

## Research Article

# Lateral Migration of Fish in the Blackwater Flood Runoff Ecosystem of the Sebangau River, Central Kalimantan

Lukas<sup>1</sup>, Belinda Hastari<sup>2</sup> and Ardianor<sup>3</sup> and Sulmin Gumiri<sup>4</sup>

<sup>1</sup>Environmental Science Doctoral Study Program, University of Palangka Raya. Yos Sudarso Street, Central Kalimantan, Indonesia.

<sup>2</sup>Dept. of Forestry, Faculty of Agriculture, University of Palangka Raya, Indonesia.

<sup>3</sup>Dept. Of Aquaculture, Faculty of Agriculture, University of Palangka Raya, Indonesia.

<sup>4</sup>Graduate Program, University of Palangka Raya, Indonesia.

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### Corresponding author:

**Lukas**, Environmental Science Doctoral Study Program,  
University of Palangka Raya. Yos Sudarso Street, Central  
Kalimantan, Indonesia

**E-mail:** [lukasinel@gmail.com](mailto:lukasinel@gmail.com)

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### Abstract:

Several types of fish with increasing of the body size and are followed by the changes of food types that cause these fish to change habitats. Fish habitat in the black water runoff ecosystem of the Sebangau River is divided into three habitus, namely habitus of herb and grass, shrub, bush and liana, and trees which existence are influenced by the water depth. There are nine fish communities identified, these fish migrate in those three habitus, that are migration due to growth and food. Some certain species such as kapar, sepat fish, tambakan fish and catfish, in the larval stage and developing into adult fish are in tree, herb and grass habitus, with a water depth of 1.3-1.7 meters, while for fish with a big enough size. such as tapah fish and snakehead fish species (Chana Sp) are scattered on shrub, bush and liana habitus with an average water depth of 1.6 - 4.1 meters. The analysis result of the food types from the stomach of fish that have been caught in the Sebangau river, based on the food composition, it is dominated by 72-99% of fry and 52-72% of plants or grains, classified as all-eating (omnivorous) and meat-eating fish (carnivores) and included in predatory fish type. The changes of food types in each fish life stage and the availability of natural food in the waters are one of the factors that affect the growth and structure of fish communities in the black water flood runoff ecosystem of the Sebangau River.

**Keywords:** Lateral migration, fish communities, growth, food composition, black water ecosystem, Sebangau River

## **Introduction**

The introduction of fish structure is inseparable from fish morphology, that is the outer shape of the fish which is a characteristic that is easier to be seen and remembered in studying fish types. Fish morphology is closely related to the fish habitat in the water. Before knowing the shape of a fish's body that can show where the fish's habitat is, it's good to know the parts of the fish's body as a whole and the measurements used in identification.

The fish caught in the Sebangau river are more dominant than the black fish group. The group of black fish which are the inhabitants of swamp fish and these fish are able to live in acidic water conditions and have little oxygen content because these fish have additional breathing apparatus (Agus et al. 2005).

In the waters of the Rungan river, omnivorous fish species are more dominant than other tropical levels, because they have a wider food niche than the other groups, so that the number of species is more (Sulistiyarto et al 2007). Species from the Cyprinidae family has ability to adapt in a water conditions that tend to be acidic (Effendi. 2003). Even so, this fish has made effort where the behavior at the spawning time aims to make all the eggs released can be fertilized.

The changes of water depth during the rainy season can affect the conditions of water quality and the rhythm of fish life. The changes of water depth are the main factors that determine the structure of fish communities. Environmental changes during migration will respond to fish behavior (phenotypic characters). The changes during the migration process include changes of behavior and morphology. Phenotypic plasticity is the ability of a genotype to produce more than one morphological, physiological, and behavioral in response to environmental changes (Melta 2010).

During the dry season in Sebangau, the river segment serves as a site for protection from bad environmental conditions also as a site for the free movement for adult individuals. The main tributary segment is also used for foraging either by adult fish or some young fish, especially at the edges. Generally, the fish originating from the Sebangau river are predatory fish. The existence of predators in the waters can reduce the ability level of the ability of the fish to find food which can have an impact on the growth rate of the fish,

naturally the fish will move to a habitat where they can get food sources. Fish habitat is important for fish life also influencing life processes, namely: foraging, shelter, reproduction and migration (Findra et al. 2016).

