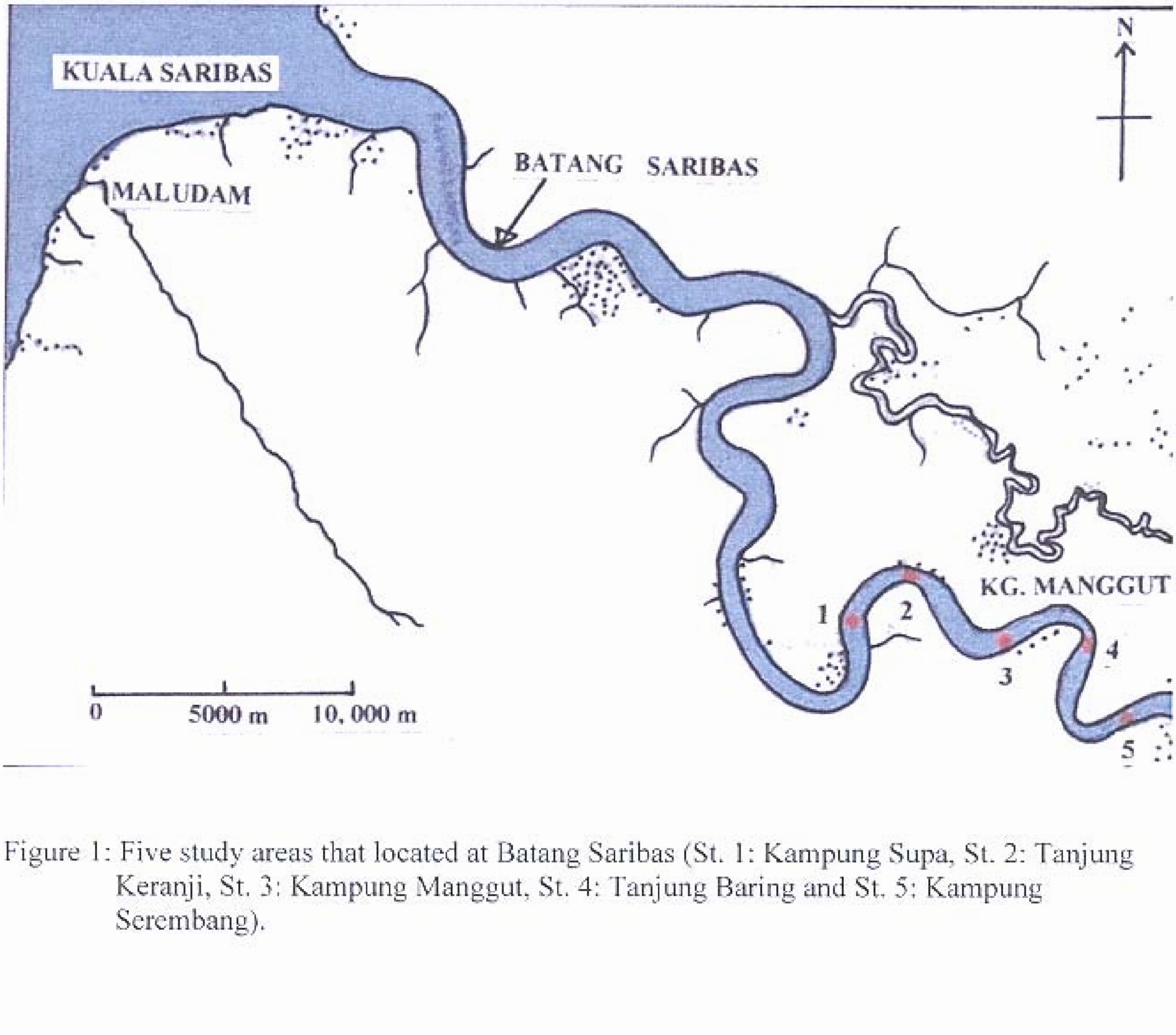


Figure 1: Five study areas that located at Batang Saribas (St. 1: Kampung Supa, St. 2: Tanjung Keranji, St. 3: Kampung Manggut, St. 4: Tanjung Baring and St. 5: Kampung Serembang).

