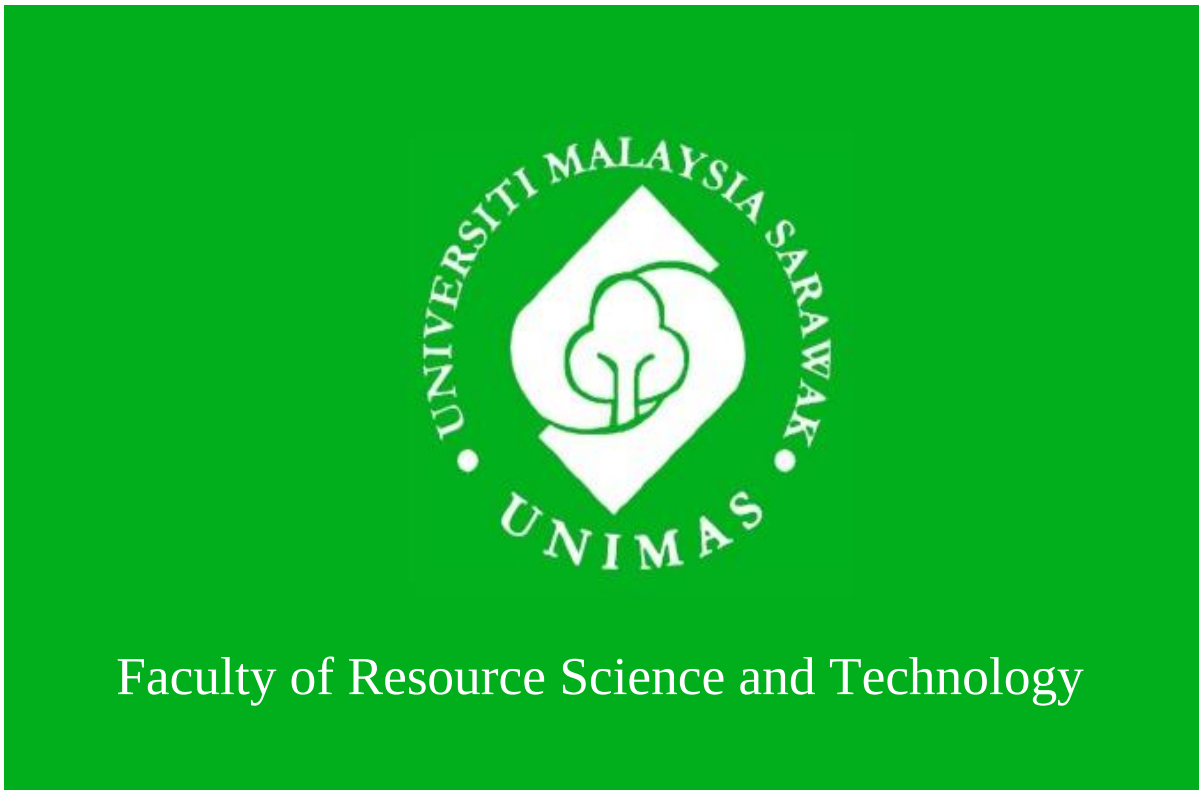

FEEDING HABITS OF CYPRINIDAE IN BATANG KERANG FLOODPLAIN, BALAI RINGIN, SERIAN, SARAWAK

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

I hereby declare that no portion of the work referred in this project has been submitted in support of an application for another degree qualification of this or any other university or institution of higher learning.

_____

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		Page
cm	Centimetre	11
%	Percent	11
N	North	9
E	East	9
g	Grams	11
±	Plus-minus	18
n	sum total	22
TL	Total length	18
SL	Standard length	18
BW	Body weight	18
SD	Standard deviation	18
GL	Gut length	20
SE	Standard error	20
GRI	Gut Relative Index	20

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ABSTRACT

Diet analysis is important for the studies of competition, predator-prey relationship, trophic level, food webs and potential fish aquaculture. The objectives of this study are to identify the feeding habit of Cyprinidae and to analyze the food composition and frequency of occurrence of food items in the fish gut in Batang Kerang habitat. Fish samples were collected from Batang Kerang floodplain, Balai Ringin in December 10^{th} to 11^{th}, 2011 and in April 13^{th} to 14^{th}, 2012 to examine the gut content. One hundred and fifty specimens were used for the study. The feeding habits were determined based on Gut Relative Index (GRI), food composition and frequency of occurrence. The results showed that the major food item consumed by Cyprinidae species are plant matter (47.02%) followed by detritus (43.86%) and insects (3.86%). Most of the species were herbivorous, followed by omnivorous and carnivorous. Further study on detail feeding habit of fish should be done.

