BIODIVERSITAS
Volume 18, Number 2, April 2017
Pages: 623-632

ISSN: 1412-033X
E-ISSN: 2085-4722
DOI: 10.13057/biodiv/d180225

A biophysical observation of Mahakam River around Tanjung Una of Kutai Kartanegara, Indonesia

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Manuscript received: 11 September 2016. Revision accepted: 23 March 2017.

Abstract. *Suyatna, I, Mislan. A. Rahman A. Winta Wijaya YI. 2017. A biophysical observation of Mahakam River around Tanjung Una of Kutai Kartanegara, Indonesia. Biodiversitas 18: 623-632.* The aim of this study is to dig up more information about the biophysical conditions of Mahakam River around Tanjung Una of Kutai Kartanegara, Indonesia including the fishery potential in these locations. The observations were conducted in two periods. Through field surveys, the sample of fish and shrimp were caught with pulled nets from many stations, while to know the water quality around the location of the observation, water sampling was conducted and then the sample was brought to a laboratory to be analyzed in order to find out its quality. On the scale of taxonomy and ecology, community structure of fish and shrimp from 21 species of fish consisted of 17 families, five orders, and one class. For the shrimp, it was only four identified species of the genus *Macrobrachium* family Palaemonidae and genus *Metapenaeus* family Penaeidae ordo Decapoda class Malacostraca. The distribution of the length and weight of fish and shrimp was found out to be small. The value of the diversity index between the fish and shrimp showed low to moderate with a value of D: 0.150 to 0.601; H': from 0.986 to 2.089, E: 0.268 to 0.621 and Margalef: 1,475-2,345 for the fish and a value of D: 0.325 to 0.688, H': from 0.615 to 1.205, E: 0.462 to 0.834 and Margalef: from 0.490 to 0.614 for the shrimp. The index indicated that there were species that tend to dominate other species. The species richness was low. Physical-chemical properties and heavy metal content in the Mahakam River around Tanjung Una were generally still below the quality standard. The observations concluded that the number of marine fish species was found two times higher than the river fish species, but not to the number of population.

Keywords: Kutai, Mahakam River, river fish, Sanga-sanga

INTRODUCTION

Mahakam River is the largest and longest river in East Kalimantan; even it is one of the longest rivers in Indonesia (more than 900 km long). Until now, 72.82% of people still regard the river as a garbage dump (Supinganto and Budiana 2015). In East Kalimantan province, there has been started a construction of a dam on the river, namely on the north side of it and according to Yi et al. (2010) dam may disrupt migration fish (*ruaya fish*), and especially, the life cycle of diadromous fish with the population of less than 20% (>20%) of overall population (Liermann 2012). Pranoto and Suripin (2012) states that dam-shape reservoir has some functions namely as flood control, power generator, irrigation and water supply, and the building itself can reduce the impact of the water flow on the river sedimentation.

Mahakam River and its flooding area like the lakes in the Central Part of Mahakam and delta at the downstream of Mahakam have important natural resources for daily economic needs for the people living in the vicinity. It was used as the fishing, fish farming, sand mining and water transportation and river crossings (Suyatna 2007). It is known that the condition of the Mahakam River began to change in 1970 since the logging of forests (deforestation) to produce logs. The hardest disruption to the river is estimated to be happened in the next 10 to 15 years after the commencement of the activities of oil palm plantations and coal mines. Some of the specific activities undertaken in upstream areas have been identified to lead to the increase of sediment load (Buschmans et al. 2011; Porter-Bolland et al. 2011), such as oil palm plantation activities and coal mines (Obidzinski et al. 2012). East Kalimantan has lost most of its moist forests due to massive logging in the 1970s to the 1990s (Jorde 2013). The river is not only influenced by human activities but also by nature such as climate. According to Nizar et al. (2014), the climate does not only affect the biophysical condition of the river but also the lives of river. The fish community structures, such as diversity and distribution, are known to be quite high during the rainy (in March) and in the transition season (in May), and low in the dry season (in July) but with high dominance during the dry season. The study of the impact of oil palm plantation and mining has been done by Rashid et al. (2014) in West Kalimantan and Papua. The research results indicate the occurrence of soil erosion and water contamination.

One of the regencies that have mining concessions in East Kalimantan is Kutai Kartanegara. Sanga-sanga is one of its subdistricts that have five wards. This subdistrict is

one of the regions producing oil and natural gas that are very important in East Kalimantan since the discovery of oil wells "Louise" in 1897, besides the oil wells "Mathilde" which is located in Balikpapan and up to now, its reserves of petroleum and natural gas is still exploited by Oil Company. As a form of concern on the environment, oil and gas companies have been doing various activities such as planting trees around the company both on land and in the river banks to prevent erosion and abrasion. Moreover, in the area around the village of Sanga-sanga Muara, there can be found the threatened primates, Bekantan. Some surveys on the type, density and habitat of this primate have been conducted, especially in Tanjung Una which is planned to be Bekantan tourism area. Tanjung Una is a small island located in the middle of the Mahakam River. To extend the information of the river, the surveys on biophysical and fishery potential of Mahakam River are conducted and through this survey, it is expected that the data about Tanjung Una could be collected extensively, since the government have made plan to make the Sanga-sanga Muara Village as a tourism area for proboscis monkey, *Nasalis larvatus* (Wurmb, 1787).

