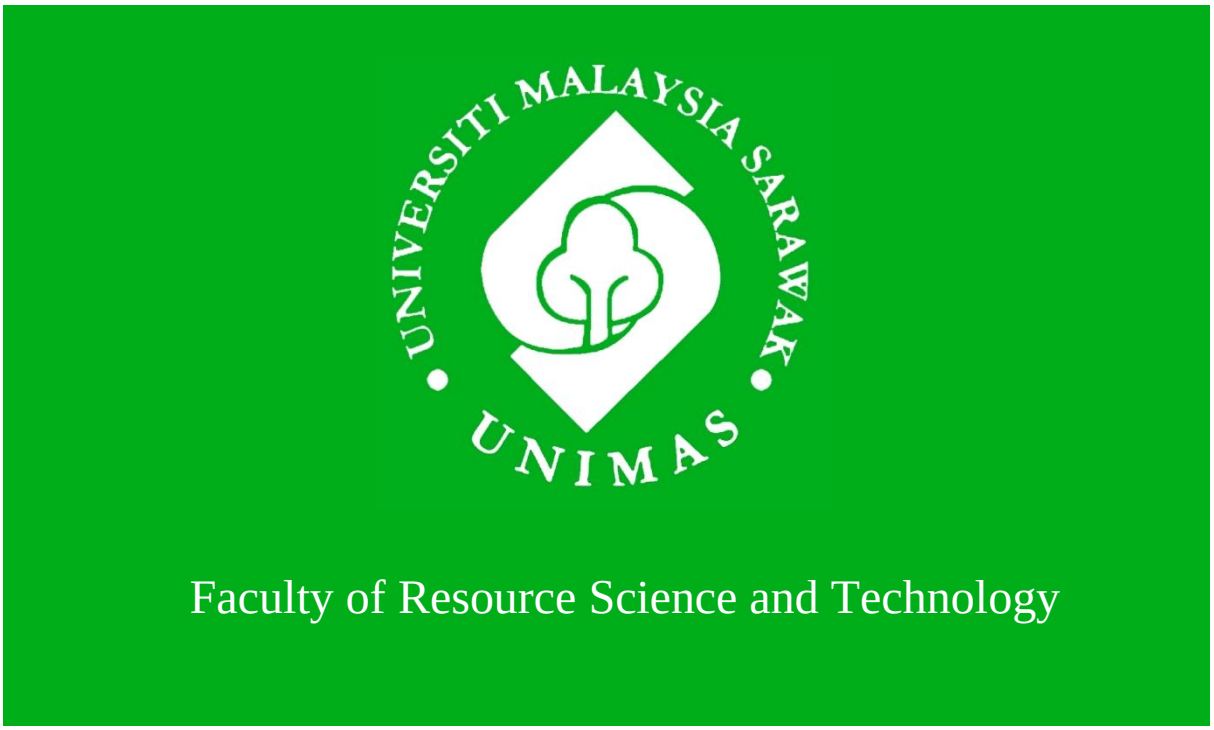

FISH FAUNA COMPOSITION IN DISTURBED AND UNDISTURBED SITES IN ASAP, BELAGA

RUNIN AK PAING

Bachelor of Science with Honours

(Aquatic Resource Science and Management)

2010

DECLARATION

No portion of the work referred to in this dissertation has been submitted in support of an application for another degree qualification of this any other university or institution of higher learning.

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ACKNOWLEDGEMENTS

Firstly, I would like to express my outmost heartfelt gratitude to my supervisor, Prof. Madya Dr. Lee Nyanti for his valuable advices and guidance in completing this study. I would like to extend my gratitude to Mr Jongkar Grinang for his help during the sampling. I am very grateful to the lab assistants, Mr. Mustafa Kamal, Mr. Zaidi bin Ibrahim and Mr Richard Toh for their assistance in the laboratory. I would like to thanks my course mates for their willing to give a helping hand when needed. Last but not least, my deepest appreciation goes to my beloved family especially to my parents for their supports in completion of this project.

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Fish Fauna Composition in Disturbed and Undisturbed Sites in Asap, Belaga

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ABSTRACT

This study was carried out at eight selected stations in Asap, Belaga. The objectives of the study were to record and to do comparative analysis the composition of fish fauna in disturbed and undisturbed sites in the study area, where two of the stations were inside the MPOB proposed area, two stations at seven years old oil palm plantation and other four stations at the secondary forest. Sampling method used was electroshocking. A total of 1,069 individuals of fish were caught comprising of 36 species, 20 genera and 8 families. Among the eight families that were caught, the family Cyprinidae was found dominant in every station. In terms of the total number of individuals caught, the dominant species is *Nemacheilus kapuasensis*. Among all the sampling stations, fish were caught most at station 4 with 258 individuals (24%) and fewest at station 3 with 36 individuals (4%). Station 1 showed the second lowest with 61 individuals (6%) caught. Station 4 which is located at the secondary forest showed the highest value of species diversity which is 1.0 and species richness at 8.3. However, station 1 which had just been cleared for oil palm plantation showed the lowest value of species diversity which is 0.5 and species richness is 1.7. This is due to high total suspended solids in the water (1.222 mg/L) at station 1 that was caused by erosion from the forest clearing activities. The distribution and population of the fish species were affected by the physical changes of their natural habitat. Therefore, composition and diversity of the fish fauna were affected by different land uses including the activities of oil palm plantation.

