DIVERSITY OF FISH FAUNA AT PERARAN AND PUNAN BAH, BATANG RAJANG, KAPIT, SARAWAK.

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Bachelor of Science with Honours
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36139

The dissertation is submitted in partial fulfillment of requirement for the degree of Bachelor Science with Honours in Aquatic Resource Science and Management

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Declaration

I, Goh Hao Chin, declare that the final year project entitled “Diversity of Fish Fauna at Peraran and Punan Bah, Batang Rajang, Kapit, Sarawak” submitted in partial fulfillment of the requirement for the Degree of Bachelor of Science with Honours (Aquatic Resource Science and Management) is the bonafide record of the original research work carried out by me, that I have exercised reasonable care to ensure that the work is original, and has not been taken from the work of others and to the extent that such work has been cited and acknowledged within the text of my work.

_____________________
(Goh Hao Chin)

Aquatic Resource Science and Management

Faculty of Resource Science and Technology

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Date:
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Diversity of Fish Fauna at Peraran and Punan Bah, Batang Rajang, Kapit, Sarawak

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ABSTRACT

A study was carried out to document the fish composition and diversity as well as selected water quality parameters at Peraran and Punan Bah, Batang Rajang, Kapit due to the lack of published information on these two areas. Eight stations were selected from downstream area (Peraran) and nine stations from upstream area (Punan Bah). Fish sampling gears such as monofilament gill nets of different mesh sizes, three-layered nets, cast net, electro-shocker device and scoop nets were used. A total of 916 fish individuals were caught from all stations with Cyprinidae as the dominant family (75.8 %), followed by the family Balitoridae (8.2 %), Siluridae (7.9 %), Bagridae (3.3 %), Pangasiidae (2.1 %), Channidae (1.0 %), Pristolepididae (0.8 %), Zenarchopteridae (0.6 %), Cobitidae (0.2 %), Mastacembelidae (0.1 %), Osphronemidae (0.1 %) and Sisoridae (0.1 %). The dominant species recorded was Rasbora rutteni with 140 individuals, followed by Cyclocheilichthys apogon with 94 individuals and Rasbora lateristriata with 89 individuals. The downstream area of Peraran, Batang Rajang has higher species composition and diversity (1.77) compared to the upstream area (1.66).

Keywords: Fish fauna, diversity, Peraran, Punan Bah, water quality parameters

ABSTRAK

Satu kajian telah dijalankan bertujuan mendokumentasikan komposisi dan kepelbagaian ikan serta parameter kualiti air sungai terpilih di Peraran dan Punan Bah, Batang Rajang, Kapit kerana kurangnya maklumat yang telah diterbitkan mengenai dua kawasan tersebut. Lapan stesen telah dipilih dari kawasan hilir (Peraran) dan sembilan stesen dari kawasan hulu (Punan Bah). Peralatan menyampel ikan seperti pukat monofilament yang berbeza saiz jaringan, pukat tiga lapis, jala, peranti elektro-kejutan dan pukat skop telah digunakan. Sebanyak 916 individu ikan ditangkap dari semua stesen dengan keluarga Cyprinidae yang dominan (75.8 %), diikuti oleh keluarga Balitoridae (8.2 %), Siluridae (7.9 %), Bagridae (3.3 %), Pangasiidae (2.1 %), Channidae (1.0 %), Pristolepididae (0.8 %), Zenarchopteridae (0.6 %), Cobitidae (0.2 %), Mastacembelidae (0.1 %), Osphronemidae (0.1 %) dan Sisoridae (0.1 %). Species dominan yang telah direkod ialah Rasbora rutteni dengan 140 individu, diikuti oleh Cyclocheilichthys apogon dengan 94 individu dan Rasbora lateristriata dengan 89 individu. Kawasan hilir Peraran, Batang Rajang mempunyai komposisi spesies dan kepelbagaian yang lebih tinggi (1.77) berbanding dengan kawasan hulu (1.66).

Kata kunci: Fauna ikan, kepelbagaian, Peraran, Punan Bah, parameter kualiti air
1.0 Introduction

The Rajang River is the longest river in Sarawak, which has a length of 565 km and total catchment area of 51,000 km$^2$ (Salam & Gopinath, 2006). The headwaters drain the western slopes of Iran Mountains, then flows north and south-west to Kapit for approximately 563 km, then channels into the South China Sea (Rajang River, 2014). The freshwater habitats around Rajang River includes the major river channel, stony hill streams in mountain area, partly shaded streams in forest with muddy or sandy bottom, along with fallen branches and leaf litter (Parenti & Lim, 2005).

