

THE BIODIVERSITY OF PEATLAND WATER IN THE MIDDLE MAHAKAM, KUTAI KARTANEGARA DISTRICT, EAST KALIMANTAN PROVINCE, INDONESIA

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INTRODUCTION

Background

The middle Mahakam region in Kutai Kartanegara district, East Kalimantan province represents the largest freshwater system and with the annual catches of 15,000 to 35,000 MT, it is one of the most productive freshwater artisanal fisheries in Indonesia.

People living in that area caused many negative effects in their local surroundings in particularly to water quality (Jong *et al*, 2015). Since the early 1980s, the middle Mahakam ecosystems have been continuously threatened by other human activities such as mono-crop (oil palm) plantations (WWF 2005).

The open pit coal mining and their jetty facilities are still working and distributed along the river of Mahakam. During the transportation a large amount of coal spills, deposits and distributes as sediments and may reach downstream.

Two activities of oil palm plantation and mainly mining created an increase of sediment load in water and pollution (Buschmans *et al* (2011), Porter Bolland *et al* (2011) and Obidzinski *et al* (2012).

Coal in water may pollute 20 potentially hazardous trace elements (PHTEs) of heavy metals (Zhang *et al* (2004).

Eighteen water samples and eighteen fish samples from two locations i.e., river downstream of Mahakam and coastal water were analyzed at the laboratory to determine 10 heavy metal levels and resulted in Fe was above the allowance limit for both water and fish, fish showed much greater (Suyatna *et al*, 2017).

In the 1980 to 1987 as long as seven years, Christensen (1992) recognized a total of 147 indigenous freshwater fish from the Mahakam River floodplains which were characterized with slow-flowing and faster-flowing rivers, lakes, small water bodies and swamps.

Four years later, in July 1991 Kottelat (1994) performed a similar investigation and he was able to identify 82 fish species obtained from the upstream to downstream and the middle Mahakam.

Aim of the study

The study aimed at knowing aquatic biodiversity around peat land water in the middle Mahakam, Kutai Kartanegara district, East Kalimantan.

MATERIALS AND METHODS

The study was carried out with a pre survey in December 2020 to decide the locations prior to conduct main survey and take water and fish samples. All sampling sites for both water and fish were performed in three periods: January 1 to 4; January 19 to 22 and February 13 to 16, 2021 while water velocity and water depth of sampling sites were measured *in site* using Current meter hydrologic velocity meter and fish finder Portable. Fish were obtained from two locations: lakes and streams/tributaries in the middle Mahakam by using 11 various gears such as Gill Net, Snakehead Pole and Line, Lift Net (“Anco”), Trap Net (“Sawaran” and “Julu”) and Fish Pot (“Tokong”, “Pangilar”, “Bubu Hati”, “Bubu Bamboo” or “Lukah”, “Bubu Paralon” and “Tempirai”). Each water sample was poured into a five liter plastic jerry can without any preservative, then put it inside the cool box before delivering to the laboratory for analysis purposes. The Analysis of samples followed APHA Procedure (1998), and their results related to the Government Regulation of East Kalimantan (Perda Kaltim) No.: 02 Year 2011 Class II. After numbering fish obtained from each gear in the locations, the fish were placed in the cool box for transporting to the laboratory. At the laboratory, fish were identified referring to the field guide book of Kottelat et al (1992), Allen (2000), Peristiwady (2006), and Masuda et al. (1975) in similarly study reports such as Suyatna et al (2010), Suyatna et al (2017a) and Suyatna et al (2017c). On the fish measuring board, fish photographs were taken using the camera Nikon coolpix, while length and weight size were measured by caliper and Krisbow digital precision scale. The PALaeontological Statistics (PAST) version 3.0 calculated fish diversity index for analyzing fish structure community, map of the study was realized by the Map INFO version 10,0, and Catch Per Unit Effort (CPUE) method was made by hand to measure fish abundance in the fishing gears