MATERIALS AND METHODS

The survey activities were conducted in May 2014 in the Mahakam river in the village of Sanga-sanga and Sari Jaya, Subdistrict of Sanga-sanga, Kutai Kartanegara District, East Kalimantan, Indonesia. The fish and water sampling were conducted in Mahakam river and between Mahakam river and its tributaries (1st period) and it was repeated in August 2015 in tributaries of Mahakam River (2nd periods) as shown in Figure 1. Samples of fish were collected using dragging nets (mini trawl) with net pulling time of 10 minutes. The coordinates of sampling points were recorded using a Global Positioning System (GPS), 117°19'32" E and 0°37'55" S in Mahakam river, 117°16'53" E and 0°35'55" S at the mouth of a tributary of Mahakam River and 117°14'53" E and 0°37'22" S on the tributary of the Mahakam River.

In the laboratory, fish were classified to each species, their individuals were counted, and their length and weight were measured. The length of fish was measured using a measuring instrument with mm accuracy, and a digital scale with the accuracy 0.01 g was used to weight the fish and shrimps, then they were photographed for documentation using a digital camera.

Water samples were taken to be analyzed in the laboratory to determine the physical and chemical properties of water. At around fish and shrimp sampling stations, the depth of the river was measured using echo-sounder to obtain the profile of the river base.

To calculate the diversity index, the Past software version 3.0 was used. To analyze the similarity of the number of individuals and the number of biota species between river fish and marine fish, Bray-Curtis index was used (Wolda 1981). Fish identification refers to Kottelat et al. 1992; Chakrabarty et al. 2008; Seah et al. 2009; Iqbal 2011; Matsunuma et al. 2011; Anam and Mostarda 2012.

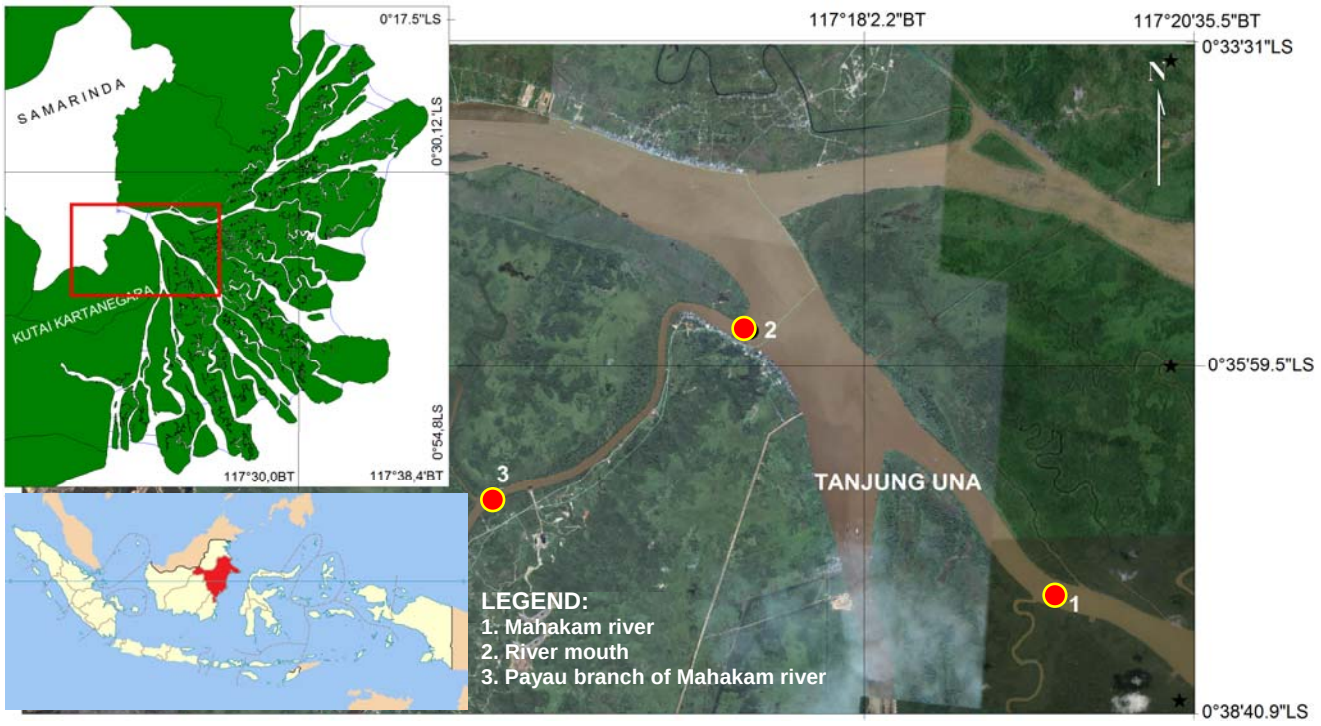

Figure 1. The geographical location of the sampling point of fish and shrimp in the Mahakam River around Tanjung Una, Subdistrict of Sanga-sanga, Kutai Kartanegara District, East Kalimantan, Indonesia

RESULTS AND DISCUSSION

The structure of biota community

Taxonomically, the observation resulted in 21 species of fish consisting of 17 families, 5 orders, and 1 class. For shrimp, there were found four species of the genus *Macrobrachium*, family Palaemonidae and genus Metapenaeus, family Penaeidae, ordo Decapoda, class Malacostraca that were presented in Table 1. Table 2, 3 and 4 are the combination of several biological samplings. For Table 2 and 3, they are done in the same period, but in different stations, while Table 4 is done at different period.