Key words: Diet analysis, feeding habits, food item, gut content

ABSTRAK

Analisis diet ikan adalah penting untuk mengetahui persaingan makanan, hubungan mangsa pemangsa, rantai pemakanan dan juga penting untuk ikan yang berpotensi untuk akuakultur. Objektif kajian ini adalah untuk mengenal pasti tabiat serta kategori pemakanan Cyprinidae spesis dan menganalisis item makanan, komposisi makanan dan frekunsi kekerapan jenis makanan yang dimakan oleh ikan Cyprinidae di Batang Kerang. Ikan ditangkap dari Batang Kerang, Balai Ringin pada 10 hingga 11 Disember, 2011 dan pada 13 hingga 14 April, 2012 untuk mengkaji kandungan isi perut ikan. Seratus lima puluh specimen telah digunakan untuk kajian ini. Tabiat pemakanan dapat diketahui melalui Indeks Relatif Perut, komposisi makanan dan kejadian frekuensi. Keputusan menunjukkan makanan utama bagi ikan Cyprinidae spesis adalah tumbuhan (47.02%) diikuti dengan detritus (43.86%) dan serangga (3.86%). Kebanyakkan spesis di kategori dalam kumpulan herbivor, diikuti omnivor dan karnivor. Kajian yang lebih terperinci tentang tabiat pemakanan ikan harus dijalankan.

Kata kunci: Analisis diet, tabiat pemakanan, item makanan, kandungan isi perut.

1.0 INTRODUCTION

1.1 Background

The most important factors affecting the growth, maturation and mortality of the fish are the quality and quantity of food. Studies of the feeding habits of the fish fauna are useful to examine both fisheries management and conservation fishery biology in an aquatic environment (Alp *et al*., 2008). Studies on the feeding habit of fish are also essential for aquaculture development. According Offem *et al*. (2009), the aquaculture has gained a growing interest over the years, due to the increasing of human population and the important of fish as a low cost source of animal protein. They also stated that for the efficiently of the fish farm management, there is need for effective nutritional strategies which can be achieved by proper understanding and future study on the food requirement and feeding habits of fish that potentially to be cultured.

Batang Kerang floodplain, which is located in Balai Ringin, Serian, Sarawak can be classified on the basis of its water quality into different types, namely brown water river and black water river. Flooded forests and floating vegetation of Batang Kerang floodplain are important habitats for fishes (Khairul *et al*., 2009). The distribution and composition of the fish species in each habitat were closely associated with various factors such as the availability of food, breeding sites, water current, depth, topography and physico-chemical properties of water (Harris, 1995).

The study on the feeding habit of Cyprinidae in Batang Kerang is analyzed through the food consumption in their natural habitats. The feeding habit of the fishes is quantified by using the main approaches that is the percentage composition by number and frequency of occurrence (Windell *et al*., 1978). According to De Silva (1985), in order to show the calculation of the ratio of the total gut length to the standard length of the fish, Gut Relative Index (GRI) can be applied. This method can determined the proportion of the total samples that have been collected that contained variety of food items.

This study will give an understanding on feeding habit of Cyprinidae and dietary of Cyprinidae in the wild habitats that useful for the future aquaculture development. This is because there are very few studies on the food and feeding habit of Cyprinidae in Batang Kerang, hence very little is known about food and feeding habits of fish in the areas. Therefore, this study was designed to provide additional information about the feeding habits of Cyprinidae species in the water habitat in Batang Kerang. The objectives of the study were to identify the feeding habit of Cyprinidae in Batang Kerang habitat, to identify the food category of Cyprinidae in Batang Kerang, and to analyze the food composition and frequency of occurrence of food items in the fish gut.