Keywords: composition, fish fauna, oil palm plantation.

ABSTRAK

Kajian ini telah dijalankan di lapan stesen terpilih di Asap, Belaga. Objektif kajian ini adalah untuk merekodkan dan membuat analysis perbandingan komposisi ikan di tapak terganggu dan tidak terganggu dalam kawasan kajian, di mana dua daripadanya terletak di dalam kawasan MPOB, dua lagi di dalam kawasan ladang kelapa sawit yang telah berusia tujuh tahun dan empat lagi stesen di kawasan hutan sekunder. Kaedah yang digunakan untuk persampelan adalah renjatan kuasa elektrik. Sejumlah 1,069 ekor ikan telah ditangkap yang terdiri daripada 36 spesies, 20 genera dan 8 famili. Di antara 8 famili tersebut, family Cyprinidae mendominasi semua stesen persampelan. Dari segi jumlah individu yang ditangkap, spesies dominan adalah Nemacheilus kapuasensis. Antara semua stesen, tangkapan ikan terbanyak adalah di stesen 4 iaitu 258 ekor (24%) dan paling sedikit di stesen 3 iaitu 36 ekor (4%). Stesen 1 menunjukkan tangkapan ke-2 paling sedikit iaitu 61 ekor (6%). Stesen 4 yang terletak dalam hutan sekunder menunjukkan nilai kepelbagaian spesies yang tertinggi iaitu 1.0 dan kekayaan spesies 8.3. Namun, bagi stesen 1 yang baru sahaja ditebang untuk penanaman pokok kelapa sawit memberi nilai yang paling rendah untuk kepelbagaian spesies iaitu 0.5 dan kekayaan spesies 1.7. Ini adalah disebabkan oleh jumlah pepejal terampai yang tinggi (1.222 mg/L) di stesen 1 yang disebabkan oleh hakisan dari aktiviti penebangan hutan. Taburan dan populasi spesies ikan dipengaruhi oleh perubahan fizikal yang berlaku kepada habitat asalnya. Oleh itu, komposisi dan kepelbagaian ikan adalah dipengaruhi oleh penggunaan tanah yang berlainan dan aktiviti penanaman kelapa sawit.

Kata kunci: komposisi, ikan, penanaman kelapa sawit

FISH FAUNA COMPOSITION IN DISTURBED AND UNDISTURBED SITES IN ASAP, BELAGA

RUNIN AK PAING

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

Faculty of Resource Science and Technology
UNIVERSITY MALAYSIA SARAWAK
2010

1.0 INTRODUCTION

In Malaysia, freshwater fish act as the main source of protein. Freshwater fish is the fish that spend most of their lives in streams or rivers that have salinity less than 0.5 psu. Rivers can be divided into upstream and downstream. Different parts of the river with different environmental condition may influence the distribution, morphology and feeding habits of fish species. There are about 900 to 1000 species of freshwater fish that have been reported in South East Asia (Kotellat and Whitten, 1993).

Freshwater fish can be found in many different places such as in canals, rivers, drainages, lakes, swamps and even in paddy fields in which the habitats ranges from small streams to extremely high in acidic ecosystem or alkaline water (Mohsin and Ambak, 1983; Ahmad and Khairul Adha, 2007). The composition and diversity of fish fauna are influenced by several factors such as food availability, breeding sites, water current, water depth, and physiochemical parameters. Besides that, topography also affects the distribution of fish fauna. In higher latitude for instance, the fish density is usually much less compared to middle and lower zones.

However, overexploitation of the natural habitats by timber harvesting (Meijaard *et al*., 2005) and land development such as oil palm plantation had caused the declination of fish stocks. Erosion caused by logging activities increased the sedimentation in the water column and thus make the river become shallower. The sedimentation process increased the water turbidity and decreased the water clarity. When the river become shallower, the water become warmer and warmer water retain less dissolved oxygen compared to cold water. These poor environmental conditions cause stress to the fish fauna and inadequate dissolved oxygen may kill the fish.

Besides that, the impact of erosion also altered the physical environment where erosion causes widening of the stream width. Destruction of the natural habitats affect the survival of the fish and this also contribute to the declination in the composition and diversity of the fish.

The utilization of pesticides and herbicides from the oil palm plantation can lead to pollution (Brown *et al.,* 2005). During heavy rainfall, runoff from the agrochemical residues that entered the nearby river caused water pollution. The presence of these chemical substances in the water column put pressure on the dissolved oxygen demands and the toxicity of the pesticides and herbicides killed the fish and other aquatic organisms. Other than that, it also caused environmental pollution when the chemical residues that dissolved in the water column are being absorbed into the sediment, and finally pollutes the groundwater which is one of the sources for human water supply.