Riverine water ecosystem is important for human usage, such as to generate hydroelectricity, food and recreation, transport of goods, logs and services, as well as to gain water for drinking and irrigation especially in rural area (Cooke et al., 2012). Fish fauna are caught for human consumption, recreation, and used as indicators for the well-being of environment, or act as the suitable subjects for testing values of population or community ecology (Bayley & Li, 1996).


The fish fauna of Rajang basin has previously been reported by Parenti and Lim (2005) where a total of 164 fish species were recorded from a few areas around Batang
Balui and Belaga (upper Rajang), Batang Baleh and Kapit (middle Rajang), as well as Sibu (lower Rajang). Their recorded list of fish diversity is not really complete as there is lack of exact initial records of fish fauna locality data.

Currently there is no data on the fish fauna composition in the area of the middle stretch of Batang Rajang, specifically at Peraran and Punan Bah, Batang Rajang, Kapit. Hence, the objectives of this study were to:

1. document the freshwater fish species in Batang Rajang at Peraran and Punan Bah, Kapit,
2. determine the fish diversity and abundance of species in Batang Rajang at Peraran and Punan Bah, Kapit,
3. record the Batang Rajang water quality parameters at Peraran and Punan Bah, Kapit, and
4. study the stomach content of six fish species caught from Batang Rajang at Peraran and Punan Bah, Kapit.
2.0 Literature Review

2.1 Ecology of Freshwater Fish Fauna

Freshwater fish fauna are the most diverse groups of vertebrates showing unique endemism, taxonomic breadth, and geographic scope in their distribution (Mims et al., 2010). Based on the study by Kottelat and Whitten (1996), Asia is home to around 3500 species of fish spending their whole lives in freshwater habitats. Most of these species have substantial economic value and act as vital food source for many poor people. Riverine lakes and large rivers are important fisheries habitats that are characterized by low oxygen concentration, very low gradient, high turbidity and high nutrient load, high temperature, muddy bottom and cyclical floods. Floods are critical events for riverine fisheries, especially when the fish enter the flooded land where food is abundant. Many fish spawn and reproduce immediately before or after floods (Kottelat & Whitten, 1996; Kottelat et al., 1993; Winemiller & Jepsen, 1998).

Local movement related with the origin and development of a fish from embryo to adult is one of the main characteristic in the life histories of freshwater fishes. Due to the changing gradients of resource availability such as shelter or food, or abiotic conditions such as current velocity or dissolved oxygen, fish movement could be affected on a local scale (Winemiller & Jepsen, 1998). As mentioned by Harris (1995), factors such as breeding sites, availability of food, water current, topography, depth and physicochemical properties of water may affect the distribution and composition of fish species in every habitat.

According to Sternberg and Kennard (2013), dispersal of species could be predicted across a wide range of habitat types, depending on the relationships between life history traits and hydrological or environmental variation. Small-bodied species with early
maturation, short-generation time and low juvenile survival should be characteristic of hydrologically unstable environments subjected to frequent disturbance events. Large-bodied, highly reproductive species with low parental care and late maturation are expected in environments subjected to seasonal or periodic flow regimes. Besides, species of intermediate body size, large egg size, low reproductive rate and high parental care should dominate in resource-limited environments with stable flows, low spatial and temporal heterogeneity. These life-history strategies correspond to ‘opportunistic’, ‘periodic’ and ‘equilibrium’ strategies respectively, and have to be in balance between generation time, juvenile survival and fecundity (Sternberg & Kennard, 2013; Winemiller & Jepsen, 1998).

2.2 Diversity of Freshwater Fish Fauna

There are generally over 300 species of freshwater fish living in the freshwater habitats in Malaysia (Bishop, 1973). Kottelat and Whitten (1996) claimed that a total of 264 freshwater fish species can be found in Peninsular Malaysia and southern Thailand. Kottelat and Lim (1995) recorded a total of 249 fish species that are found in Sarawak and Brunei.