The observation and identification of fish caught in Mahakam River around Tanjung Una show that most of the fish comes from the sea. Thus, generally and ecologically, the species of fish found in the Mahakam River, especially around Tanjung Una comprises two groups, group of river fish and group of marine fish. The fish is same with the fish caught in the mouth of the Mahakam delta at salinity of 1.3 to 33.0‰ (Suyatna et al. 2010). In addition, Juliani and Suyatna (2014) found the species in the coastal waters of Sangatta in salinity of 20.2 to 33.0‰. *Otek, Baung, Ikan Sebelah, Puput, Gulamah, Bilis, Ikan Bulu Ayam, Ikan Kaca, Pepetek* and *Buntal* are found in saltwater (Sriwidodo 2013; Khatib 2015; Farrag et al. 2016). Archerfish (*Ikan Sumpit*), that tends to swim in surface in order to spurt its insects prey as food, lives in its habitat around the mangrove, estuary and river (Simon et al. 2013). *Tempakul* fish (Gobi) can live in the rivers or near the sea as reported by Hermosilla et al. (2012). As much as 98% of all catches made during the year in the mouth of Obitsugawa River is fish genus Gymnogobius family Gobiidae. While the fish species such as *Tikusan* fish, *Lidah* fish, *Sebelah* fish, *Pepetek* fish and *Gulamah* fish are found in Johor bay Singapore for the first time (Ng et al. 2015). All species of fish is caught in the survey locations and is also commonly found in the lake including *Lais* fish, *Wader* fish, *Tikusan* fish and *Patin*. *Lais* fish has six species namely *Kryptopterus limpok, K. cryptopterus, K. schilbeies, K. hexapterus, Hemisilurus moolenburghi* and *K. bicirrhis*. *Patin* lives in the river, and there were about 14 species lived in Indonesia but due to the intense catches, their population has continued to decline and in some areas, it has already been categorized into protected fish, but the effort of cultivation for accelerating growth process still continues through a test of adding cinnamon leaf for additional feed (Setiawati et al. 2016). On the study site, one species is identified as a member of the family Carangidae namely *Carangoides* sp. which is commonly found in the sea with quite high salinity (about 30‰). According to Hugueny et al. (2010) the dynamic and the structure of sea and river fish community can not be

Table 1. The result of observation on fish and shrimp species from the Mahakam River around Tanjung Una of Kutai Kartanegara, Indonesia

Species	Family	Order	Class
Fish			
Kaca (*Ambassis* sp.)	Ambassidae	Perciformes	Actinopterygii
Beseng (*Apogon* sp.)	Apogonidae	Perciformes	Actinopterygii
Baung (*Arius* sp.)	Ariidae	Siluriformes	Actinopterygii
Otek (*Mystus* sp.)	Bagridae	Siluriformes	Actinopterygii
Tikusan (*Bagrichthys* sp.)	Bagridae	Siluriformes	Actinopterygii
Trakulu (*Carangoides* sp.)	Carangidae	Perciformes	Actinopterygii
Lidah (*Cynoglossus* sp.)	Cyglossidae	Pleuronectiformes	Actinopterygii
Wader (*Puntioplites* sp.)	Cyprinidae	Cypriniformes	Actinopterygii
Bilis (*Thryssa* sp.)	Engraulidae	Clupeiformes	Actinopterygii
Bulu Ayam (*Setipinna* sp.)	Engraulidae	Clupeiformes	Actinopterygii
Teri (*Stolephorus* sp.)	Engraulidae	Clupeiformes	Actinopterygii
Ikan Gobi (*Amoya* sp.)	Gobiidae	Perciformes	Actinopterygii
Petek (*Leiognathus* sp.)	Leiognathidae	Perciformes	Actinopterygii
Petek (*Secutor* sp.)	Leiognathidae	Perciformes	Actinopterygii
Patin (*Pangasius* sp.)	Pangasidae	Siluriformes	Actinopterygii
Puput (*Pellona* sp.)	Pristigasteridae	Clupeiformes	Actinopterygii
Sebelah (*Psettodes* sp.)	Psettodidae	Pleuronectiformes	Actinopterygii
Gulamah (*Jhonius* sp.)	Sciaenidae	Perciformes	Actinopterygii
Lais (*Kryptopterus* sp.)	Siluridae	Siluriformes	Actinopterygii
Buntal (*Tetraodon* sp.)	Tetraodontidae	Tetraodontiformes	Actinopterygii
Sumpit (*Toxotes* sp.)	Toxotidae	Perciformes	Actinopterygii
Shrimp			
Udang Galah (*Macrobrachium* sp.)	Palaemonidae	Decapoda	Malacostraca
Udang Galah Rospen (*Macrobrachium* sp.)	Palaemonidae	Decapoda	Malacostraca
Udang Galah Batu (*Macrobrachium* sp.)	Palaemonidae	Decapoda	Malacostraca
Udang Bintik (*Metapenaeus* sp.)	Penaeidae	Decapoda	Malacostraca