2.2 Fish sampling

A total of 100 adult yellow puffers were collected, mostly purchased from the local fishermen during the peak congregation in August. Gill net with three layers was used by the fishermen to capture the puffers. The mesh size of the net was 6.35 cm for the one layer gill net and 2.54, 3.81 and 10.16 cm for the three layer gill net. The gill net is a single wall of fabric by hanging vertically with a float line at the top and lead line at the bottom (Larger, 1978). The fish will be captured when it swims into the net. Total length (TL), standard length (SL) and body weight (BW) for each fish sample was recorded (Mokerji *et al.*, 1998; Grant & Brown, 1998). TL is a distance from the tip of snout or upper jaw to the caudal fin. SL is a distance from the tip of snout or upper jaw to the base of caudal fin (Al-Baharna, 1986). Once the fish samples were caught, they were being dissected as soon as possible to take out the stomach for preservation. The purpose of doing so was to reduce further digestion process of foods in the fish stomach. The whole stomach including the esophagus was removed and the total length of the stomach was measured by using the measuring board (Wildco). The fish gut was preserved in 40 % formalin and its content were counted and identified in the laboratory (Al-Baharna, 1986). All available information like date of capture, location and numbers of the fish catches were labeled to give a clear picture about the fish samples.

2.3 Zooplankton sampling

Zooplankton samples were collected at the five stated stations with 2L Van Dorn Bottle. Two replicates for each water depth which were at the surface, middle and bottom of five stated study areas during high tide and low tide respectively. Van Dorn Bottle was a cylinder bottle that was let down in certain depth of the water. It was closed by sliding down a weight or messenger. After that, the collected water sample in the cylinder bottle was filtered through a sieve with a mesh-size of 120 μm to collect zooplankton. The zooplankton samples were then immediately preserved in 5 % Lugol's solution (formaldehyde and potassium plus iodine). The identification and calculation of zooplanktons were conducted in laboratory.

2.4 Physico-chemical parameter of the water

The physico-chemical parameters of the water were taken from Magdelyn (2004) who was working in the similar study area.

2.5 Laboratory analysis

2.5.1 Fish diet analysis

The diet of *X. naritus* was determined based on the result of stomach contents analysis. Numerical analysis was selected to use for the stomach content analysis since it is the easiest and less time was needed to get the result. The food composition and the frequency of occurrence were the representative of this stomach content analysis method (Hyslop, 1980). The preserved stomach was washed with tap water. It was then opened and the entire stomach contents were removed. Stomach contents of each specimen were analyzed under the stereo microscope (Stemi SV6). Identification of the gut contents were made based on the morphology characteristic of each organism. Number of prey item in the contents was counted in a grid Petri dish. Items were identified to the higher taxonomic level. Unidentified food materials were not counted in this analysis.

2.5.2 Gut content analysis

Relative Gut Index (RGI)

The Relative Gut Index (RGI) is based on the ratio of the total stomach length of a fish to the standard length of the fish and multiplies it by 100 % (Beumer, 1978).

$$\text{RGI} = \frac{A}{B} \times 100\%$$

A = Stomach length of a fish in cm

B = Standard length of the fish in cm

Food Composition (% Cn)

Food composition (Cn) is expressed as percentage numbers or the relative abundance of a particular food item that found in all food items (Pirro *et al.*, 1999; Mookerji *et al.*, 1998; Windell & Bowen, 1978). The percentage composition of prey is shown as the following formula:

$$\%\ \text{Cn} = \frac{C}{D} \times 100\%$$

C = Number of food items of a given type in all specimens

D = Total number of all food items that are found in all specimens

Frequency of Occurrence (% F)

This figure is used to estimate the proportion of the population that feed on that particular food items (Windell & Bowen, 1978).

$$\% \text{ F} = \frac{E}{F} \times 100\%$$

E = Number of stomachs contain a particular food item

F = Total number of stomachs being analyzed

2.5.3 Zooplankton identification

Zooplankton was observed with a zoom stereo microscope (Stemi SV6). It was identified to higher taxa level and counted in a grid Petri dish. The number of zooplankton at each station was recorded. The data was converted to numbers of individual/liter. The relative abundance of zooplankton was evaluated by numerical abundance, expressed as the percentage contribution to the total number of zooplankton taken.