Hydrologically, the Sebangau area is an area with a relatively varied zone because during the rainy season the area along the Sebangau River is a flooded swamp area which is inundated by water while in the dry season this area experiences drought and is prone to forest and land fire disasters. The complex ecosystems can provide habitats for fish for sheltering from predators also as natural food sources (Snover 2008). The water depth changes in rainy season can affect the water quality conditions and the rhythm of fish life. The change of water depth is the main factor that determine the fish community structure. The purpose of this study was to determine the lateral migration of fish in the black water flood runoff ecosystem of the Sebangau River, especially on the riverbanks where there were vegetations with different habitus, for growth migration and food.

## **Methods**

### **Description of Study Area**

This research activity was carried out for 7 months, starting from March 2020 to October 2020. The location of this research activity was carried out in the black water flood runoff ecosystem of the Sebangau River.

The study was divided into 4 observation stations, where there was vegetation with habitus from the riverbank (shallow) to the middle part (deep) of the black water ecosystem of the Sebangau River with a quite high riparian species and an area with full of aquatic plants.

Station 1 was located at -2o21'32'S113o59'42"E, station 2 was at -2o21'32'S113o59'42"E, station 3 was located at -2o21'31'S113o59'42"E, station 4 was located at at -2o21'31'S113o59'41"E. Fish samples were obtained from fishermen who catch fish using several fishing gears: nets, tempirai, bubu (trap), at the research location. The water quality measurement was carried out with in situ at the research location of the Sebangau river using the Horiba U52G tool.



Figure 1. Research location and observation station of the Sebangau River.

## Introduction

Measurement of length and weight of fish and food analysis using the formula proposed by Effendie (1997), namely:

$$W = aLb$$

Where: W = Fish weight (grams)  
 L = length of fish (cm)  
 a and b = constants

Food analysis uses the Largest Part Index with the formula (Effendie, 1997).

$$ii = \frac{Vi \times Oi}{\sum Vi \times Oi} \times 100$$

Where:

ii = index of preponderance  
 Oi = Percentage of frequency of occurrence of one food type  
 Vi = Percentage by volume of one food type  
 $\sum Vi \times Oi$  = total of  $Vi \times Qi$

## Result and Discussion

The Sebangau River, especially the main tributary, is used for foraging, either by adult fish or some young fish, especially on the edges. The caught fish in the Sebangau river are more dominant than the black fish group. The group of black fish which are inhabitants of swamp fish and these fish are able to live in acidic water conditions and have little oxygen content, because these fish have additional breathing apparatus (Agus et al. 2005).

In general, the habitat in the black water flood runoff ecosystem of the Sebangau River has an important ecological role, including as a source of nutrients and organic matter, also as a habitat provider for a number of aquatic biota, especially fish. For several types of fish, usually with increasing of body size and followed by a change in the food type and the increasing of fish age, causing the fish move habitats or known as ontogenetic habitat movement. In general, aquatic organisms, changes in each phase of their life development will occur, such as fish habitat and food type changes. These changes are to meet the needs of biological and ecological aspects, including food and shelter for hiding from predators. Besides that, there are also the changes of environment, especially in water depth changes during the rainy season which can affect water quality conditions, this is the main factor that determines the structure of fish community. In addition, with the availability of complex habitats can also cause the movement of fish habitats. According to Snover (2008), that a complex ecosystem can provide a habitat for fish to find food or shelter from predators.

### Literal Migration Due to Growth

The black water habitat of the Sebangau River which has a major role in fish interaction, especially in the Sebangau river black water runoff area. The fish habitat in the black water runoff ecosystem of the Sebangau River is divided into three habitus, namely habitus of herb and grass, bush, shrub and liana also tree which existence is influenced by water depth. The habitat of the Sebangau river consists of the habitats of Herbs and Grasses, Shrubs, Bushes and Lianas, Trees. The high abundance of forest building vegetation can be a benefit for aquatic biota.