Several studies had been carried out regarding the population of fish fauna in some rivers in Sarawak. However, no detailed research had been done in Asap, Belaga where the Malaysian Palm Oil Board (MPOB) had proposed for the oil palm plantation. Therefore, the aims for this study were to determine the diversity and composition of fish fauna at each station of the study area, to record the dominant species in Bera'an River, Asap, Belaga and to identify the impact of oil palm plantation on fish fauna.

2.0 LITERATURE REVIEW

2.1 Fish Fauna Diversity

According to Mohsin and Ambak (1990), majority of the studies on community of freshwater fish that had been done in Malaysia is in Peninsular Malaysia and Sabah. There are 380 species of freshwater fish that had been recorded in Malaysia (Khan *et al.,* 1996) while in Borneo, 300 species that had been found (Roberts, 1989; Kotellat *et al.,* 1993; Inger and Chin, 2002).

Kotellat *et al.* (1995) recorded 249 species of freshwater fish from Sarawak and Brunei. Allan and Brown (1987) also reported 39 species from family Belontiidae from Sarawak. According to Watson and Balon (1984), 57 species were recorded in Sungai Baram. Besides that, about 66% of freshwater fish in Sungai Rajang are from the family Cyprinidae (Nyanti *et al*., 1995).

Among 7 families, 19 genera and 24 species found in Bario, Kelabit Highlands Sarawak, majority are from family Cyprinidae and Balitoridae (Nyanti *et al.,* 1998). A study carried out in Sungai Bakong, Miri found 23 species of freshwater fish and it was dominated by fish from family Helostomatidae (Kelvin *et al.,* 2002). According to Kelvin *et al.* (2002), *Puntius collingwoodi* was dominant in Sungai Layar and Sungai Spak, Betong. In Tanah Tinggi Ba'Kelalan, Lawas, 22 species were found and *Osteochilus* sp. from family Cyprinidae dominated the area. In Batang Lemanak, Engkilili 29 species were recorded and the majority was from family Cyprinidae (Lee, 2004).

2.2 Biology of Freshwater Fish

Most of freshwater fish have flattened underparts of its body and possess sensitive lips (Marshal, 1999). Some of them also have barbels that act as their sensory organs.

There are also some species that live as bottom-dwellers such as catfish and loaches. Differ from marine fishes, freshwater fish has their own physiological adaptation to survive in rivers or streams. For example, their gills allow water diffusion but still maintain the ion concentration in their body fluids. Besides that, they also possess well developed kidneys to support a lot of water to pass through.

2.3 Distribution of Freshwater Fish

Generally, habitat characteristics for most of the freshwater fish are such as fast flowing water with partially or well-shaded, substrate consists of mud, sand, silt and rocky bottom (Lee, 1994; Ng, 2006). There are several factors that influenced the distribution and species richness of freshwater fish in certain areas. Water depth and altitude affect the diversity of some species in a river (Wotton, 1990). Species that are bigger in size usually can be found in low altitude which is 600 meters below sea water level (Chin, 1978; Abdullah, 1990). According to Nyanti *et al.* (1995), more fish are usually found in areas of low altitude. Fish from genus *Gastromyzon* always dominated the river at altitude 600 meters above the sea level (Nyanti *et al.,* 1995). Other than that, availability of food source, breeding areas, velocity of water current, topography and chemical parameters of water also influenced the composition of fish presence in the river (Ali *et al.,* 1988).

However, there are some species which can tolerate unfavorable conditions. Fish from the family Channidae for instance, can survive in wide ranges of water temperature as low as 13 °C and had been found in hot springs in Sri Lanka. Besides that, they are also present in streams with low mineral concentration and the pH ranges from 3.1-9.6. Furthermore, there are Channidae such as *Channa gachua* had been reported to enter the brackish water (Lee, 1994).

2.4 Impact of Oil Palm Plantation

Over these past few years, freshwater fish caught in Malaysia had decline and the primary factor for this declination is due to the destruction of their natural habitat (Khan *et al*., 1996) especially by logging activities and development of oil palm plantation. In Malaysia, most plantations were established in newly cleared forest rather than using the disused agriculture land such as the old paddy fields. This is to minimize the cost of plantation that required rehabilitating the disused agriculture land when compared to clearing new land (Brown and Jacobson, 2005). In oil palm plantation, it involves several stages such as nursery establishment, site preparation, maintenance and harvesting (State Environmental Conservation Department, 2000). For all the stages, much works need to be done including land clearing and utilization of fertilizer, pesticides and herbicides, and all these activities contribute to water pollution which may affect the aquatic life.

Clearing the forest for the purpose of access road, nursery and plantation especially along the riverbank caused loss of tree cover for the surface of water. As a result, the water temperature increased and warmer water retain less dissolved oxygen. Hence, the fish compete for the lack of dissolved oxygen and this becomes poorer environment for many species (Atack, 2006). For instance, study that had been carried out in Sg. Baram and Ulu Skrang River in Sarawak showed that low density of fish population in that area are due to secondary timber harvest and shifting cultivation activities (Charles, 2000). Removal of the trees caused soil erosion when there were no tree covers for the topsoil especially during heavy rain. Soil erosion lead to transportation of the agro-chemicals residues which adhere to the suspended solids to enter the waterways and thus contaminated the rivers (Lord and Clay, n.d).