2.0 LITERATURE REVIEW

2.1 Status of Fish Fauna in Malaysia

Fish is one of the important components to the ecosystem and humans. It is also essential for inland fishery industries as it supports the livelihood of rural communities on Malaysia as fish is the main animal protein source for the people (Khan *et al*., 1996). The largest number of fish species found in tropical region, with freshwater species being most numerous in the river drainage of South-Eastern Asia (Jobling, 1995) and almost 1000 fish species were recorded by Kottelat and Whitten (1993) in Southeast Asia. According to Chong *et al*. (2010), approximately 1957 species of freshwater and marine fishes belonging to 704 genera and 186 families of fishes were recorded in Malaysia. The family of Cyprinids fish is the most dominant, which consisting of 30% of all species in Peninsular Malaysia and Borneo (Salam and Gopinath, 2006).

In Borneo, more than 300 species were recorded by Inger and Chin (1990). There are several studies done on Sabah (Nyanti, 1995), in Sayap Kinabalu Park (Nyanti *et al*., 1999) in Tawau Hills Park and in Crocker Range National Park Sabah (Khairul *et al*., 2002). In addition, several studies have been conducted by Kottelat and Lim (1995); Parenti and Lim (2005); Watson and Balon (2006); and Khairul *et al.* (2009) on fish distribution in Sarawak. Robert (1989) stated that about one-third of all the freshwater fishes in Western Borneo. Nyanti (1995) and Leh (2000) reported that approximately 66% and 46% of the fish collections in Sarawak were from the Cyprinidae family. In Batang Kerang river, the fishes in brown water habitat were dominated by Cyprinidae. However, there were few studies on fish diet analysis and feeding habit is done on this family. This study can provide some information about status of Cyprinidae species and also feeding habit of Cyprinidae species in Batang Kerang.

2.2 Feeding Behavior of Fish

Food is an important factor regulating growth, abundance, feeding, and migratory movements of fish (Nyunja *et al*., 2002). Feeding habit has become a part of their daily routine. This is because they depend on food in order to keep survive and long lasting in their habitats. Food and feeding habits have been known to vary for individual fish with respect to size, age, life history stage, kinds of food available, season, time of the day, as well as locality in which they are found (Lagler, 1956) as cited in (Saliu, 2002). All fishes can consume a wide variety of food that present in their habitats.

The amount of food ingested per day and the times of day that feeding is performed depends on many factors. Daily and seasonal temperature fluctuations may affect food intake in most fishes. Some species feed mainly by sight and are active by day although peaks of feeding actively occur in mourning and evening. Other fishes that depend more on chemical sense can feed effectively in the absence of light or at night (Hanjavanit and Sangpradub, 2009). The result of many studies on feeding of various fishes however show that small individuals consume more per day in relation to their body weight, than large individual.

Freshwater fishes can be divided into four feeding types which are herbivorous, omnivorous, carnivorous and plankton feeders. Herbivorous fishes feed mainly on unicellular algae, filamentous algae and portion of higher aquatic plants along with some sand or mud. Plant material of the food is 75% or more of total gut content, hence considered herbivorous (German and Horn, 2006). Omnivorous fishes, they consume on unicellular and filamentous algae and aquatic plants, rotifers, insects, insect larvae, crustaceans, mud and sand. Carnivorous fishes feed on high percentage of animal such as crustacean mainly copepods, water bugs, beetles, dragonfly larvae, small fishes and tadpoles. Study on feeding habits of carnivorous fish had been studied by Yang (1988) on

Hampala macrolepidota. For plankton feeders, they consume on phytoplankton and zooplankton by filtering the water through their gill rakers.

2.3 Diet of Fishes in Wild Habitat

In nature, fish generally feed on a diverse of food items such as phytoplankton, zooplankton, benthic invertebrates, benthic deposits, other fish and aquatic macrophytes. They also absorb nutrients such as glucose and calcium. The nature of food composition of fish depends on the possible habitats. Different fish will feed on different type of foods according their natural habitats. Fish species need to use the habitat in energy-efficient ways in order to identify the nutritious food sources (Kelly and Magurran, 2003; Warburton, 2003). If they are not able to overcome the challenges, it may result in mortality (Kelly and Magurran, 2003).