**Table 1.** Vegetation Types in Peat Swamp Forest Habitus Type

Habitus	Local Name	Latin Name
Herb and Grass	Water Grass 1	<i>Hydrilla verticillata</i>
	Water Grass 2	<i>Ischaemum sp.</i>
Shrub, Bush and Liana	Shrub	<i>Timonius sp.</i>
	Rasau	<i>Pandanus helicopus</i>
	Bejakah	<i>Uncaria nervosa Elmer</i>
Trees	Belangeran	<i>Shorea balangeran</i>
	Guavas	<i>Barringtonia sp.</i>

One of the ecological functions of this habitus is to provide space for aquatic biota as a place for spawning, laying eggs and nesting of small shrimp, mollusc and various types of fish, and the falling leaves will be broken down by microorganisms and become the food source for various aquatic biota.

The structure of the fish population in the Sebangau river, which is scattered in the habitat of peat swamp forest, which is spread over habitus of herb and grass, shrub, bush and liana and trees can be determined by analyzing of fish species, analysis of fish length and weight, eating habits and types of fish food during research activities. From the identification of fish caught, there were 9 types of fish communities, which were scattered in the peat swamp forest habitat in the Sebangau river, namely Touman fish (*Channa micropeltes*), catfish (*Clarias batrachus*), Tapah (*Wallago leerii*), Karandang (*Channa pleurophthalmus*), cork (*Channa striata*), Kehung (*Chana lucius*), Kapar (*Belontia hasselti*), Sepat (*Trichogaster sp.*), and Tambakan fish (*Helostoma temminckii*). Fish that live on the riverbed have characteristics of fish mustaches (both long and short) which are used to detect food in turbid waters, and a large mouth is generally to indicate the nature of fish as predators, for example Tapah fish, Tahuman fish and Kerandang. Several other types are fish that usually live on the surface of the water. Certain species such as kapar, sepat, tambakan and catfish, in the larval stage and developing into adult fish are in tree, herb and grass habitus, with a water depth of 1.3-1.7 meters, while for fish with a large enough size. such as tapah fish and snakehead fish species (*Chana Sp*) are scattered on shrub, bush and liana hebitus with an average water depth of 1.6 - 4.1 meters.

The dominant fish species caught in the study were Kapar, Kehung, and Swamp Sepat. These types of fish are mostly found in tree, herb and grass hebitus along the black water runoff of the Sebangau river. The local fish originating from the Sebangau river consist of tapah fish, saluang fish, and swamp sepat fish (Minggawati et al. 2020). Shrub or often known as bush plant is a woody plant with a height no more than 7 meters at a certain location on the Sebangau river and usually have several stems. The characteristics of the shrubs in the Sebangau river are small, low shrubs, generally measuring less than 2 meters.

In the early stages as larvae of the fish in the Sebangau river, they live in shallow areas or in the pelagic area, after growing up they become demersal fish, or vice versa. Especially for fish such as Tapah, Kehung and Tahuman fish, usually adults are in a deeper demersal area in the habitus of shrub, bush and liana. These fish are included in the group of predatory fish in freshwater. This fish preys on small fish, insects, and various other aquatic animals also grains. For the type of fish that is included in the *Channa* Genus (group of snakehead fish) has ability to breathe directly from the air, using a kind of labyrinth organ but is more primitive. In the breeding season, male and female fish work together to prepare nests among the plants on the riverbank. The cubs of snakehead fish, swim in groups that move together to find food and for these young fish will be guarded by their mother.

Kapar fish are often found in the Sebangau river in swampy waters, especially found in peat waters, which are calm water where there are many aquatic plants such as herb and grass habitus. While for tambakan fish, it is included in fish that live between



the surface and deep-water areas, especially in shallow waters, with calm flowing and many aquatic plants in shrub, bush and liana habitus in the Sebangau river



**Figure 1.** Herbs and Grasses Habitus and some of them are Shrubs, Bushes and Lianas, as fish habitat in the Sebangau River



**Figure 2.** Fish identified from the Sebangau River

### **Literal Migration due to Food**

Migration literally, habitat which is done by fish is influenced by many things. Change of food types in each stage of its life becomes one influencing factor. In general, fish with seed size tend to eat plankton species.