Besides that, the logging activities also disturbed the natural habitats of the flora and fauna including the aquatic organisms. These environmental changes affected the survival rate of fish fauna in that disturbed areas because of destruction of their breeding area (State Environmental Conservation Department, 2000).

Runoff of chemical residues including fertilizers, pesticides and herbicides from the existing oil palm plantation nearby the river pollute the water. Besides that, other factors such as sewage from workers population (State Environmental Conservation Department, 2000) and palm oil mill effluent also contributed to the pollution of the water column. Unfavorable condition resulting from the water pollution affected the population and density of the fish fauna in the affected areas.

3.0 MATERIALS AND METHODS

3.1 Study Site

This study was carried out at the Malaysian Palm Oil Board (MPOB) plantation at Asap, Belaga from 9 to 11 October 2010. Since no pristine stream in the study site, thus 20-year logged over forest streams are classified as undisturbed area or control site, while 7-year old oil palm plantation and MPOB proposed area are classified as disturbed sites. Fish fauna surveys were carried out at eight sampling stations that were selected within and outside the MPOB area. Two stations were outside of the MPOB area at an existing oil palm plantation that is seven years old. Two stations were inside the MPOB proposed area that is about to be developed and another four stations were at the 20-year logged over forest that will not be developed for oil palm plantation (Figure 1).

3.2 Fish Sampling

An electroshocker device consist of two copper electrodes on wooden handles powered by 1000-watt portable AC generator was used for fish sampling. Shocked fish were collected using scoop net. Fish samples were preserved using 10% formalin for a period of about 72 hours. After that, the samples were rinsed and soaked in tap water for about five to ten minutes before transferred into 70% ethanol for laboratory analysis.