Cyprinids consumed insects and fungi which were categorized into carnivorous but they evolutes to herbivores because they also feed on green algae, microbes and diatoms. Yap (1998) stated that Cyprinids such as *Barbodes schwanenfeldii*, *Cyclocheilichtys apogon*, and *Labiobarbus festiva* feed mainly on detritus. Bluegill *Lepomis machrochirus* feed on zooplankton, macroinvertebrates, small fish and insect (Olson *et al*., 2003). According to Chakrabarti *et al*. (1995), Channidae feed on dipteran larvae, zooplankton, fish fry, womb, insects, crustaceans, mollusks, fishes and plants.

2.4 Importance Study on Fish Diet

Fish diet analysis is the study of the food items present in a gut of an individual of a fish. The gut content is an important part in which measurement of gut length is essential. For the ecological theory, information on the quality and quantity of consumed food by fish is important, mainly in identifying omnivory, feeding competition, assessing predator-prey functional responses and structure as well as stability of food webs. Diet composition data are also important used for the estimation of trophic levels. The trophic level expresses the relative position of an animal in the food webs that nourish them (Rogdakis *et al*., 2010).

It is imperative to study the food and feeding habits of freshwater fish species on a continuous basis to sustain and improve their relevance in aquaculture (Ndimele *et al*., 2010). Aquaculture contribution to the foods fish supply will increase due to the development of aquaculture (Fariduddin, 1998; Mgendi and Haskins, 2007; Bostock *et al*., 2010). It is necessary to study on fish diet for enhancing the food security and nutritional value in aquaculture (Reantosa and Subasinghe, 2008). In addition, the farmer can also manage the feed of the fishes adequately and subsequently this information can empower farmer or aquaculturist on the appropriate diet and nutrient for the fish cultured (Reantosa and Subasinghe, 2008).

Study on fish diet can also provide information on the fish feed formulation. Several studies have been conducted in order to determine the nutrient requirement of fish cultured (Kaushik *et al.,* 1993; Ramseyer and Garling, 1993). The main criteria in the diet of fish are on the essential nutrients and energy in adequate proportion to optimize the requirement of diet in the fish cultured (Kaushik *et al.*, 1993; Mgendi and Haskin, 2007; Sogbesan and Ugwumba, 2008).

2.5 Gut Anatomy

Gut is a muscular tube lined by a mucous membrane of columnar epithelial cell (Switman *et al*., 2008). Gut of fish is commonly divided into four parts: head gut, fore gut, mid gut and hind gut. Head gut is anterior part, most often considered in terms of the two components, the oral (buccal) and gill (branchial and pharyngeal) cavities. The foregut begins at the posterior edge of the gills and includes the oesophagus, the stomach and the pylorus. The mid gut includes the intestine posterior to the pylorus. This part always the longest portion of the gut and may be coiled into complicated loops (often characteristic for each species) when longer than the visceral cavity (Smith, 1998). In some fish, the beginning of the hindgut is marked by an increase in diameter of the gut where the posterior end of the hindgut is the anus.

2.6 Gut Length of the Fish

Herbivores have longer guts than carnivores but this may be true in limited groups of fish. The longest guts are found in herbivores (Wagner *et al*., 2009), but not all herbivores have long guts. The gut lengths of some herbivores are shorter than those of some carnivores. This is because many fish eat a variety of food, sometimes ingested with considerable indigestible material (mud) which often influences gut length. The size of the food particles from submicroscopic plankton to whole fish may also influence gut configuration as study by Yap (1998).

In general, most studies relating food habits to gut morphology show considerable relationship, for examples study done by Gosch *et al*. (2009); Ndimele *et al*. (2010); Mat Isa *et al*. (2010). Many factors could contribute to the difference in feeding behavior such as habitat, trophic level and food availability (Mat Isa *et al*., 2010).

3.0 MATERIALS AND METHODS

3.1 Study Area

Batang Kerang floodplain (N 01˚13’ 60”, E 110˚ 41’ 60’’) located at Balai Ringin, Serian, Sarawak (Figure 1). The surrounding vegetation of Batang Kerang was covered with floodplain of riverine mixed-dipterocarp, swamp forest and marshes. Batang Kerang floodplain has two different types of water habitat; brown water river and black water river. Brown water was muddy caused by high sediment contents and characterized with many floating plants and other submerged aquatic vegetation (Khairul *et al*., 2009). The brown water habitat support more diverse and abundant population of fishes compare to the black water habitat. Batang Kerang floodplains were important habitat and provide food source for fishes due to floating vegetation and flooded forest. The floating meadows was known as the nursery grounds for young fishes which use the submerged roots as refuge from predation and foraging substrate (Putz, 1997). This characteristic could probably create suitable niches for a variety of fish species, and subsequently higher fish abundance and species richness found in that habitat. Batang Kerang were also important for fishing and transportation activities for the local people.