Table 2. Species, number of individuals and the average of length-weight of four times sampling from the Mahakam River around Tanjung Una of Kutai Kartanegara, Indonesia and its tributary (1st Period, 2014)

Species	Number of individuals	Length (cm)	Weight (g)	Habitat
Fish				
Baung (*Arius* sp.)	22	4.4-25.0	1.0-251.5	River
Bilis (*Thryssa* sp.)	27	6.5-15.5	3.0-40.0	Sea/Brackish river
Buntal (*Tetraodon* sp.)	20	3.0-6.5	2.0-15.5	Sea/Brackish river
Gulamah (*Jhonius* sp.)	8	5.0-11.5	5.0-27.0	Sea/Brackish river
Ikan Gobi (*Amoya* sp.)	4	7.0-8.1	5.5-8.0	Sea/Brackish river
Lais (*Kryptopterus* sp.)	8	8.2-20.0	5.0-40.0	River
Otek (*Mystus* sp.)	3	12.0-20.0	21.5-91.5	Sea/Brackish river
Patin (*Pangasius* sp.)	6	5.0-19.0	1.0-42.0	River
Puput (*Pellona* sp.)	5	9.5-10.6	11.5-17.0	Sea/Brackish river
Wader (*Puntioplites* sp.)	344	5.5-13.5	4.5-72.5	River
Total number of fish	447			
Shrimp				
Udang Galah (*Macrobrachium* sp.)	15	5.5-14.0	1.0-29.0	River
Udang Galah Rospen (*Macrobrachium* sp.)	109	2.1-6.4	0.1-3.5	River
Udang Galah Batu (*Macrobrachium* sp.)	1	8.3	5.8-6.0	River
Udang Bintik (*Metapenaeus* sp.)	8	3.2-6	0.5-2.5	Sea/Brackish river
Total number of shrimp	133			
Total	580			

Table 3. Species, number of individuals and the average of length-weight of fish and shrimp from three times sampling of the Mahakam River around Tanjung Una of Kutai Kartanegara, Indonesia (Period 1, 2014)

Species	Number of individuals	Length (cm)	Weight (g)	Habitat
Fish				
Baung (*Arius* sp.)	49	10.2-35.0	8.1-302.0	River
Bilis (*Thryssa* sp.)	5	8.5-11.5	3.4-9.4	Sea/Brackish river
Buntal (*Tetraodon* sp.)	22	3.5-7.5	1.7-11.5	Sea/Brackish river
Gobi (*Amoya* sp.)	12	4.8-15.0	3.2-15.9	Sea/Brackish river
Gulamah (*Jhonius* sp.)	44	7.8-15.0	8.0-32.0	Sea/Brackish river
Kaca (*Ambassis* sp.)	9	7.3-11	6.0-17.0	Sea/Brackish river
Lais (*Kryptopterus* sp.)	21	6.5-24.0	2.2-57.4	River
Otek (*Mystus* sp.)	18	10.0-2.5	7.7-110.5	Sea/Brackish river
Patin (*Pangasius* sp.)	1	7.3	4.0	River
Puput (*Pellona* sp.)	0	0	0	Sea/Brackish river
Sebelah (*Psettodes* sp.)	1	11.0	15.8	Sea/Brackish river
Sumpit (*Toxotes* sp.)	1	13.0	41.1	Sea/Brackish river
Tikusan (*Bagrichthys* sp.)	1	17.8	29.9	River
Wader (*Puntioplites* sp.)	20	7.6-12.0	6.6-22.7	River
Shrimp				
Udang Galah (*Macrobrachium* sp.)	71	4.5-24.0	0.8-167.8	River
Udang Galah Rospen (*Macrobrachium* sp.)	195	3.7-7.0	0.7-3.9	River
Udang Galah Batu (*Macrobrachium* sp.)	19	7.2-9.7	4.1-12.4	River
U.Bintik (*Metapenaeus* sp.)	1	8.0	8.9	Sea/Brackish river
Total number of shrimp	286			
Total number	490			

predicted or understood only by the interaction with the nature of the local habitat. It is also described by Muchlisin and Azizah (2009) that the nature of the group of river fish greatly varies, as they have reported about the discovery of 41 families from five locations. Five families are found all over the place while other five families are only found in one place.

Table 4. Species, number of individuals and the average of length-weight of fish and shrimp from three times sampling of the Mahakam River around Tanjung Una of Kutai Kartanegara, Indonesia (2nd Period, 2015)