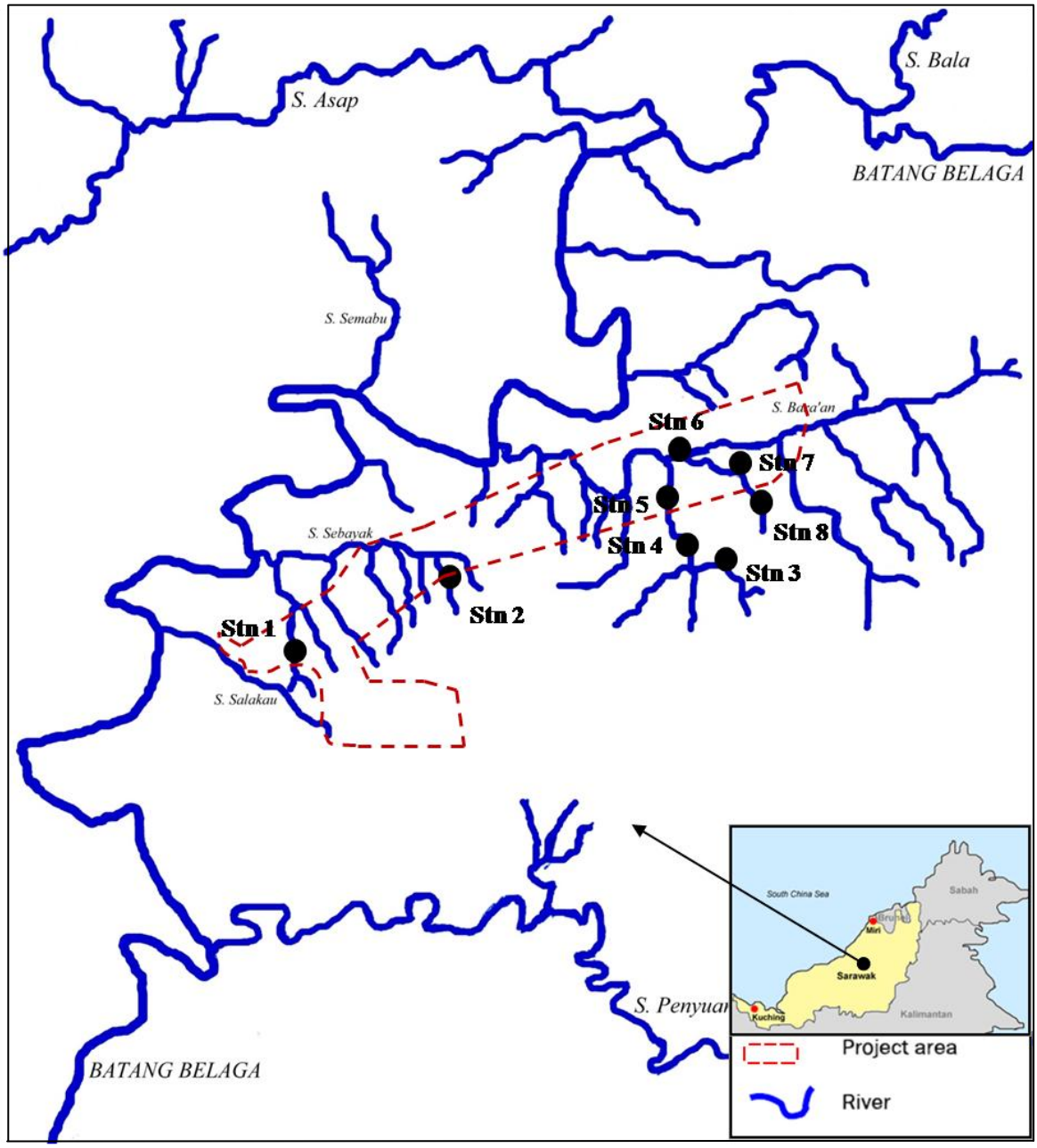

Figure 1: Sampling stations for fish fauna within and outside the MPOB proposed area.

3.3 Laboratory Analysis

In laboratory, the fish were identified using the taxonomic method according to Kotellat *et al.* (1993), Inger and Chin (2002) and Tan (2006). The samples were weighed using weighing machine of model EK-120A CAPACITY and the length (total length and standard length) were measured using a ruler. Total length is the measurement from the tip of the mouth to the end of the tail. Standard length is the measurement from the tip of the mouth to the end of fleshy caudal peduncle (Kotellat *et al*., 1993).

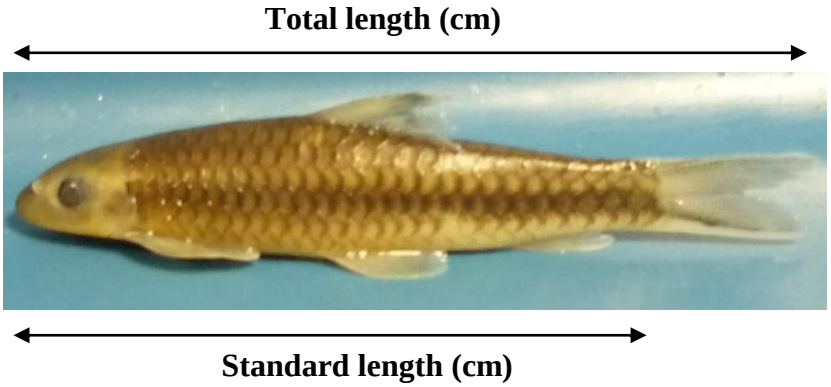

Figure 2: Total length and standard length of fish.

3.4 Indices

For each station, the diversity, richness and evenness indices were analyzed using Shannon-Weiner's Diversity Index (H'), Margalef's Species Richness Index (D) and Pielou's Evenness Index (J) as below:

i) *Shannon-Weiner's Diversity Index* (Shannon and Weaver, 1963)

$$H' = \frac{n \log n - \Sigma fi \log fi}{n}$$

n = sample size

fi = number of individuals per species

ii) *Margalef's Species Richness Index* (Margalef, 1958)

$$D = \frac{(S-1)}{\log N}$$

S = total number of species

N = total number of individual

iii) *Pielou's Evenness Index* (Pielou, 1966)

$$J = H / \ln S$$

H = Shannon-Weiner's Diversity Index

S = total number of species

iv) *Sorensen's Index* (Sorensen, 1948)

$$S = 2j / (a+b)$$

S = coefficient of association between sites A and B

j = number of species common to both sites A and B

a = number of species present at site A

b = number of species present at site B

3.5 Statistical analysis

Microsoft Excel 2003 was used to calculate the mean and standard deviation for standard length (SL)(cm), total length (TL)(cm) and total weigh (TW)(g) of the samples. Besides that, it is also used to calculate the fish indices which are the species diversity, richness and evenness, to aid in analyzing the fish indices and to construct relevant pie charts. SigmaPlot 8.0 was used to construct vertical bar chart for the mean and standard deviation of standard length, total length and total weight of the selected species, *Puntius binotatus* and *Rasbora sumatrana*.

4.0 RESULTS

4.1 Habitat Description

There are three different land uses in the sampling stations which are 7-year old oil palm plantation, 20-year logged over forest and MPOB proposed area. Station 1 and 2 are located inside the MPOB proposed area and station 1 had just been cleared and bulldozed for planting oil palm saplings while station 2 was about to be cleared. Stations 3, 4, 5 and 8 are located in the 20-year logged over forest. Station 6 and 7 are located within the 7-year old oil palm plantation.

Table 1: Coordinate and habitat descriptions of the sampling stations.