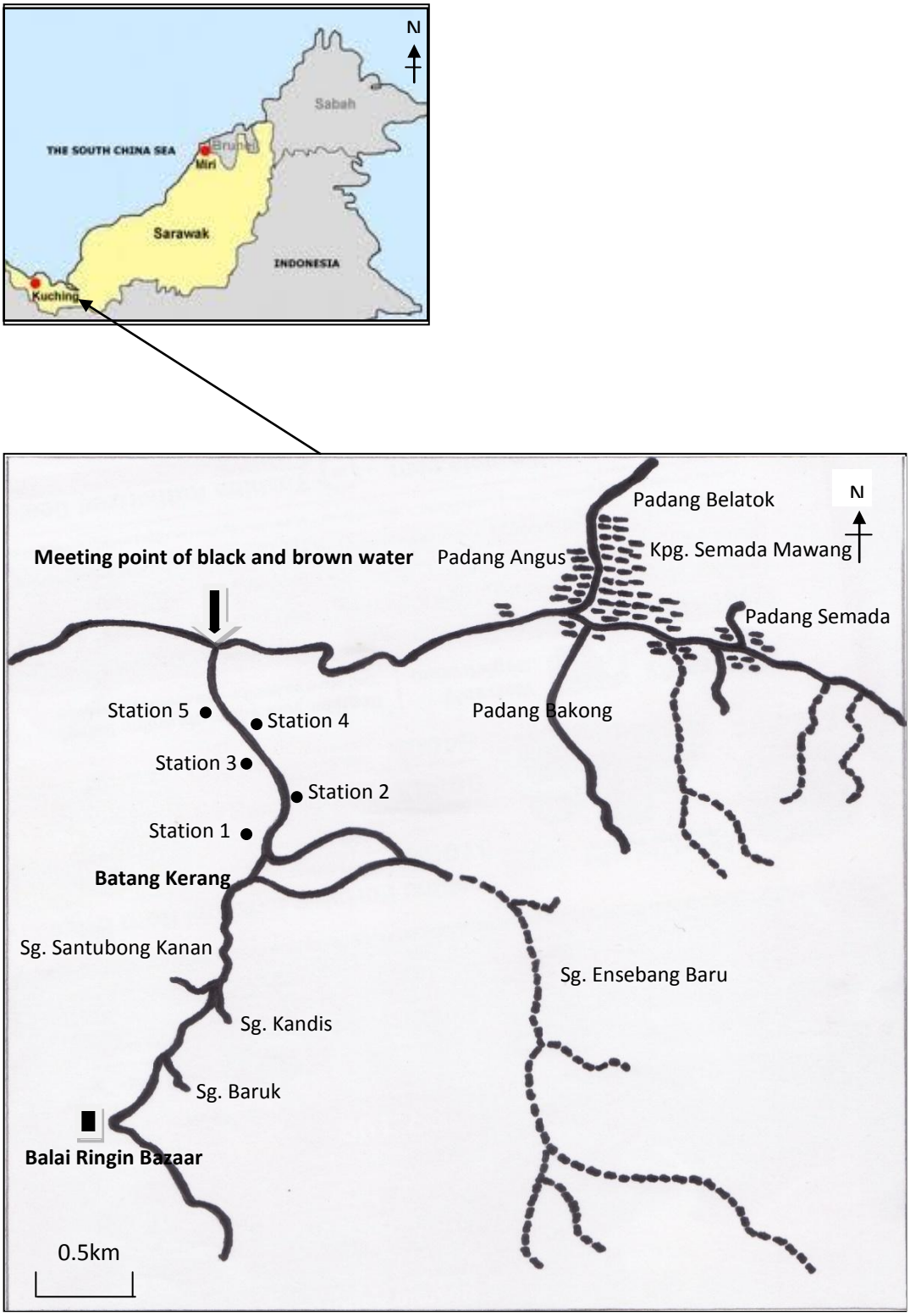

Figure 1: Map showing the sampling area and sampling station at Batang Kerang floodplain, Balai Ringin, Serian, Sarawak.