Many fish species are capable to adapt to the food supply in the waters due to the prevailing seasons. For a large geographic area in one fish species that lives separate, different eating habits may occur. This difference is not only for one size but for all sizes, one species of fish with the same size in different areas, their eating habits can be different. This is clear difference for fish species that live in freshwater areas. Food composition analysis data on the stomach of fish caught in the Sebangau river can be seen in Figure 3. The type of food contained in the stomach of the fish caught in the Sebangau river from 9 types of fish that are analyzed, the dominant food composition which become the food of the fish,

For Toman fish and Sepat fish, the type of foods are not identified because all the contents of the stomachs are empty. The analysis result of food types from the stomach of fish caught in the Sebangau river, based on the food composition, dominated by 72-99% fry and plants or seeds 52-72%, classified as all-eating fish (omnivorous) and meat-eating fish (carnivores) and included in predatory fish type.

The difference of food composition in the fish stomach for each type of fish is very closely related with the availability of feed in nature and environmental conditions, where the fish can utilize the feed in the waters. The following are pictures of the types of foods that come from the fish stomach which are identified, namely insects, fish and plants (grains). Tambakan fish are omnivorous fish that are willing to eat almost any types of foods. The foods are varied, from mosses, aquatic plants, zooplankton, to aquatic insects.