Parenti and Lim (2005) reported at least 164 species of fish from the Rajang basin. Sixty-four fish species are recorded for the first time in Rajang River, including two new records (Pangio piperata and Macrognathus circumcinctus) for Borneo. Throughout the other freshwater habitats in Southeast Asia, Rajang basin is dominated by a species from the family Cyprinidae, which is more than one-third (55 of 164 or 34 %) of the total species found (Nyanti et al., 1999; Parenti & Lim, 2005; Salam & Gopinath, 2006). Furthermore, the family Cyprinidae consisted of 63.8 % in the brown water habitat at Batang Kerang in Balai Ringin, Sarawak (Khairul Adha et al., 2009). Salam and Gopinath (2006) stated that the most common cyprinids in Malaysia are kelah or Malaysian Mahseer
(Tor spp.), sebarau (Hampala macrolepidota), lampam sungai (Barbonymus schwanenfeldii) and temoleh (Probarbus jullieni).

2.3 Threats to Freshwater Fish Fauna

Yusoff et al. (2006) reported that the major threats to freshwater fishes in Malaysia includes habitat loss and alteration, siltation of river caused by land-clearing activity as well as deforestation, and even pollution of sewage discharges from industrial area. A lot of aquatic habitats have been replaced by other land development such as agriculture, aquaculture or infrastructure development. The sewage runoff contains high organic matter which could drop the pH and increase the suspended solids as well as biochemical oxygen demand (BOD) of river water (Kottelat et al., 1993; Yusoff et al., 2006). The decomposition of organic matter by bacteria may reduce the oxygen concentration in the water. In addition, the inorganic compounds from industrial area may contaminate the flesh of fish, which then are further ingested by other animals or human. Those inorganic compounds include dyes, heavy metals and bleaches (Kottelat et al., 1993).

Similarly, Fu et al. (2003) also reported that the fish biodiversity in Yangtze River are affected by problems of pollution, habitat loss, overfishing, deforestation, land erosion and sedimentation. In addition, the introduction of exotic species also affects the native fishes in plateau lakes at the upper reaches of Yangtze River. Non-indigenous species compete with local species for food and in fact cause the decline in the number of local species. Nevertheless, the threats of exotic species to native fish communities in Malaysia still need to be studied (Yusoff et al., 2006).

Chong et al. (2010) reported that 96 % of threatened Malaysia freshwater fish species are facing the threat of habitat degradation and destruction. This was followed by 20 % of threatened species that was harmed by overharvesting. The nursery grounds and
food sources of fishes are destroyed by clearing riparian vegetation that flanks the rivers. The decreased shading of fish habitat may increase the water temperature. As water temperature rise, the metabolic rate in fish become higher, but the concentration of dissolved oxygen becomes lower (Kottelat et al., 1993). The effect becomes more serious when aquatic plants does not photosynthesize at night and the decomposition of decaying organic matter uses oxygen, thus the rate of mortality of aquatic organisms could increase in large quantity. For the case of overfishing, large riverine fishes such as mahseers (*Tor* spp.), shark catfish (*Pangasius* sp.) and Isok barb (*P. jullieni*) are being overharvested in Malaysia. In inland rural communities, these freshwater fishes act as the vital cheap source of protein (Chong et al., 2010).

2.4 Status and Characteristics of Fish Fauna and Riverine Fisheries in Sarawak

Borneo Island with a land area of 745,567 km² is the world’s third largest island (Sulaiman and Mayden, 2012). The main rivers in Sarawak are Rajang River with a watershed area of 51,315 km² and length of 560 km, Baram River (22,325 km², 402 km), Limbang River (3,578 km², 200 km) and Lupar River (6,745 km², 210 km) (Yusoff et al., 2006).

Sarawak has a wide range of freshwater habitats from rocky hill streams inside mountain area, to blackwater peat swamps, to forest hill streams and partly shaded forest streams with muddy substrate along with rocks, fallen branches and leaf litter. Atack (2006) recorded 254 fish species in Sarawak Rivers. There are about 4 families, 31 genera and 79 species of cypriniformes fishes in Rajang River, Sarawak (Mayden & Chen, 2010; Parenti & Lim, 2005).

In previous study, Nyanti et al. (1999) reported 7 families, 19 genera and 24 species of fish fauna from Bario, Kelabit Highlands. Among the 518 fish samples
collected, 57.9% were from the family Cyprinidae, 38.2% from Balitoridae, 1.5% from Bagridae, 0.8% from Clariidae, 0.8% from Cichlidae, 0.6% from Anabantidae, and 0.2% from Mastacembelidae. In the Rayu basin, 13 families, 18 genera and 27 species were recorded by Doi et al. (2001). The families include Cyprinidae, Bagridae, Clariidae, Hemiramphidae, Synbranchidae, Chandidae, Nandidae, Gobiidae, Anabantidae, Belontiidae, Luciocephalidae, Channidae and Mastacembelidae.