3.2 Sampling Method

The fish were collected using monofilament gill nets with different mesh sizes (2.5, 3.5 and 5.0 cm), and three-layered gill nets (inner mesh = 4 cm; outer mesh = 14 cm) at five stations in brown water habitat. The nets were placed at the five selected station at different depth and were left overnight during first sampling on 10th to 11th December 2011 and second sampling on 13th to 14th April 2012. Samples were also obtained using a traditional fishing method locally known as *"selambau"*. The total length (cm), and standard length (cm) of each individual samples was measured using a ruler to the nearest centimeter (cm). The weight (g) of the samples was recorded using portable electronic balance. All the fish were identified to the species level following Mohsin and Ambak (1983); Inger and Chin (1990); Atack (2006); Kottelat and Lim (1995) and Kottelat *et al.* (1993). Half of the fishes collected were dissected in the field to remove the gut. The total length of the gut was measured using a ruler. The gut was preserve in 5% formalin and each of gut was keep in bottle sample follow their station. The remaining samples that not yet been dissected were tagged and preserved in 5% formalin for further analysis in laboratory.

3.3 Laboratory Analysis

Prior for gut content analysis, the gut of each fish sample was carefully removed and then preserved in 5% formalin solution with labeled according their station. The guts were dissected to remove the food items in the gut. Then, gut content of each specimen were removed and were placed on a petri dish and on slides for observing very small food item (Melo *et al*., 2004). The number of food items present in the gut was identified and counted. The food items were observed under stereo microscope (brand Raxvision). In addition, compound microscope was used to observe the small food items. The food obtained were identified and listed in a table form. Summary of the material and methods in this study was shown in Appendix A.

3.4 Data Analysis

The gut contents analysis was examine using three methods which include:

a.) **Gut Relative Index (GRI) = (X/Y) × 100%**

X = stomach length of a fish (cm)

Y = standard length of fish (cm)

This Relative Gut Index (GRI), calculates the ratio of total gut length to the standard length of fish multiplied by 100% (De Silva, 1985).

b.) **Food composition = (X/Y) × 100%**

X = number of food items of given type in all specimen

Y = total number of all food items that are found in all specimen

Food composition was calculated with the number of food items of a given type in all specimens which divided by the total number of all food items in all the specimens.

c.) **Frequency of occurrence = (X/Y) × 100%**

X = number of guts containing a particular food items

Y = total number of gut being analyzed

The percentage of frequency of occurrence was calculated according to the number of gut that contained food items (Windell and Bowen, 1978; Obande and Kusemiju, 2008). Frequency of occurrence was used to estimate the proportion of population that feed on the particular food items (Windell and Bowen, 1978).

4.0 RESULTS AND DISCUSSION

4.1 Fish Composition

A total of 265 individual fish fauna of Cyprinidae were collected from Batang Kerang floodplain (Table 1). Fish species such as *Hampala macrolepidota, Cyclocheilichtys apogon, Barbonymus spesies., Osteochilus hasseltii, Osteochilus enneaporos, Puntius lineatus, Puntius orphoides* and *Oxygaster anomalura* were presented in both sampling period. There were more diverse fish fauna collected during the second sampling period compare to the first sampling period, which total amount of 149 and 115 of Cyprinidae individual species collected respectively. The most abundant fish species were represented by *Cyclocheilichtys apogon* which show 124 individuals collected.

Table 1 : The fish species samples of Cyprinidae collected at Batang Kerang floodplain of Balai Ringin, Serian, Sarawak during 2 sampling period on 10th and 11th December 2011 and 13th and 14th April 2012.

Family	Species	Total
Cyprinidae	*Barbonymus gonionotus*	1
	Barbonymus species	37
	Cyclocheilichtys apogon	124
	Hampala macrolepidota	44
	Leptabarbus hoevenii	5
	Osteochilus enneaporos	3
	Osteochilus hasseltii	23
	Oxygaster anomalura	7
	Parachela oxygastroides	1
	Puntius lineatus	9
	Puntius orphoides	9
	Rasbora caudimaculata	2
Total (n)		**265**