Station	GPS reading	Habitat Description
1	(start shocking) N 02° 58’ 48.3” E 113° 56’ 41.4” (end shocking) N 02° 58’ 47.1” E 113° 56’ 43.5” Elevation: 190 m	Recently cleared land for oil palm plantation. Oil palm nursery located upstream. Riparian vegetation consists mainly of trees and shrubs and stream was partly shaded. Localized erosion observed at river bank. Bottom substrate was dominated by sand. Water was muddy with profuse sedimentation at bottom of the river.
2	(start shocking) N 02° 59’ 46.2” E 113° 57’ 53.6” Elevation: 192 m (end shocking) N 02° 59’ 41.7” E 113° 57’ 54.5” Elevation: 193 m	Small area of hill rice cultivation. Riparian vegetation consists mainly of trees and shrubs and river was exposed. Localized erosion observed at river bank. Bottom substrate was dominated by gravel and pebble. Water was clear with almost no sedimentation at bottom of the river.
3	(start shocking) N 02° 59’ 36.3” E 111° 59’ 46.6” (end shocking) N 02° 59’ 36.3” E 113° 59’ 49.8” Elevation: 200 m	The predominant surrounding land use is of primary forest with no evidence of localized erosion and pollution. Riparian vegetation consists mainly of trees and shrub and river was exposed. Some localized erosion at the river bank. Bottom substrate was dominated by sand, gravel and pebble. Water was tea-coloured with slight sedimentation at bottom of the river.

4	(start shocking) N 02° 59’ 45.2” E 113° 59’ 27.2” Elevation: 191 m (end shocking) N 02° 59’ 42.9” E 113° 59’ 26.6” Elevation: 193 m	20-year logged over forest with riparian vegetation consists mainly of shrubs and river was exposed. Localized erosion was observed at river bank. Bottom substrate was dominated by sand, gravel and pebble. Water was tea-coloured with slight sedimentation at bottom of the river.
5	(start shocking) N 03° 00’ 12.5” E 113° 59’ 20.5” Elevation: 185 m (end shocking) N 03° 00’ 12.3” E 113° 59’ 17.8” Elevation: 186 m	Small area planted with tapioca and oil palm plantation. Riparian vegetation consists mainly of trees and shrubs and river was exposed. No erosion observed at the river bank. Bottom substrate was dominated by pebble, cobble and boulder. Water was tea-coloured with profuse sedimentation at bottom of the river.
6	(start shocking) N 03° 00’ 28.2” E 113° 59’ 04.9” Elevation: 171 m (end shocking) N 03° 00’ 29.0” E 113° 59’ 06.2” Elevation: 192 m	7-year old oil palm plantation area. Riparian vegetation consists mainly of grasses and shrubs and river was exposed. Localized erosion was observed at river bank. Bottom substrate was dominated by gravel. Water was muddy but no sedimentation was observed.
7	(start shocking) N 03° 00’ 35.4” E 114° 00’ 09.6” Elevation: 186 m (end shocking) N 03° 00’ 33.6” E 114° 00’ 10.5” Elevation: 186 m	7-year oil palm plantation area and staff quarters. Riparian vegetation consists mainly of grasses and shrubs and river was partly shaded. Localized erosion was observed at river bank. Bottom substrate was dominated by pebble and cobble. Water was tea-coloured with almost no sedimentation at bottom of the river.
8	N 03° 00’ 29.5” E 114° 00’ 10.1” Elevation: 184 m	Oil palm plantation alternated with primary forest. Riparian vegetation consists mainly of trees and shrubs and river was partially exposed. No localized erosion observed at river bank. Bottom substrate was dominated by pebble and cobble. Water was tea-coloured with almost no sedimentation at bottom of the river.

4.2 Fish fauna

A total of 1069 individuals of fish were caught from eight stations belonging to 36 species, 20 genera and 8 families (Table 2). Among all the sampling stations, the number of fish caught were highest at station 4 with a total of 258 individuals (24%), followed by station 2 with total of 180 individuals (17%), station 8 with 174 individuals (16%), station 6 with 161 individuals (15%), station 7 with 109 individuals (10%), station 5 with 89 individuals (8%), station 1 with 61 individuals (6%) and the least number was caught at station 3 with 36 individuals (4%) (Figure 3).

Table 2: List of fish families, species and number of individuals caught in disturbed and undisturbed sites in Asap, Belaga.

No	Family	Species	N
1	Balitoridae	*Gastromyzon cranbooki*	8
		Gastromyzon zebrinus	6
		Homaloptera macrolepidota	1
		Homaloptera orthogoniata	6
		Homaloptera stephensoni	46
		Homaloptera tateregani	2
		Homaloptera weberi	3
		Nemacheilus kapuasensis	317
2	Channidae	*Channa lucius*	5
		Channa striata	11
3	Cyprinidae	*Barbonymus collingwoodii*	3
		Chela oxygastroides	5
		Garra borneensis	131
		Hampala macrolepidota	3
		Leptobarbus hoevenii	20
		Leptobarbus melanopterus	5
		Nematabramis borneensis	4
		Nematabramis steindacheri	56
		Osteochilus eneaporos	4
		Osteochilus harrisoni	2
		Osteochilus hasseltii	27
		Osteochilus waandersii	3
		Paracrossochilus vittatus	50