Species	Number of individuals	Length (cm)	Weight (g)	Habitat
Fish				
Otek (*Mystus* sp.)	43	4.8-22.0	0.6-88.7	Sea/Brackish river
Wader (*Puntioplites* sp.)	279	6.5-9.4	2.5-35.2	River
Gulamah (*Jhonius* sp.)	63	5.1-15.5	1.0-30.7	Sea/Brackish river
Baung (*Arius* sp.)	41	4.1-18.8	13.5-222.8	River
Gobi (*Amoya* sp.)	16	8.2-21.1	2.0-59.8	Sea/Brackish river
Buntal (*Tetraodon* sp.)	21	4.0-12.2	2.0-59.8	Sea/Brackish river
Puput (*Pellona* sp.)	13	6.0-15.5	2.0-26.9	Sea/Brackish river
Bilis (*Thryssa* sp.)	53	4.8-20.4	2.0-63.7	Sea/Brackish river
Kaca (*Ambassis* sp.)	3	5.6-12.6	2.5-15.6	Sea/Brackish river
Petek (*Leiognathus* sp.)	37	4.5-8.4	1.4-9.6	Sea/Brackish river
Petek (*Secutor* sp.)	12	3.2-5.7	0.5-1.9	Sea/Brackish river
Teri (*Stolephorus* sp.)	2	4.3-7.0	0.5-2.1	Sea/Brackish river
Lidah (*Cynoglossus* sp.)	2	7.2-15.8	3.8-43.7	Sea/Brackish river
Beseng (*Apogon* sp.)	6	6.8-9.0	3.4-7.0	Sea/Brackish river
Bulu Ayam (*Setipinna* sp.)	2	8.5-10.7	2.0-5.0	Sea/Brackish river
Trakulu (*Carangodies* sp.)	7	6.3-8.2	3.6-7.4	Sea/Brackish river
Total number of fish	600			14
Shrimp				
Udang Galah (*Macrobrachium* sp.)	163	2.3-15.7	0.5-82.6	River
Udang Galah Rospen (*Macrobrachium* sp.)	22	2.5-5.9	0.6-6.0	River
Udang Galah Batu (*Macrobrachium* sp.)	92	3.8-17.0	1.5-105.4	River
Udang Bintik (*Metapenaeus sp*.)	178	2.0-7.7	0.3-7.4	Sea/Brackish river
Total number of shrimp	455			
Total	1055			

Unlike fish, only four species of shrimp, from two genera, are found. Either the number of species or the number of individuals, Udang Galah gets higher result than Udang Brintik. All of the shrimp species lives in river or in brackish. Shrimp is a water biota that is particularly vulnerable because it is a living food for many species of predatory fish. Therefore, shrimp needs shelter to increase its survival (Priyono et al. 2011). Population decreases so quickly due to the high frequency of catching. To overcome this, restocking is usually done. A restocking is conducted to restore an ecosystem and it was being tested by Obolski et al. (2016). Udang Galah is amphidromous. During the rainy season, the adult female shrimps swim to the sea (migrate) to release their eggs. After they hatch and grow into larvae, these larvae swim back to upstream or to their habitat in the dry season along the side of the river (Bauer 2016).

In general, the result of calculating the diversity index of community structure of fish and shrimp showed diversity between low to moderate. There is a tendency of one species to dominate other species and it makes the species richness low (Table 5). According to Wambold et al. (2011), the higher number of factors, both abiotic and biotic, in an environment the higher the effect on the composition of a community.

The comparison results of fish populations from sampling activity in Mahakam River and in around the confluence of Mahakam River and Mahakam tributary showed almost no different. The similar condition happens to the comparison results of river fish and marine fish after being separated. The species number of marine fish in the Mahakam River around Tanjung Una is two times higher than the river fish species. Both fish and shrimp which were found during the observation are at a small size, namely larvae-size fish and baby fish size. Based on the shrimp population between stations on 1st period (Mahakam river and around the Mahakam river and its tributaries), the difference is quite high, while between the period (P1 and P2), it shows almost the same (Table 6).

Water quality

Good water quality is necessary for the life of biota in the water. Many factors affect the quality of the water river, namely, dense settlements, passenger port, the port of loading and unloading of coal, the high frequency of vessel traffic including coal pontoon and the pontoons mooring, and these factors are found at the study site. Djiriéoulou et al. (2014) reported that from the result of fish and shrimp catching activity which is done once a month, the highest abundance of fish and shrimp is found at location that is far from the waste location of processed palm oil. Therefore, it became really important to do an analysis of the water quality given the condition at the research site. The results of the analysis of water samples to determine the physicochemical properties of the waters around the location of the observation are presented in Table 7.

Table 5. The diversity Index of community structure of biota of Mahakam River around Tanjung Una, Sanga-sanga Subdistrict, Kutai Kartanegara District, East Kalimantan, Indonesia

Periods	No. of species	No. of ind.	D	H'	E	Marga lef
Fish						
1.1	10	447	0.601	0.986	0.268	1.475
1.2	13	204	0.150	2.089	0.621	2.256
2.1	16	600	0.252	1.908	0.421	2.345
Shrimp						
1.1	4	133	0.688	0.615	0.462	0.614
1.2	4	286	0.531	0.807	0.560	0.530
2.1	4	455	0.325	1.205	0.834	0.490

Note: two times survey were undergone on 1st Period, one-time survey was undergone on 2nd Period

Table 6. Bray-Curtis Index of fish population among period, the population and the species number of river fish and marine fish around Tanjung Una, Sanga-sanga Subdistrict, Kutai Kartanegara District, East Kalimantan, Indonesia

	Dissimilarity	Similarity
Fish		
Fish population between stations on P1	0.0783	0.9217
River fish and Marine fish population on P1 and P2	0.2672	0.7328
The number of River fish and Marine fish species on P1 and P2	0.5238	0.4762
Shrimp		
Shrimp population between stations on P1	0.3652	0.6348
Shrimp population between 1st Period and 2nd Period	0.0412	0.9588

Table 8. The structure of plankton communities from each sampling points in the Mahakam River around Tanjung Una, Sanga-sanga Subdistrict, Kutai Kartanegara District, East Kalimantan, Indonesia.