RESULTS AND DISCUSSION

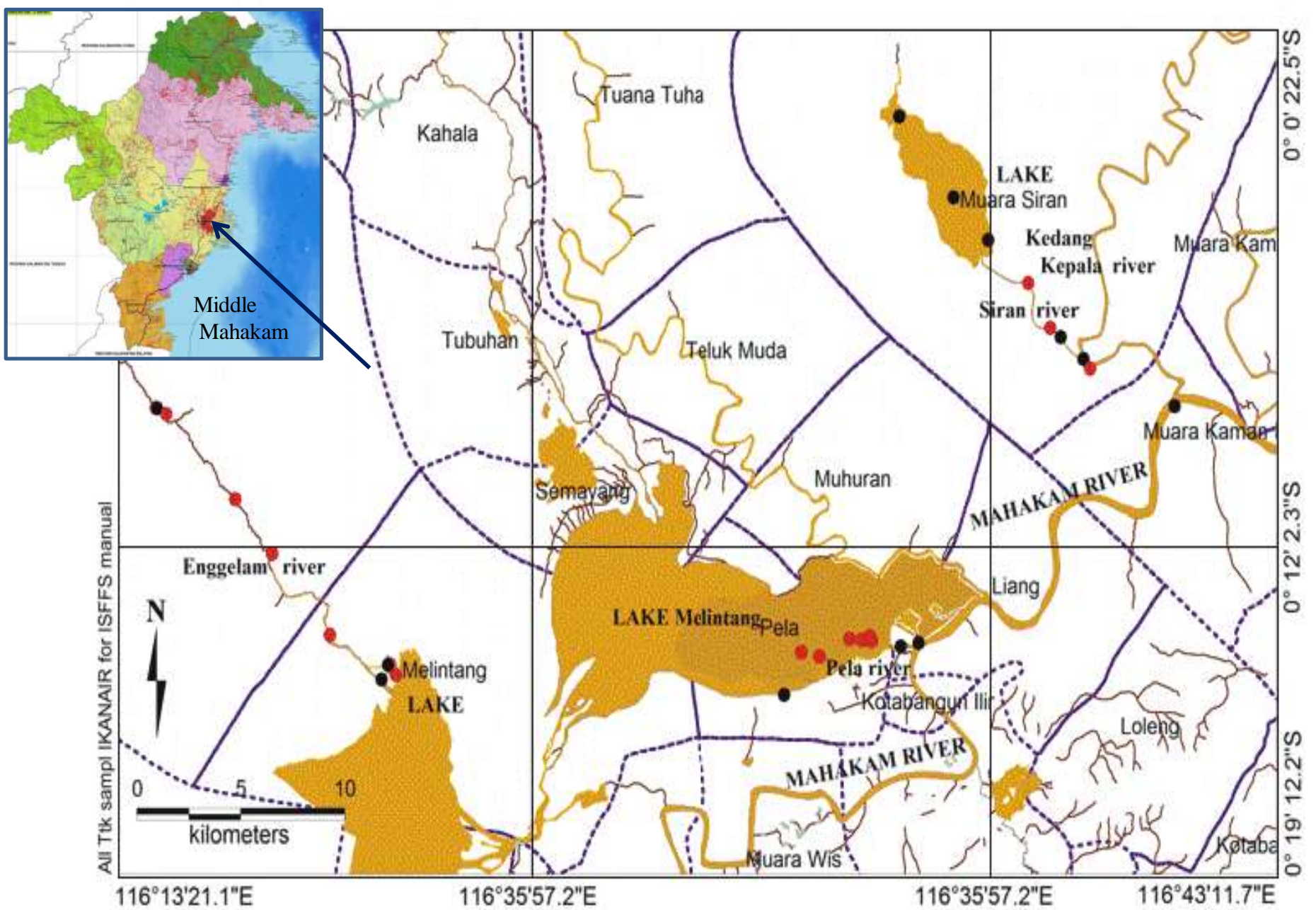


Fig. 1. The distribution of the sampling/measuring sites (black circle: for water sample; red circle: for fish collection)



Figure 2.

Local fishing gears used for fish sampling in the study locations in the middle Mahakam, Kutai Kartanegara, East Kalimantan.

The study succeeded in identification, 50 fish species of the total number 7,377 ind obtained from two locations: lakes and streams/tributaries, which belonging to 19 families, 8 orders and 2 classes were recognized. Among the families, **Cyprinidae** was the most populated and species (1,022 ind and 21 taxa) followed by **Bagridae** (63 ind and five taxa), **Channidae** (53 ind three taxa), **Clariidae** (10 ind three taxa), **Siluridae** (403 ind and three taxa), while other families had just one species. Fish species identified from the two locations are presented in the Tables below.