2.6 Data Analysis

All statistical calçulation was done by using the statistical packages SPSS 11.0 and Excel. Statistical analyses used included linear regression, simple ANOVA Significance levels were set at $P < 0{\cdot}05$ and T-test. Correlation of the gut contents and the zooplankton found in the water was evaluated.

3.0 RESULT

3.1 Physico-chemical of water at the five stations

The highest pH value was 7.55 ± 0.04 that was observed at St. 2 (Tg. Keranji) during high tide and the lowest pH value was 6.69 ± 0.03 that was recorded at St. 5 (Kg. Serembang) during low tide (Table 3). The mean pH of the study area at Btg. Saribas was 7.18. There was no significant difference in the pH values in the five stations (Table 1) and during high tide and low tide (Table 2).

The highest and lowest dissolved oxygen content were 7.50 ± 0.30 mg/L at St. 5 and 6.52 ± 0.09 mg/L at St. 2 respectively (Table 3). The dissolved oxygen content not significantly differs during high tide and low tide (Table 2) and in the five stations (Table 1). The mean dissolved oxygen of the study areas at Btg. Saribas was 6.85 mg/L.

Table 1: One-way ANOVA of physico-chemical water parameters for the five stations (St 1: Kampung Supa, St 2: Tanjung Keranji, St 3: Kampung Manggut, St 4: Tanjung Baring and St 5: Kampung Serembang).

Water Parameters	F	Sig.
PH	3.947	.013
DO (mg/L)	4.651	.006
Transparency (cm)	45.235	.000
Temperature (^{0}C)	8.295	.000

* $p < 0.05$, significant different

The mean temperature of the five stations was 29.98 ^{0}C. The highest value of temperature was observed at St. 5 and the lowest value was at St. 2 (Table 3). There was significantly difference of temperature in the five stations (Table 1).

Table 2: Independent T-test of physico-chemical water parameters during high tide and low tide at the five stations.

Water Parameters	F	Sig.
PH	6.041	0.20
DO (mg/L)	0.194	0.663
Salinity (psu)	94.929	0.00
Transparency (cm)	1.052	0.314

* p <0.05, significant different

The salinity of the five stations ranged from 10.00 psu to 18.33 psu (Table 3) and the mean was 13.43 psu. Statistical analysis found that there was significant difference of salinity during high tide and low tide (Table 2).

The mean transparency for the study areas was 29.05 cm depth. The transparency did not vary significantly during high tide and low tide (Table 1). However, there was significantly difference of transparency in the five stations (Table 1).

The highest total suspended solid value was 654.89 ± 31.51 mg/L at St. 4 during low tide and the lowest total suspended solid value was 10.00 ± 11.68 mg/L in St. 3 during low tide (Table 4). There was significant different of total suspended solid during high tide and low tide (T-test, $F = 7.476$, $P < 0.05$).

Table 3: The physico-chemical water parameters at the five stations (St. 1: Kampung Supa, St. 2: Tanjung Keranji, St. 3: Kampung Manggut, St. 4: Tanjung Baring and St. 5: Kampung Serembang) on August 2003.

Station	Date	Tidal	Time	Depth	pH	DO (mg/L)	Temp. (^{0}C)	Salinity (psu)	Trans. (cm)
1	23/8/03	HT	1040	9.7	7.33±0.03	5.86±0.43	31.93±1.20	18.33±0.58	50.20±2.04
	23/8/03	LT	1700	5.0	6.80±0.04	6.85±0.03	31.23±0.25	11.00±0.00	56.07±0.32
2	23/8/03	HT	1215	8.4	7.55±0.04	6.52±0.09	29.83±0.12	17.00±0.82	27.33±1.94
	25/8/03	LT	1000	6.0	7.31±0.03	6.78±0.05	30.37±0.70	12.00±0.00	0.22±0.44
3	25/8/03	HT	1635	9.5	7.29±0.02	7.02±0.02	30.27±0.21	12.00±0.00	38.77±0.95
	25/8/03	LT	1115	5.0	7.18±0.02	7.32±0.01	30.20±0.36	12.00±0.00	25.50±0.17
4	22/8/03	HT	1300	3.6	7.33±0.02	6.61±0.03	29.00±0.00	18.00±0.00	26.87±1.01
	26/8/03	LT	1055	4.9	7.05±0.04	7.30±0.19	28.60±0.10	12.00±0.00	19.20±0.20
5	25/8/03	HT	1515	8.4	7.24±0.02	6.78±0.14	30.73±0.59	10.00±0.00	26.67±0.15
	26/8/03	LT	1000	4.1	6.69±0.03	7.50±0.30	27.67±0.45	12.00±0.00	19.70±0.10