Index	Sampling point 1	Sampling point 2	Sampling point 3
Diversity (H')	2.05	1.77	1.91
Uniformity (E)	0.98	0.99	0.98
Domination (D)	0.13	0.17	0.16

Based on laboratory analysis, both physical-chemical contents and heavy metal content in the waters around Tanjung Una are generally still below the quality standard even though the surrounding areas are densely populated and agricultural activities are active. Ambedkar and Muniyan (2012) found a concentration of heavy metal Cd in river fish exceeding the quality standard. It is also reported by Opaluwa et al. (2012) and Klake et al. (2012) that heavy metals such as Zn, Pb, Fe, Mn, Cd and Hg in the sediment and in the water exceeded the quality standard though it can still be tolerated, and it is suggested to monitor it regularly since these metals have long-term effects. In the research area, the river has its ups and downs twice each day. Therefore, part of the Mahakam River encounters dilution and also receives submissions water each time from upstream, so it helps to stabilize the water conditions. It can be seen from the results of water quality analysis of the study sites showing good water conditions which is indicated by high concentration of nutrients such as phosphate from 0.17 to 0.20 mg/L, nitrates from 1.02 to 1.18 mg/L and DO from 5.86 to 6.60 mg/L, with temperature from 29,1° - 30,2°C, but the abundance of plankton is only about 250 individuals / l. While, the research results from Simanjuntak (2009) in a study found that concentrations of phosphate and nitrate have much smaller number namely 0.013 to 0.028 mg/L and 0.007 to 0.015 mg/L, DO from 4.09 to 4.52 mg/L and the water temperature of 28.85 -29.55°C and low plankton abundance is only about 39.0 ind./L. Thus, the Mahakam River around Tanjung Una is still suitable as organism life-sustaining, though many activities having the potential for river pollution are there in the vicinity. The results of the analysis of plankton reinforce this point because of its abundance indicates a near-uniformity in size of the population, otherwise, if there is a bad environmental condition, only certain species may grow significantly (blooming). In all plankton sampling points, six species of phytoplankton and five species of zooplankton were identified. The abundance of phytoplankton and zooplankton for each sampling point is presented in Figure 2 and their community structure is presented in Table 8. Phytoplankton species of Chlorophyceae family are scattered throughout the sampling points, but only two species of zooplankton species are found in the sampling points. According to Veronica et al. (2014), an abundance of plankton is strongly influenced by the environmental conditions, including predation by zooplankton or by herbivores fish.

The depth of the river

The results of river sounding on Mahakam River, especially in the location of fish and shrimp sampling as well as water sampling showed that the water depth ranges between 6.0-11.0 m. The detailed profile of measured river is presented in Figure 3 and 4.

Generally, species of fish can live in various places, but they, specifically, occupy a particular place. Costa et al. (2013) caught 1223 fishes of seven species in four rivers with different depths (> 8 m) and wide range of conditions. 70% of the fishes were caught from river with depth of <4 m and had a weight of 64% of overall weight. Lakra et al. (2010) added that the species richness of river fish with hydrology attributes positively correlated to the depth of water affecting DO concentration and pH to determine the fish gathering.

Table 7. The conditions of Mahakam River water quality around Tanjung Una, Sanga-sanga Subdistrict, Kutai Kartanegara District, East Kalimantan, Indonesia

Parameter	Sampling point			Standard Quality *)	
	1	2	3	Kelas I	Kelas II
Physic					
Temperature (^oC)	29.1	29.2	30.2	deviasi3	deviasi3
Turbidity (NTU)	38.3	37.1	38.7	-	-
Color (mg/L PtCo)	62	58	53	100	180
TSS (mg/L)	38.8	18.75	37.5	50	50
TDS (mg/L)	71.3	70	81.25	1000	1000
DHL, uS	72.1	62.3	77.1	-	-
Chemical					
pH	6.2	6.13	6.01	6 – 9	6 – 9
Dissolved Oxygen (DO, mg/L)	6.6	6.43	5.86	6	4
BOD_5 (mg/L)	3.4	2.31	3.81	2	3
COD (mg/L)	32.5	24.14	36.74	10	25
Total of Water hardness ($CaCO_3$, mg/L)	30.1	39.42	39.42	50	50
Ammonia	0.1	0.12	0.11	0.5	-
(NH_3-N), mg/L	0.1	0.12	0.11	0.5	-
Nitrite (NO_2-N), mg/L	0.01	0.01	0.01	0.06	0.06
Nitrate (NO_3-N), mg/L	1.18	1.02	1.09	10	10
Phosphate (PO_4-P), mg/L	0.19	0.19	0.17	0.20	0.2
Sulphate (SO_4), mg/L	10.99	11.44	31.2	400	-
Chloride (Cl^-), mg/L	8.73	4.76	6.15	600	-
Free Chlorine (Cl_2), mg/L	<0.02	<0.02	<0.02	0.03	0.03
Sulfide (H_2S), mg/L	<0.001	<0.001	<0.001	0.002	0.002
Ferrite (Fe), mg/L	0.29	0.28	0.27	0.3	-
Manganese (Mn), mg/L	0.032	0.071	0.043	0.1	-
Arsene (As), mg/L	<0.001	<0.001	<0.001	0.05	1
Cobalt (Co), mg/L	<0.03	<0.03	<0.03	0.2	0.2
Mercury (Hg), mg/L	<0.0005	<0.0005	<0.0005	0.001	0.002
Lead (Pb), mg/L	0.013	0.011	<0.01	0.03	0.03
Zinc (Zn), mg/L	0.005	0.027	0.003	0.05	0.05
Cadmium (Cd), mg/L	<0.001	<0.001	<0.001	0.01	0.01
Copper (Cu), mg/L	<0.01	<0.01	<0.01	0.02	0.02
Fluoride (F), mg/L	0.144	0.134	0.114	0.5	1.5
Boron (B), mg/L	<0.05	<0.05	<0.05	1	1
Barium (Ba), mg/L	<0.02	<0.02	<0.02	1	-
Cyanide (CN), mg/L	<0.01	<0.01	<0.01	0.02	0.02
Hexa Chromium (Cr^{6+})	<0.01	<0.01	<0.01	0.05	0.05
(Cr^{6+}), mg/L	<0.01	<0.01	<0.01	0.05	0.05
Detergent (MBAS), mg/L	0.012	0.012	0.012	0.2	0.2
Oil and fat, mg/L	<0.1	<0.1	<0.1	1	1
Phenol, mg/L	<0.001	<0.001	<0.001	0.001	0.001
Microbiology					
Total coliform, MPN/100	240	230	140	1000	5000
E. coli, MPN/100	90	40	40	100	1000