Table 1. The fish species obtained from lake of Semayang and Melintang in the middle Mahakam, Kutai Kartanegara district, East Kalimantan province

No	Family	Species	Local name	No. ind	Weight
1	Cyprinidae	<i>Osteochilus repang</i>	Repang (Cyprinid)	191	506.9
2	Cyprinidae	<i>Cyclocheilichthys apogone</i>	Buin (Cyprinid)	3	133.5
3	Cyprinidae	<i>Cyclocheilichthys enoplos</i>	Buin/Repang	22	175.5
4	Cyprinidae	<i>Luciosoma setigerum</i>	Rasbora panj./Apollo (Cyprinid)	2	13.7
5	Cyprinidae	<i>Leptobarbus hoevenii</i>	Jelawat (Cyprinid)	2	157.1
6	Cyprinidae	<i>Osteochilus vittatus</i>	Puyau/Nilem (Cyprinid)	12	353.2
7	Cyprinidae	<i>Parachela oxygastroides</i>	Alalang (Cyprinid)	9	53.0
8	Cyprinidae	<i>Barbodes schwanenfeldii</i>	Salap (Cyprinid)	30	238.1
9	Cyprinidae	<i>Barbichthys laevis</i>	Berukung (Cyprinid)	4	300.5
10	Cyprinidae	<i>Labiobarbus festivus</i>	Puyau/Nilem Panjang (Cyprinid)	11	222.8
11	Cyprinidae	<i>Luciosoma trinema</i>	Seluang Garis (Cyprinid)	12	20.0
12	Cyprinidae	<i>Rasbora</i> spp	Seluang (Cyprinid)	126	72.4
13	Cyprinidae	<i>Rasbora argyrotaenia</i>	Seluang (A)(Cyprinid)	12	45.7
14	Cyprinidae	<i>Rasbora einthovenii</i>	Seluang B (Cyprinid)	24	40.0
15	Cyprinidae	<i>Thynnichthys thynnoides</i>	Kendia (Cyprinid)	34	407.6
16	Bagridae	<i>Arius maculatus</i>	Legok	1	27.8
17	Bagridae	<i>Mystus singaringan</i>	Kalibere	3	76.3
18	Channidae	<i>Channa striata</i>	Haruan/Gabus	2	119.6
19	Siluridae	<i>Kryptopterus apogon</i>	Bentilap	1	143.4
20	Belontiidae	<i>Trichogaster pectoralis</i>	Sepat Siam	16	493.9
21	Belontiidae	<i>Trichopodus trichopterus</i>	Sepat Jawa	3	17.1
22	Helostomatidae	<i>Helostoma temminckii</i>	Biawan	9	339.0
23	Anabantidae	<i>Anabas testudineus</i>	Betok/Pepuyu	70	2391.3
24	Chiclididae	<i>Oreochromis niloticus</i>	Nila	8	229.8
25	Engraulidae	<i>Stolephorus</i> sp	Teri Kaca	5050	596.0
26	Eleotrididae	<i>Oxyleotris marmorata</i>	Betutu	5	209.2
27	Loricariidae	<i>Liposarcus pardalis</i>	Ikan Cicak	2	49.7
28	Mastacembelidae	<i>Macrognathus maculatus</i>	Sili/Tilan	1	66.0
29	Pristolepididae	<i>Pristolepis fasciata</i>	Ikan Tempe	6	307.6
30	Soleidae	<i>Synaptura orientalis</i>	Ikan Lidah	2	64.5
				5673	7871.2

Table 2. The fish species obtained from Enggelam river, Pela river and Siran river in the middle Mahakam, Kutai Kartanegara district, East Kalimantan province

Notes:

Enggelam river:

Small stream of black water (peat land) entering Melintang lake;

Pela river:

Stream entering mainstream of Mahakam river coming from Semayang lake;

Siran river:

Small stream of black water entering Kedang Kepala river (tributary/branch of Mahakam mainstream).