Table 4: The mean total suspended solid (TSS) of water at the five stations (St. 1: Kampung Supa, St. 2: Tanjung Keranji, St. 3: Kampung Manggut, St. 4: Tanjung Baring and St. 5: Kampung Serembang) on August 2003.

Stations	Date	Tidal	Depth	TSS (mg/L)
1	23/8/03	HT	S	28.22 ± 8.23
			M	54.22 ± 6.05
			B	110.89 ± 29.97
	23/8/03	LT	S	29.11 ± 5.75
			M	44.89 ± 5.38
			B	52.00 ± 7.21
2	23/8/03	HT	S	104.44 ± 0.77
			M	150.00 ± 25.73
			B	269.11 ± 64.56
	25/8/03	LT	S	130.00 ± 10.73
			M	156.89 ± 9.90
			B	152.44 ± 14.91
3	25/8/03	HT	S	27.78 ± 5.67
			M	37.11 ± 15.00
			B	69.56 ± 24.32
	25/8/03	LT	S	71.78 ± 1.54
			M	10.00 ± 11.68
			B	186.89 ± 13.99
4	22/8/03	HT	S	61.33 ± 1.15
			M	76.67 ± 6.11
			B	80.00 ± 9.40
	26/8/03	LT	S	302.00 ± 16.04
			B	654.89 ± 31.51
5	25/8/03	HT	S	98.89 ± 8.49
			M	132.00 ± 5.81
			B	209.56 ± 14.45
	26/8/03	LT	S	201.78 ± 0.77
			B	272.44 ± 8.88

3.3 Size of yellow puffer

The size of male *X. naritus* for this analysis ranged from 12.7 cm to 18.0 cm SL and of female ranged from 20.0 cm to 29.1 cm SL (Table 5). The standard length, total length and stomach length of observed fish did not significantly difference between male and female samples (T-test, $P > 0.05$) (Table 6). Male puffer was significantly smaller and weighed less than their female counterparts (T-test, $P < 0.05$) (Table 6). The mean weight of male puffer was 97.36 ± 32.93 g compared to 497.63 ± 144.78 g of female puffer (Table 5). There is positive relationship between the body weight (g) and total length (cm) of *X. naritus* (Figure 2).

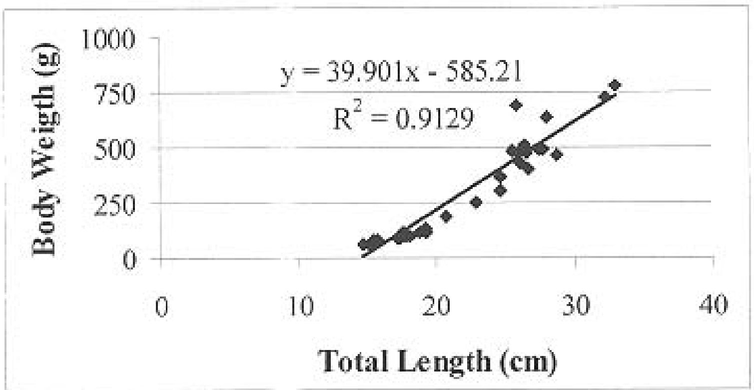
Table 5: Standard length (cm), total length (cm), body weight (g) and stomach length (cm) for *Xenopterus naritus*.