Note: 1 = Mahakam River, 2 = between Mahakam River and its tributaries, 3 = Mahakam River tributaries. * = Regional Regulation of East Kalimantan Province No. 2, Year 2011

The results of biophysical observations on Mahakam River in Tanjung Una which is decided to be Bekantan tourism area in Sanga-sanga Subdistrict show the number of marine fish species is two times higher than the number of river fish species. The number of fish was identified as many as 21 species and shrimp was four species and many of them are economically valuable. Most of the river fish species utilized by fishermen are Putihan fish. Akbar (2014) classifies the river fish into group of Putihan fish and Hitaman fish with the consideration of the size, and the economical value. This shows the potential for excellent fishing and therefore, the Mahakam River in around Tanjung Una can be considered as the breeding place since the caught fish are mostly small (baby fish and baby shrimp), as the feeding area, as protected areas and also as spawning areas for species of fish and shrimp both of river and of marine. Factors causing disturbance of the river fish life and causing damage to the ecosystems are the habitat degradation and destruction of riparian (Cooke, 2012). In Ghana, the threat of fish life is caused by low dissolved oxygen with 0.7 mg/L which is as the effect of abundance of organic materials (Olalekan et al. 2015).

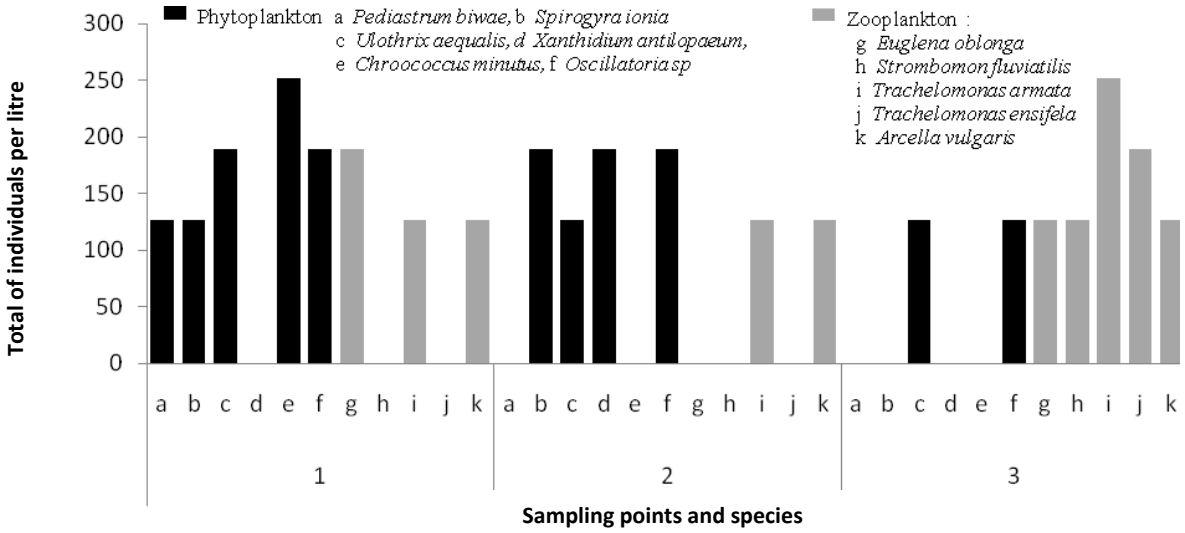

Figure 2. Total (ind./L) and the species of phytoplankton and zooplankton that are found in every sampling point (1, 2 and 3) in Mahakam River, around Tanjung Una, Sanga-sanga Subdistrict, Kutai Kartanegara District, East Kalimantan, Indonesia