No	Family	Species	Local name	No. ind	Weight
1	Cyprinidae	<i>Osteochilus repang</i>	Repang (Cyprinid)	16	766.9
2	Cyprinidae	<i>Cyclocheilichthys armatus</i>	Buin (Cyprinid)	3	179.3
3	Cyprinidae	<i>Puntius brevis</i>	Rasbora (Cyprinid)	10	7.5
4	Cyprinidae	<i>Puntius endecanalis</i>	Sumatra (Cyprinid)	70	33.6
5	Cyprinidae	<i>Cyclocheilichthys apogon</i>	Gelageh repang (Cyprinid)	93	2540
6	Cyprinidae	<i>Leciosoma setigerum</i>	Rasbora panj./Apollo (Cyprinid)	15	28.2
7	Cyprinidae	<i>Leptobarbus hoevenii</i>	Jelawat (Cyprinid)	10	5525
8	Cyprinidae	<i>Osteochilus melanoptleura</i>	Kelabau (Cyprinid)	8	888
9	Cyprinidae	<i>Osteochilus triporos</i>	Berukung (Cyprinid)	169	860.2
10	Cyprinidae	<i>Parachela oxygastroides</i>	Alalang (Cyprinid)	125	725.6
11	Cyprinidae	<i>Rasbora argyrotaenia</i>	Susur Batang (Cyprinid)	2	85.1
12	Cyprinidae	<i>Macrochirichthys macrochirus</i>	Parang-Parang (Cyprinid)	1	32
13	Cyprinidae	<i>Barbodes schwanenfeldii</i>	Salap (Cyprinid)	1	212
14	Cyprinidae	<i>Barbichthys laevis</i>	Berukung (Cyprinid)	1	19.9
15	Bagridae	<i>Mystus pelaniceps</i>	Kalibere (Catfish)	16	654.4
16	Bagridae	<i>Mystus migriceps</i>	Kalibere (Catfish)	9	365
17	Bagridae	<i>Mystus nemurus</i>	Baung (Catfish)	34	2327.2
18	Clariidae	<i>Clarias batrachus</i>	Lele (Catfish)	2	87
19	Clariidae	<i>Clarias nieuhofii</i>	Keli (Catfish)	7	419.1
20	Clariidae	<i>Clarias sp</i>	Lele Payang (Catfish)	1	124.8
21	Channidae	<i>Channa lucius</i>	Kesung/Haruan (Snakehead)	3	253.1
22	Channidae	<i>Channa micropeltes</i>	Toman (Snakehead)	2	517
23	Channidae	<i>Channa striata</i>	Haruan (Snakehead)	44	1443.2
24	Siluridae	<i>Kryptopterus macrocephalus</i>	Lais Kembang (Catfish)	290	8649.7
25	Siluridae	<i>Kryptopterus apogon</i>	Lais Hitam (Catfish)	109	5768.6
26	Siluridae	<i>Ompok bimaculatus</i>	Ompok Bima (Butter catfish)	7	311
27	Belontiidae	<i>Trichogaster pectoralis</i>	Sepat Siam (Gourami)	106	1717.6
28	Belontiidae	<i>Trichopodus trichopterus</i>	Sepat Jawa (Gourami)	167	97
29	Notopteridae	<i>Notopterus borneensis</i>	Belida (bronze featherback)	15	2055.6
30	Helostomatidae	<i>Helostoma temminckii</i>	Biawan Kiss. gourami)	281	2297.1
31	Pangasiidae	<i>Pangasius pangasius</i>	Patin (Shark catfish)	1	93.9
32	Anabantidae	<i>Anabas testudineus</i>	Pepuyu Climbing perch)	74	218.2
33	Synbranchidae	<i>Monopterus albus</i>	Belut (Swamp eel)	8	1029.5
34	Sisoridae	<i>Bagarius yarrelli</i>	Kuyur (giant devil catfish)	1	1211.0
35	Chicliidae	<i>Oreochromis niloticus</i>	Nila (Nile tilapia)	3	1000.0
				1704	42543.3

FIG. 3
THIRTY TWO OF 50 FISH SPECIES
IDENTIFIED



- 1 *Thynnichthys thynnoides*, 2 *Puntius everetti*, 3 *Osteochilus hasseltii*, 4 *Osteochilus vittatus*, 5 *Osteochilus enoplos*, 6 *Osteochilus repang*, 7 *Barbichthys laevis*, 8 *Barbonymus schwanenfeldii*, 9 *Labiobarbus festivus*, 10 *Leptobarbus hoevenii*, 11 *Macrochirichthys macrochirus*, 12 *Parachela oxygastroides*, 13 *Anabas testudineus*, 14 *Trichogaster pectoralis*, 15 *Trichopodus trichopterus*, 16 *Pristolepis fasciata*, 17 *Helostoma temminckii*, 18 *Oreochromis niloticus*, 19 *Pangasius pangasius*, 20 *Arius maculatus*, 21 *Mystus singaringan*, 22 *Hemibagrus nemurus*, 23 *Channa striata*, 24 *Channa lucius*, 25 *Channa micropeltes*, 26 *Macragnathus maculatus*, 27 *Bagarius yarrelli*, 28 *Oxyleotris marmorata*, 29 *Kryptopterus apogon*, 30 *Liposarcus pardalis*, 31 *Monopterus albus*, 32 *Synaptura orientalis*

Table 3.