In Batang Kerang Floodplain, Balai Ringin, Khairul Adha et al. (2009) recorded a total of 13 families, 25 genera and 36 species. Among the 234 individuals, the families were from Anabantidae, Bagridae, Belontidae, Channidae, Clariidae, Cobitidae, Cyprinidae, Eleotrididae, Helostomatidae, Luciocephalidae, Pangasiidae, Siluridae and Tetraodontidae. Jongkar (2013) reported 7 families, 13 genera and 21 species of fishes from Padawan Limestone. The 7 families composed of Cyprinidae (42.8%), Balitoridae (23.8%), Siluridae (9.5%), Channidae (9.5%), Sisoridae (4.8%), Hemiramphidae (4.8%), and Mastacembelidae (4.8%).

Cyprinidae, Bagridae, Clariidae, Anabantidae and Mastacembelidae are the common families that were recorded in those previous studies. Cyprinidae comprising of minnows, carps and barbs and are a large family of freshwater fish fauna in Sarawak. They can be distinguished by their pharyngeal teeth and the absence of jaw teeth (Kottelat et al., 1993). Under the family Cyprinidae, *Osteochilus vittatus*, also known as Waandersii’s hard-lipped barb often live in clear fast-flowing rivers and streams along with substrate of stone. It swims into the flooded areas nearby to rivers when water level increases (Clarke, 2014).

Bagridae are catfishes that have a large conspicuous adipose fin, strong serrated pectoral spines, a ventral curved mouth and a forked caudal fin. They are bottom-dwellers, no scales and often have long maxillary barbels. Kottelat et al. (1993) reported that
Bagridae are mostly nocturnal and some of them that survive in turbid water could be active at day time. Clariidae are the family of walking catfish, which is using their pectoral and pelvic fins to walk and hunt for food. They have flat bony head, eel-like cylindrical body, a single long dorsal fin without spine and a transverse mouth with four pairs of long barbels. They have an accessory respiratory organ arising from gills which is able to breathe atmospheric oxygen (Kottelat et al., 1993). Both Bagridae and Clariidae are under the order of Siluriformes.

The family Anabantidae, also known as the climbing perches, belonged to the order of Anabantoidei. Kottelat et al. (1993) stated that *Anabas testudineus* is a kind of species that can live out of water as long as its skin is wet. It has an accessory breathing organ and may drown without breathing atmospheric air. Mastacembelidae are spiny eels with long compressed tails and no pelvic fins. The distinctive characteristics of this family are the extended snout into a proboscis with side located anterior nostrils and possess a row of small spines in front of soft ray dorsal fin. They often survive in slow moving water with thick vegetation or hunting for prey on the soft mud (Kottelat et al., 1993).

### 2.5 Length-weight Relationship (LWR)

Zakeyudin et al. (2012) stated that LWR is important in studying the biology and management of various fish species. It indicates the disturbance of environment and continual management of the stock. It is useful to investigate the typical health parameters of fish, such as the feeding states, spawning states and fatness. In fisheries biology, LWR is vital to indicate the variations between separate unit stocks within the same species, to determine the health condition of each individual, to supply the important information on the habitat of the fish, and to evaluate the average weight of fish in certain length group (Dan-Kishiya, 2013; Lim et al., 2013).
The $b$ value in the formula ($W = a L^b$) that serves as the body form of fish is linked to the biological and ecological factors such as food availability, level of dissolved oxygen in the water, age and sex of fish, as well as the breeding condition (Zakeyudin et al., 2012). According to Othman et al. (2002), most fish fauna favour DO that is more than 5 mg/L and pH of 6.5-9.0. Jobling (2002) mentioned that when $b$ is equal to 3, the fish has isometric growth, whereas when $b$ is greater or less than 3, the fish has allometric growth. When $b$ is less than 3, the fish becomes thinner with increasing body length. On the other hand, when the $b$ is more than 3, the fish becomes robust with increasing body length (Jobling, 2002).