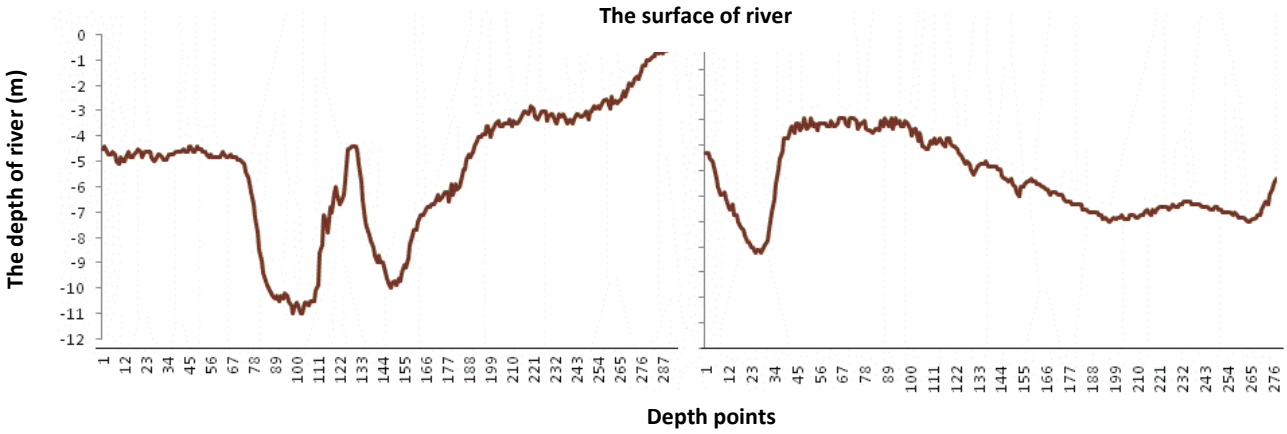

Figure 3. Base topography of Mahakam River, East Kalimantan, Indonesia. The *left* is closest to Tanjung Una with river width of 1.6 km; the *right* is in front of Tanjung Una with river width of 1.3 km

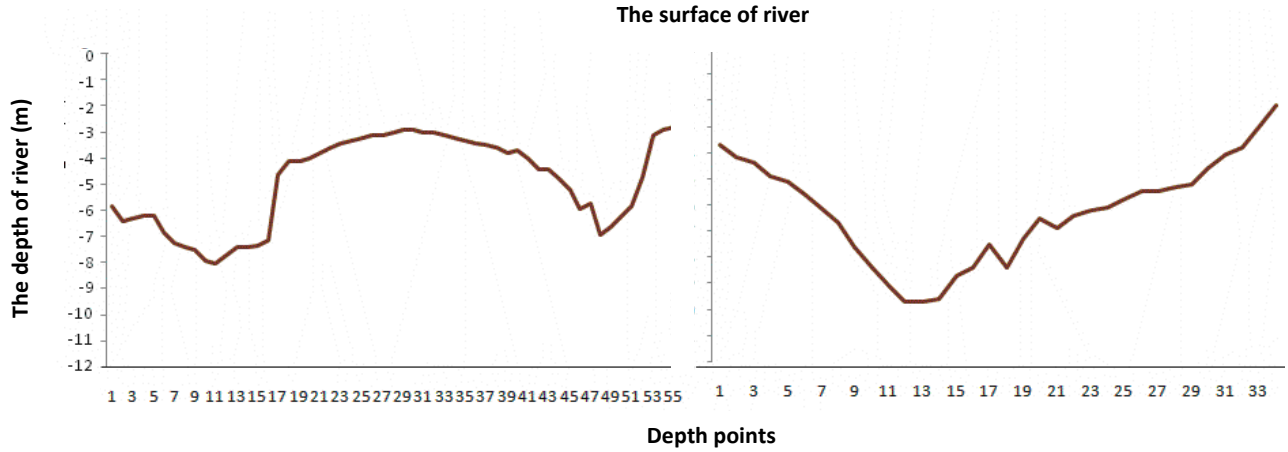

Figure 4. Base topography of Mahakam River, East Kalimantan, Indonesia. The *left* is the estuary of Sungai Payau (a tributary of the Mahakam) with width of 0.28 km; the *right* is Sungai Payau with width of only 0.20 km

ACKNOWLEDGEMENTS

We would like to express our gratitude to the Dean of the Faculty of Fisheries and Marine Sciences and the Dean of Faculty of Mathematics and Natural Sciences of Universitas Mulawarman, Samarinda, Indonesia who has given us the trust to perform these activities. Our gratitude also goes to Pertamina E & P Sanga-sanga, Kutai Kartanegara, Indonesia and Fish Quarantine and Inspection Agency Class I Balikpapan, East Kalimantan, Indonesia for the collaboration and financial support of these activities. And also to the field and laboratory work team for their assistance during the event: Widya Kusumaningrum, M. Raafi, Rusdiansyah, Muhammad Takin, Tedy Hanjoko and Muhammad Bagja Suyatna Britain. And our acknowledgement is also to Erwansyah, a man who gives elucidation on the fishery in Bureau of Agricultural Elucidation and an owner of speedboat and mini-trawl boat.

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