Sex	N	SL (cm)	TL (cm)	BW (g)	Stomach Length (cm)
Male	15	14.85±1.59	17.20±1.83	97.36±32.93	52.13±14.91
Female	16	24.16±2.48	27.05±2.61	497.63±144.78	49.93±15.64

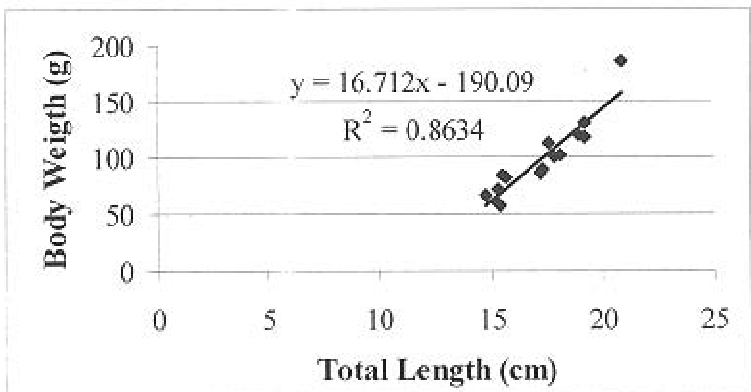
Table 6: Independent T-test for the size of *Xenopterus naritus*.

Fish Size	F	Sig
SL (cm)	1.406	0.245
TL (cm)	0.561	0.460
BW (g)	10.207	0.003
Stomach length (cm)	0.101	0.753

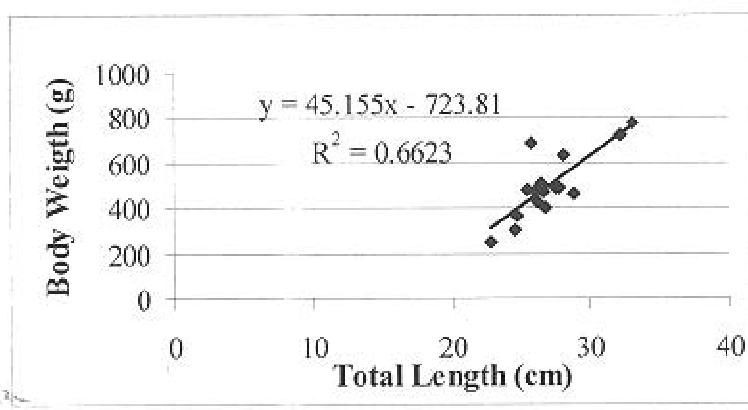
* p <0.05, significant different



All Specimens



Male



Female

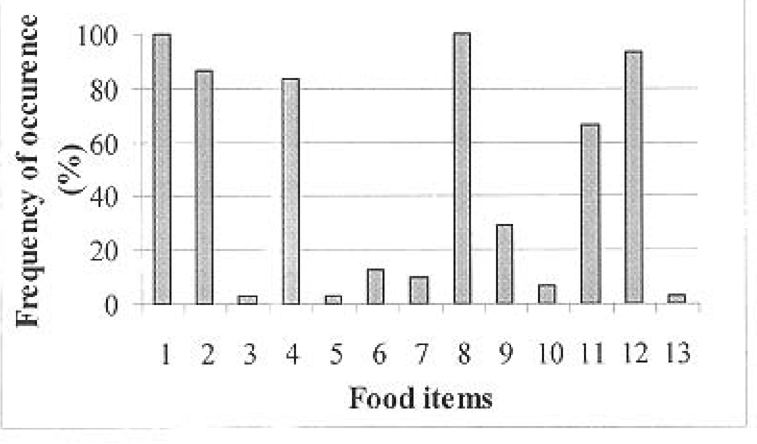
Figure 2: The relationship between the body weight (g) with the total length (cm) of *Xenopterus naritus*.

3.4 Diet of yellow puffer

A total of 13 food items were identified within the 31 observed stomachs of *X. naritus* (Apendix). Juvenile gastropods were the primary food of yellow puffer which present in large quantities and contributed 95.15 % of food composition (Table 7). The frequency occurrence of algae, amphipod, calanoid copepod, juvenile gastropod, nematode and adult gastropod were high in the gut of this fish (Figure 3). Filamentous algae and adult gastropod were present in all observed specimens, but were in small quantities. However, ten other groups were appeared in small quantities. The second highest occurrence of prey was nematode that occurred in 29 stomachs (Table 7). There was no significant difference in the prey categories found in the stomachs of male and female in this study. Overall, bivalves were only observed in stomach of male puffer and adult polychaetes as well as ciliates were identified only in stomachs of female puffer. Amphipods, calanoid copepods, juvenile gastropods and nematodes were found in all stomachs of female puffer.