The $a$ value in the formula ($W = a L^b$) is a constant. When the formula is transformed into a logarithmic formula ($\log W = \log a + b \log L$), $\log a$ is the intercept of the linear graph on the Y-axis of $\log W$ (Dan-kishiya, 2013; Lim et al., 2013; Schneider et al., 2000; Zakeyudin et al., 2012).

### 2.6 Water Quality Parameters

The water quality parameters are consist of pH, depth, temperature, turbidity, dissolved oxygen (DO), transparency, conductivity, total suspended solids (TSS), biochemical oxygen demand (BOD) and chlorophyll $a$ (Chl $a$). pH is the measurement of acidity or alkalinity of the water body. Turbidity is the measure of the cloudiness in the water caused by suspended particles. It is related to the TSS, which is the amount of suspended solids in the water. Transparency is the clarity and opaqueness of the water body and relates to the depth that light can pass through water. DO is the amount of oxygen that is available or dissolve in the water. BOD is the amount of DO required by microorganisms to decompose organic matters present in the water under aerobic condition. Conductivity is the measure of the ability of
water to conduct electricity, which is affected by the inorganic dissolved ions present in the water. Chl \(a\) is the measure of primary productivity produced by phytoplankton or photosynthetic algae in the water.

Water quality parameters are important to indicate the diversity abundance of freshwater fish fauna in the river (Reash & Pigg, 1990). The safe range of pH for freshwater fish is 6.5 to 9.0 (Viessman & Hammer, 2005) or 5.0 to 9.0 (Alabaster & Lloyd, 1982). Slight changes of pH may harm aquatic organisms especially on fish eggs and fry. This can be seen when pH increases above neutrality, ammonium ion is converted to much more toxic form of unionized ammonia. According to Viessman and Hammer (2005), the minimum DO value to sustain diverse fish population is 5 mg/L. The solubility of DO in water is 8.4 mg/L at 20 °C (Lau, 2011). The higher the temperature, the lower the amount of DO present in water. Besides, due to the continual mixing of water and oxygen, fast flowing water usually has higher DO value compared to stagnant water.

The conductivity is measured to indicate the amount of dissolved ions present in water. Usually the sources of dissolved ions are from inorganic materials such as rocks, and also metal ions from the industrial wastes (Lau, 2011). Under normal condition, BOD value is less than 2 mg/L, which originates from decomposing vegetative debris (Lau, 2011). If the BOD value increases, the DO value decreases and this may threaten the survival of aquatic life. Land use activities such as conversion of land for usage of agriculture and deforestation might cause soil erosion. The runoff of sediment could flow and suspend in the water. Thus, this may elevate the turbidity and reduce the transparency of water as the suspended solids are blocking the penetration of sunlight into deeper part of water body. Excess suspended solids may destroy the breeding ground of fish and clog the fish gills.
Burford et al. (2012) mentioned that the phytoplankton productivity is greatly affected by nutrient availability and physical characteristics of freshwater. The physical properties include geomorphological characteristics, tidal exchange scale, and also the timing, duration and magnitude of flow events in freshwater. The higher the nutrient inputs into the water, the greater the amount of algal bloom and in turns increases the amount of Chl $a$ in the watershed. However, high turbidity and TSS which limits the amount of light penetration into water could inhibit the growth of algae. Besides, low rate of water flow may increase the water residence time to retain the phytoplankton in the water system (Burford et al., 2012).
3.0 **Materials and Methods**

3.1 **Study Sites**

The site of the study area is at the middle stretch of Batang Rajang at Peraran and Punan Bah which is situated around 32 km upstream from Kapit town. The study area is below the Bakun Hydroelectric Dam but above the proposed Pelagus Dam. Hence, the water flow at the Peraran and Punan Bah area is regulated by the discharge from Bakun Dam and the study site is considered as regulated river. A total of seventeen stations for fish fauna survey were selected at the Batang Rajang and its tributaries for downstream (Peraran) and upstream (Punan Bah) area. Sampling at Peraran and Punan Bah were carried out from 25 August 2014 until 30 August 2014 and 12 January 2015 until 17 January 2015, respectively. The distance from downstream to upstream area is around 90.4 km.

At Peraran area, seven stations (D1 to D6 and D8) were located at the tributaries of Batang Rajang and one station (D7) at the main Batang Rajang. At Punan Bah area, eight stations (U1 to U8) were located at the tributaries of Batang Rajang and one station (U9) at the main Batang Rajang. The locations of all stations of both study areas are shown in Figure 1.