		Puntius binotatus	136
		Puntius orphoides	4
		Rasbora argyrotaenia	4
		Rasbora borneensis	6
		Rasbora caudimaculata	6
		Rasbora sumatrana	154
		Rasbora trifasciata	18
		Tor tambroides	2
4	Gobiidae	*Stiphodon elegans*	3
5	Hemiramphidae	*Hemirhamphodon tengah*	1
6	Mastacembelidae	*Mastacembelus armatus*	2
7	Siluridae	*Pterocryptis furnessi*	1
8	Sisoridae	*Glyptothorax major*	14
			TOTAL= 1069

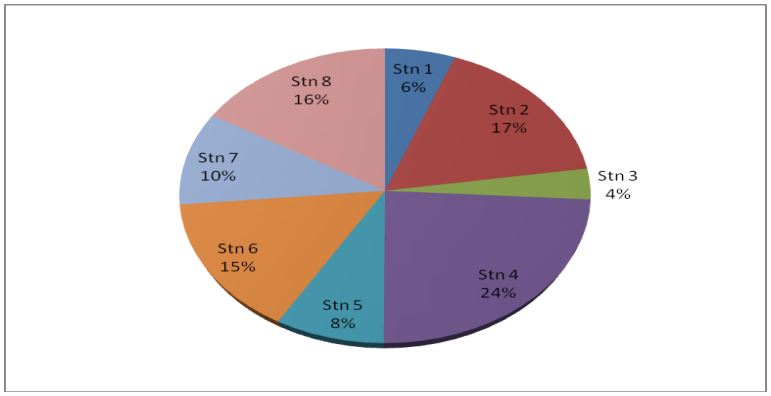

Figure 3: Number of fish caught at each station.

In terms of the individuals caught, 60.2% belong to the family Cyprinidae, 36.4% belong to the family Balitoridae, 1.5% from the family Channidae, 1.3% from the family Sisoridae, 0.3% from the family Gobiidae, 0.2% from the family Mastacembelidae, and 0.1% from each from the families Hemiramphidae and Siluridae (Figure 4).

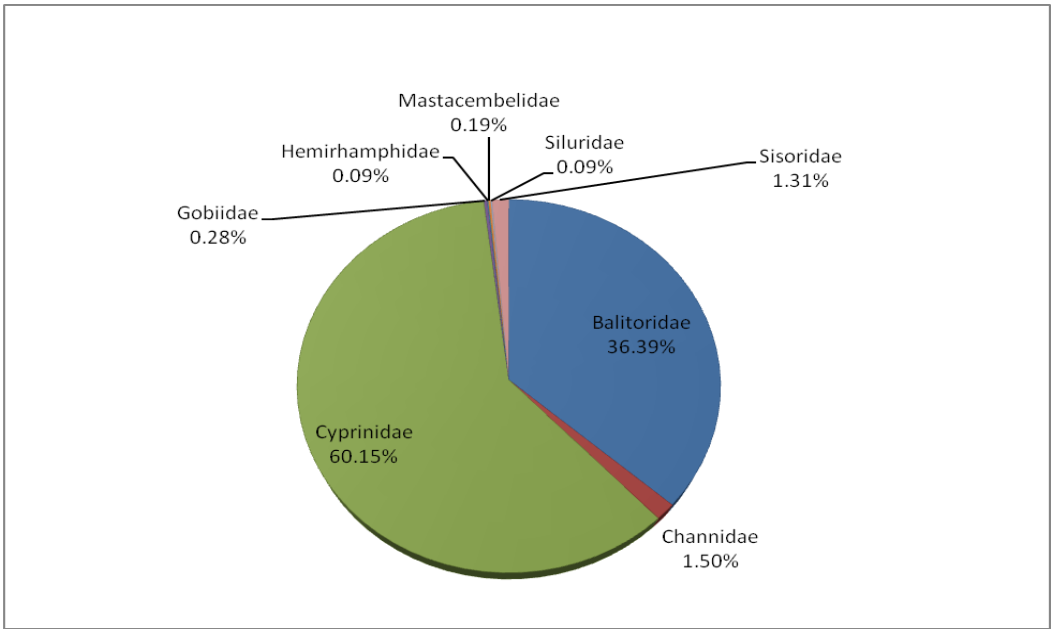

Figure 4: Percentage of fish families caught in all stations.

Among the eight families that were caught, the family Cyprinidae was found to be dominant in every station. In terms of the total number of individuals caught, the dominant genus is *Nemacheilus* (Figure 5) and the dominant species is *Nemacheilus kapuasensis* with a total of 317 individuals (Table 2).