Table 7: Food composition (%Cn) and frequency of occurrence (%F) of the food items identified in the 31 guts of *Xenopterus naritus*.

Food items	All specimens		Male		Female	
	%Cn	%F	%Cn	%F	%Cn	%F
Algae	0.79	100.00	5.24	100.00	0.37	100.00
Amphipoda	1.06	87.10	2.15	73.33	0.96	100.00
Bivalvia	0.08	3.23	0.87	6.67	-	-
Calanoida	2.05	83.87	5.08	66.67	1.76	100.00
Ciliata	1.35×10^{-3}	3.23	-	-	1.48×10^{-3}	6.25
Decapoda	1.80×10^{-3}	12.90	0.01	13.33	9.88×10^{-4}	12.50
Foraminifera	1.35×10^{-3}	9.68	5.18×10^{-3}	6.67	9.88×10^{-4}	12.50
Adult Gastropoda	0.42	100.00	2.06	100.00	0.27	100.00
Insecta	0.01	29.03	0.09	33.33	3.95×10^{-3}	25.00
Isopoda	6.32×10^{-3}	6.45	0.07	6.67	4.94×10^{-4}	6.25
Juvenile Gastropoda	95.12	67.74	82.41	33.33	96.33	100.00
Nematoda	0.46	93.54	2.02	86.67	0.31	100.00
Adult Polychaeta	4.51×10^{-4}	3.23	-	-	4.94×10^{-4}	6.25



1. Algae
2. Amphipoda
3. Bivalvia
4. Calanoida
5. Ciliata
6. Decapoda
7. Foraminifera
8. Adult Gastropoda
9. Insecta
10. Isopoda
11. Juvenile Gastropoda
12. Nematoda
13. Adult Polychaeta

Figure 3: Frequency of occurrence (%F) of the food items identified in the guts of *Xenopterus naritus*.

3.5 Relative Gut Index (RGI)

The mean stomach length for all specimens was ranged from 25.60 cm to 73.60 cm. The mean RGI of male *X. naritus* was 352.08 % and of female was 207.97 %. Based on the research of Justin (1991), noted that the RGI range for herbivore fish was about 516–1058 %. Then for the carnivore fish and omnivore fish were about 94 to 170 % and 143-325 % respectively (Justin, 1991). Thus, *X. naritus* was omnivore with the RGI range from 207.97 to 352.08 %.

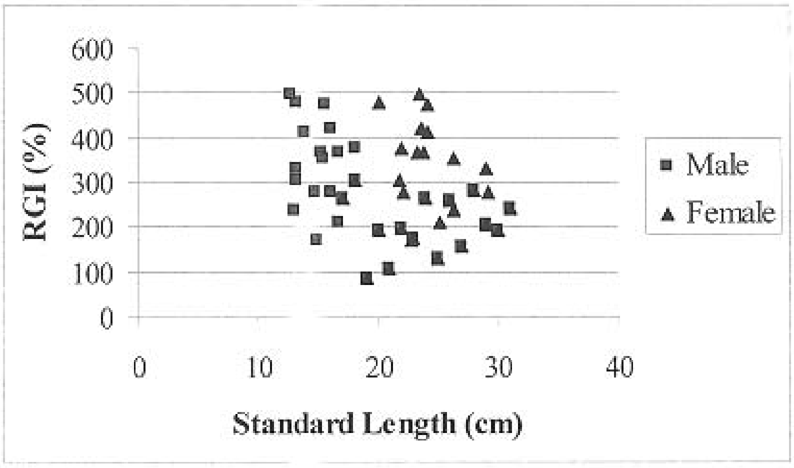


Figure 4: Relationship between Relative Gut Index (% RGI) and the standard length (cm) for *Xenopterus naritus*.