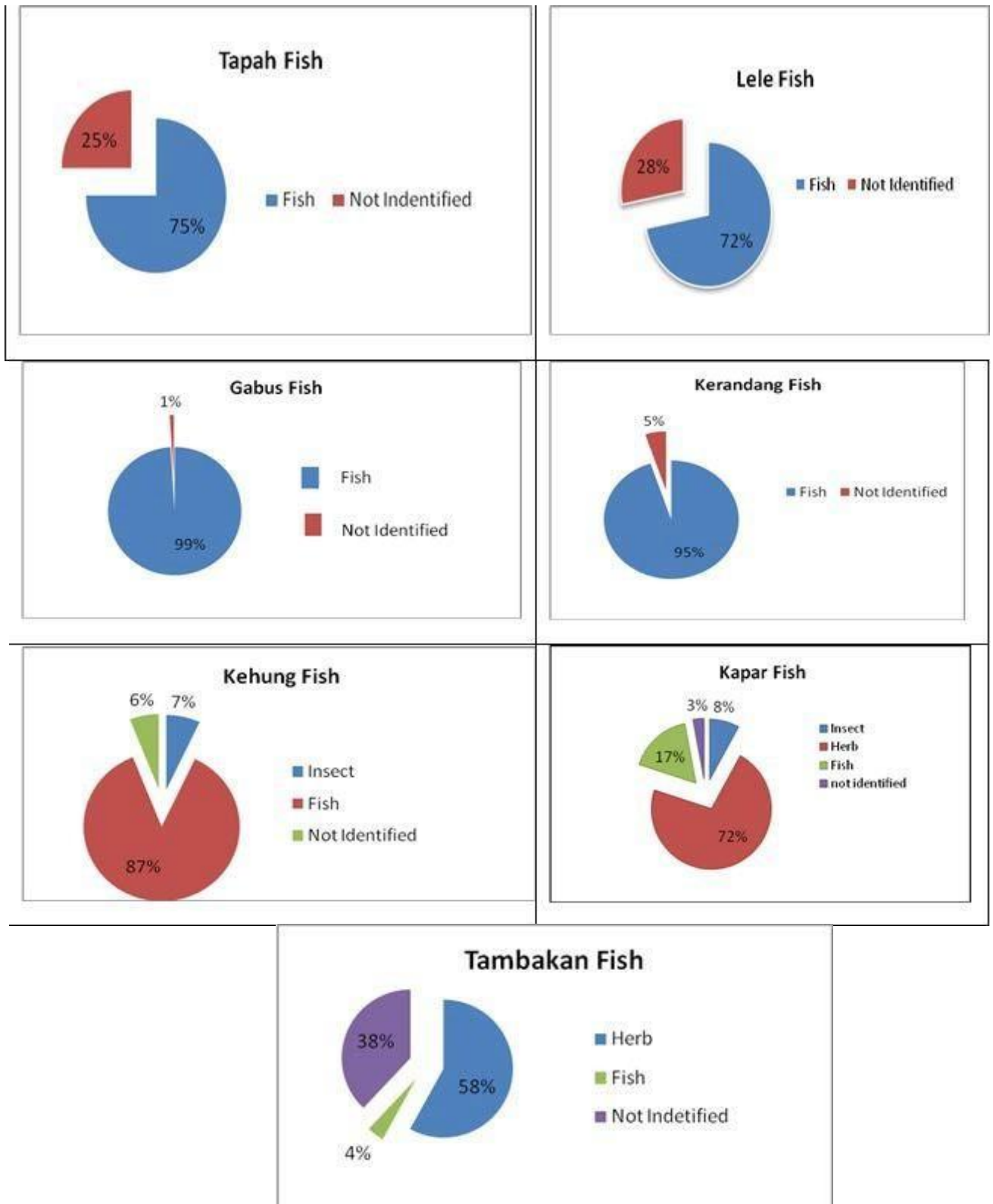


Figure 3. Diagram of the food composition contained in the fish stomach



**Figure 4.** Types of foods that are contained in the stomach of fish caught in the flood runoff ecosystem of the Sebangau river (insects, fry, grain).

These fish have a wide distribution along the Sebangau river and are an important component in the black water flood runoff ecosystem. These fish make the black water flood runoff ecosystem, as a habitat during the fish life cycle, especially in trees habitus, herb and grass as enlargement areas during the larval stage and then will migrate to the shrub, bush and nearby liana habitus for adult fish, so this shows the existence of the relationship of water biota migration between the three habitus in the black water flood runoff waters of the Sebangau River, especially fish. This habitat plays a role in the life of migrating organisms, especially fish, by making the habitat of an adaptation to avoid predators and also to meet the body's needs for growing by utilizing the food resources in that habitat.

Fish originating from the Sebangau river also need a strategy when going into the habitat of the Sebangau river flood runoff ecosystem, by following the tide water where in the research location is still influenced by tides and the depth that can be tolerated to be used as habitat that avoided from predators. According to Sheaves (2005), fish have strategies such as following the movement of tides and being at a habitable depth, although this strategy will also be different when facing the risk of predation in the process of migration to other habitats.

From the data above, in March 2020, in the Sebangau river research location; water temperature between 30.53-30.89°C, pH of peat water 3.48-3.69, dissolved oxygen (DO) 4, -62 -4.85 mg / L, and water depth of 1.3 -4.1 meters. Whereas in the data from Table 2, for January 2021, the water temperature was between 29.71-29.93°C, the pH of peat water was 4.05-4.66, dissolved oxygen (DO) 3, -29 -5.66 mg / L, and a water depth of 1.0-3.4 meters.

In an effort to manage fish resources, a variety of information is needed about the existence of these fish resources, such as aspects of biology and ecology. The process of fish life development, which starts from the eggs then hatches into larvae, fry and adult fish that inhabit various habitats, including habitats in the black water flood runoff ecosystem of the Sebangau River, the management efforts so that these fish resources remain sustainable. In providing natural food, riparian vegetation plays an important role (Gumiri et al. 2009). The loss of vegetation of a habitat can be caused by the river flow removal activities, the land in the flood swamp is used for agricultural activities which can cause the loss of riparian vegetation (Siahaan 2004). If one of the habitats in the black water flood runoff ecosystem of the Sebangau River is damaged, so it can result in the discontinuation of one phase of fish life and of course it will be a major impact on extinction. Therefore, management, especially habitat conservation, is urgently needed, including other habitats that have ecological connectivity and literal migration of fish.