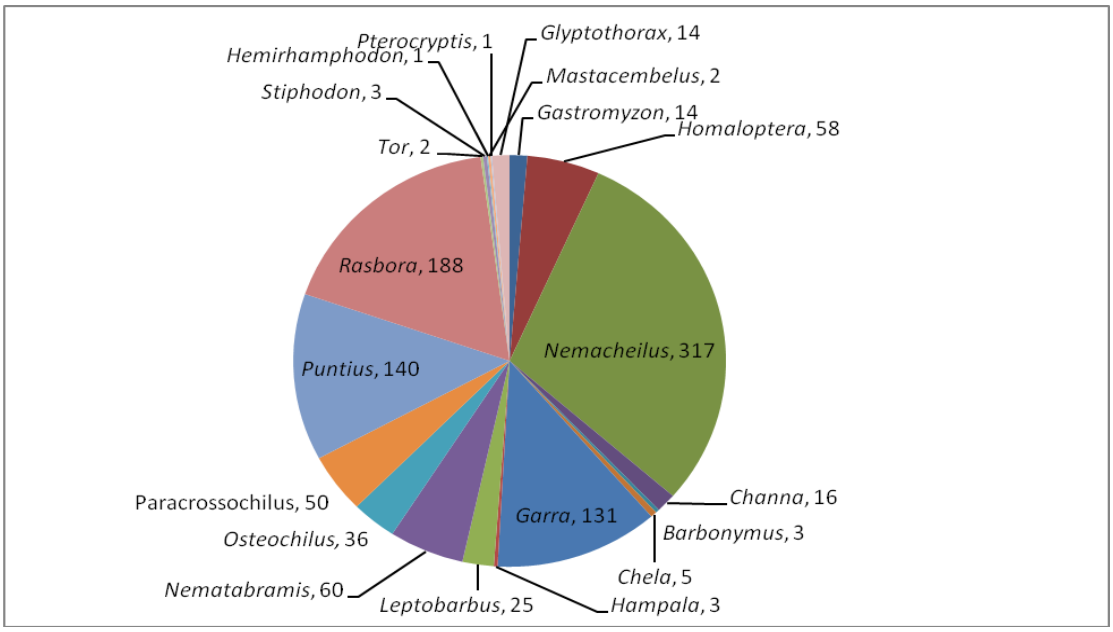

Figure 5: Number of fish genera caught in all stations.

The standard length, total length and total weight of the various species caught are shown in Table 3. For *Puntius binotatus*, the largest was caught in station 5 while the smallest was caught in station 3. The standard length ranged from 2.6 – 10.0 cm, total length ranged from 3.3 – 12.4 cm and the total weight ranged from 0.6 – 27.4 g (Figure 6). *Rasbora sumatrana* from the family Cyprinidae which were also found in all sampling stations also showed significant differences in their sizes. The largest individual was caught in station 6 and the smallest individual was caught in station 7. The standard length ranged from 2.9 – 7.7 cm, total length ranged from 3.7 – 10.1 cm and the total weight ranged from 0.5 – 8.2 g (Figure 7).

Table 3: List of species, number caught (N), standard length (SL), total length (TL), total weight (TW) and their standard deviations (SD) at every station.

Stn	Family	Species	N	SL ± SD (cm)	TL ± SD (cm)	TW ± SD (g)
1	Cyprinidae	*Nematabramis steindacheri*	22	3.52 ± 1.52	4.46 ± 1.96	0.89 ± 1.18
		Osteochilus hasseltii	1	10.5	13.4	27.85
		Puntius binotatus	15	3.13 ± 1.44	4.08 ± 1.83	1.48 ± 3.56
		Rasbora sumatrana	23	4.67 ± 2.18	6.13 ± 2.87	2.83 ± 3.67
2	Balitoridae	*Homaloptera stephensoni*	6	3.82 ± 0.20	4.68 ± 0.24	0.73 ± 0.12
		Homaloptera weberi	2	4.70 ± 0.42	5.65 ± 0.35	1.44 ± 0.42
		Nemacheilus kapuasensis	60	4.78 ± 0.37	6.02 ± 0.47	1.42 ± 0.43
	Channidae	*Channa striata*	2	12.90 ± 7.92	15.5 ± 9.19	47.02 ± 57.74
	Cyprinidae	*Puntius binotatus*	21	3.94 ± 2.01	5.05 ± 2.56	3.18 ± 4.78
		Nematabramis steindacheri	2	7.60 ± 0.28	9.65 ± 0.21	7.09 ± 0.43
		Garra borneensis	28	7.17 ± 1.58	9.41 ± 2.06	8.01 ± 4.87
		Osteochilus hasseltii	17	8.45 ± 0.89	10.85 ± 1.07	15.70 ± 4.77
		Osteochilus waandersii	1	7.10	9.50	8.40
		Nematabramis borneensis	4	5.48 ± 1.59	7.08 ± 1.92	2.80 ± 2.00
		Rasbora sumatrana	12	5.10 ± 1.40	6.61 ± 1.77	2.81 ± 2.26
		Leptobarbus hoevenii	17	6.21 ± 1.30	8.09 ± 1.63	6.06 ± 4.09
	Gobiidae	*Stiphodon elegans*	3	3.73 ± 0.15	4.53 ± 0.23	0.65 ± 0.11
	Hemiramphidae	*Hemirhamphodon tengah*	1	4.00	4.80	0.41
	Sisoridae	*Glyptothorax major*	4	4.75 ± 0.26	6.08 ± 0.29	2.40 ± 0.61
3	Balitoridae	*Homaloptera stephensoni*	5	3.16 ± 0.66	3.84 ± 0.74	0.39 ± 0.21