3.6 Zooplankton

Calanoid copepod was the main zooplankton found at the five stations which contributed more than 95 % of the total zooplankton composition (Table 8). Nine taxa were identified at the five stations. The highest total zooplankton was found at St. 3, Kg. Manggut (Figure 5).

Table 8: Zooplankton composition (%) of different taxa at the five stations (St. 1: Kampung Supa, St. 2: Tanjung Keranji, St. 3: Kampung Manggut, St. 4: Tanjung Baring and St. 5: Kampung Serembang).

Zooplankton	St. 1		St. 2		St. 3		St. 4		St. 5	
	Bil.	%	Bil.	%	Bil.	%	Bil.	%	Bil.	%
Calanoida	10.63	95.15	11.29	61.36	30.17	84.19	18.88	85.3	19.25	91.45
Harpaticoida	0.29	2.61	0.13	0.68	0.08	0.23	-	-	-	-
Nauplius	0.17	1.49	5.92	32.27	5.08	14.19	2.94	13.28	1.60	7.60
Actinospaerium	0.04	0.37	0.83	4.55	0.08	0.23	0.25	1.13	0.00	-
Chaetognatha	-	-	0.04	0.23	0.42	1.16	0.06	0.28	0.05	0.24
Ostracoda	0.04	0.37	0.04	0.23	-	-	-	-	-	-
Larvae decapoda	-	-	0.04	0.23	-	-	-	-	0.05	0.24
Nauplius decapoda	-	-	-	-	-	-	-	-	0.10	0.48
Larvae Polychaeta	-	-	0.04	0.23	-	-	-	-	-	-
Total	11.17	10.29	18.33	16.90	35.83	33.02	22.13	20.39	21.05	19.40

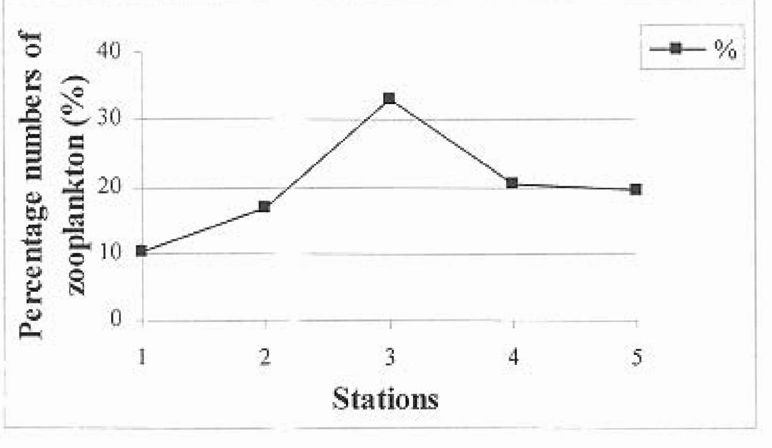


Figure 5: Percentage numbers of zooplankton (%) identified at five stations (St. 1: Kampung Supa, St. 2: Tanjung Keranji, St. 3: Kampung Manggut, St. 4: Tanjung Baring and St. 5: Kampung Serembang).

3.7 Zooplankton Vs Gut Contents

The zooplankton that identified in the water column and the food items that observed in the 31 fish guts were compared to find any similarity which showed in table 9. From the findings, only calanoid copepod was found in water column and fish gut contents. There was significant different of calanoid copepod (T-test, $F = 156.35$, $P < 0.05$).

Table 9: Comparison of different taxa that found in the water column and fish gut contents.
- indicates absence; + indicates presence.

Taxa	In water column	Fish gut contents
Actinospaerium	+	-
Algae	-	+
Amphipoda	-	+
Bivalvia	-	+
Calanoida	+	+
Chaetognatha	+	-
Ciliata	+	-
Decapoda	-	+
Decapoda zoea	+	-
Foraminifera	-	+
Gastropoda	-	+
Harpaticoida	+	-
Insecta	-	+
Isopoda	-	+
Juvenile Gastropoda	-	+
Larvae polychaeta	+	-
Nauplius	+	-
Nauplius decapoda	+	-
Nematoda	-	+
Ostracoda	+	-
Aldult Polychaeta	-	+