**Table 2. Water Quality in the Sebangau river**

No	Parameter	Measurement Results			
		Sta I	Sta II	Sta III	Sta IV
1	GPS	- 2°21'32"S113° 59'42"E	- 2°21'32"S113° 59'42"E	- 2°21'31"S11 3° 59'42"E	-2°21'31"S113° 59'41"E
2	Temperature (°C)	30.57	30.88	30.89	30,53
3	pH	3.56	3.54	3.48	3,69
4	pHmV	176	168	186	190
5	Electrical Conductivity <i>Oxidation Reduction Potential</i> (ORP) pHmV	363	360	382	369
6	<i>Conductivity</i> mS/cm	0,064	0,061	0,065	0,063
7	Turbidity-NTU	15,9	15,3	13,5	15,5
8	Dissolved Oxygen (DO) mg/L	4.82	4,70	4.62	4,85
9	Total of Dissolved Solid (Tds) g/L	0.042	0.040	0.043	0,032
10	Salinity or Water Salinity ppt	0.02	0.03	0.03	0,02
11	Depth (Meter)	1,7	1,3	1,6	4,1

## Conclusions

Several types of fish that live in the black water flood runoff ecosystem of the Sebangau River, experience habitat displacement literally, especially from shallow riverbanks to deep waters, which is indicated by the presence of some vegetation along the Sebangau riverbanks. With the development of the fish life cycle, there are several types of fish that will move their habitat literally to the surrounding ecosystem, which accompanied by the development of body size and to meet the needs of food, which is part of the fish strategy to maximize growth and avoid it. Therefore, the integrated conservation of related ecosystems is needed.



## References

1. Agus D. U dan Dadik Prasetyo. 2005. Evaluasi Hasil Tangkapan Beberapa Kegiatan Penangkapan Ikan Di Sungai Barito, Kalimantan Tengah dan Selatan. JPPI Edisi Sumber Daya dan Penangkapan Vol.11 No.2. Page 9-27.
2. Effendie, M.I.1997. Biologi Perikanan. Yayasan Pustaka Nusantara. Bogor.
3. Effendi, H, 2003. Telaah Kualitas Air. Kanisius: Yogyakarta.
4. Fidra M.U., Hasrun L. O., Adharani N dan Herdiana L. 2016. Perpindahan Ontogenetik Habitat Ikan Di Perairan Ekosistem Hutan Magrove. Media Konservasi Vol. 21 No. 3: 304-309.
5. Gumiri S. Ardianor. Torang I. Minggawati, I. 2009. The Conservation strategy for fishery in tropical oxbow lake ecosystems : A case study on the diet of Ompok hypoplthamus in Lake Dapur, Central Kalimantan-Indonesia.
6. 16th Asian Symposium on Ecotechnology. Dalian Neusoft Institute of Information, Dalian, China. 129 pp.
7. Melta R. F. 2010. Phenotypic plasticity Kunci Sukses Adaptasi Ikan Migrasi : Suti Ikan Sidat (*Anguilla* sp).
8. Prosiding Forum Inovasi Teknologi Aquakultur. Hal 9-17
9. Minggawati I, Mardani, Marianty R. 2020. Aspek Biologi Dan Manfaat Ekonomi Ikan Yang Tertangkap Di Sungai Sebangau Kota Palangka Raya, Kalimantan Tengah. Jurnal Ziraah. Vol. 45. No. 3.
10. Sheaves M. 2005. Nature and consequences of biological connectivity in mangrove systems. Marine Ecology Progress Series. 302: 293-305.
11. Siahaan R. 2004. Pentingnya Mempertahankan Vegetasi Riparian. Sekolah Pasca Sarjana/S3 Institut Pertanian Bogor. Paper, 8 pages
12. Snover ML. 2008. Ontogenetic habitat shifts in marine organisms: influencing factors and the impact of climate variability. Bulletin of Marine Science. 83(1).
13. Sulistiyarto B., Soeharma D., Rahardjo M.F., Sumardjo. 2007. Pengaruh Musim Terhadap Komposisi Jenis dan Kemelimpahan Ikan di Rawa Lebak, Sungai Rungan, Palangkaraya, Kalimantan. Biodiversitas Journal vol. 8 no. 4. (page 270-273).