Values of the diversity indices of fish community in lake and streams/tributaries, and the biodiversity on the basis of location in the middle Mahakam, Kutai Kartanegara district, East Kalimantan province

	Biodiversity			
	Lake	Stream/tribute	Sites	No.of species
Taxa_S	30	35	Semayang lake	30
Individuals	5673	1704	Melintang lake	30
Dominance_D	0.794	0.097	Enggelam river	26
Shannon_H	0.606	2.632	Pela river	7
Evenness_e^H/S	0.061	0.397	Siran river	9
Margalef	3.355	4.569	Kedang kepala river	6

Table 4.

The mean **Catch per Unit Effort (CPUE)** of different type of fishing gears used during the study in the middle Mahakam, Kutai Kartanegara, East Kalimantan.

No	Type of gear	Fish. Time (hr)	Total weight	Total ind.	CPUE		No.of activ	Location
					g/hr	(ind /hr)		
1	Anco	4	5000.0	3783.0	1250.0	945.8	1	Lake
2	Sawaran	192	77866.5	55245.0	405.6	287.7	4	Lake
3	Pengilar	120	22148.2	3032.0	184.6	25.3	2	L. and riv
4	Tempirai	96	41808.5	2060.0	871.0	21.5	2	River
5	Rengge	46	46350.0	781.0	1007.6	16.9	5	River
6	Lukah Rawai	96	21213.6	351.0	220.9	3.7	2	River
7	(h)	20	6082.7	26.0	304.1	1.3	1	River
8	Tokong	20	4900.0	8.0	245.0	0.4	1	River

Table 5.
Water depth
and
water velocity
measured
in the study
locations
in the middle
Mahakam,

	Sites observed	Lat/Long		Depth (m)	Velocity (m/sec)
		Lat.	Long.		
2	Enggel. R	0° 13' 59.2"	116° 18' 48.4"	2.2	0.5
15	Enggel. R	0° 14' 58.4"	116° 20' 07.6"	4.0	0.4
13	Enggel. R	0° 08' 53.3"	116° 14' 18.0"	4.1	0.4
11	Enggel. R	0° 13' 59.1"	116° 18' 48.6"	2.1	0.5
3	Melint. R	0° 17' 05.8"	116° 24' 23.4"	4.2	0.3
4	Pela R	0° 14' 18.5"	116° 33' 16.5"	3.6	0.3
6	Pela R	0° 14' 14.7"	116° 34' 00.8"	1.6	0.4
7	Pela R	0° 14' 18.7"	116° 33' 16.6"	3.6	0.5
17	Pela R	0° 14' 14.1"	116° 33' 39.2"	3.5	0.59
21	Siran R	0° 07' 17.4"	116° 37' 48.9"	3.4	0.48
18	Mahakam R	0° 14' 09.0"	116° 34' 07.2"	1.7	0.37
19	Mahakam R	0° 08' 49.8"	116° 40' 46.3"	4.5	0.46
20	Ked kepla R	0° 07' 47.0"	116° 38' 24.0"	6.8	0.69
1	Enggel. swamp	0° 14' 00.7"	116° 18' 47.1"	1.2	ND
8	Semay. L	0° 14' 38.6"	116° 29' 09.5"	1.9	0.1
12	Melint. L	0° 15' 06.3"	116° 20' 15.6"	3.4	0.1
14	Melint. L	0° 14' 38.5"	116° 20' 18.0"	1.1	0.1
5	Semay. L	0° 14' 43.5"	116° 31' 55.5"	2.3	0.1
16	Semay. L	0° 15' 18.9"	116° 30' 37.8"	1.4	0.3
23	Siran L	0° 04' 08.9"	116° 35' 01.5"	2.7	0.3
22	Siran L	0° 05' 06.5"	116° 35' 55.6"	2.1	ND
24	Siran L	0° 02' 19.9"	116° 33' 37.1"	2.4	ND

Notes: R= river, L= lake

WATER QUALITY IN THE STUDY LOCATION

-Parameter of water temperature, pH, PO₄-P, NO₃-N, NO₂-N, NH₃-N, BOD₅ were within the tolerable limit for all sampling sites;

-Parameter of DO and TSS were within the acceptable limit for most sampling sites;

-Parameter of color of water and COD were higher the allowable limit for most sampling sites;

-Parameter of H₂S exceeded the limit for all sampling sites

-Sixteen (16) heavy metals which were investigated, 13 were below the detection limit, others higher the allowable limit such as Iron (Fe)

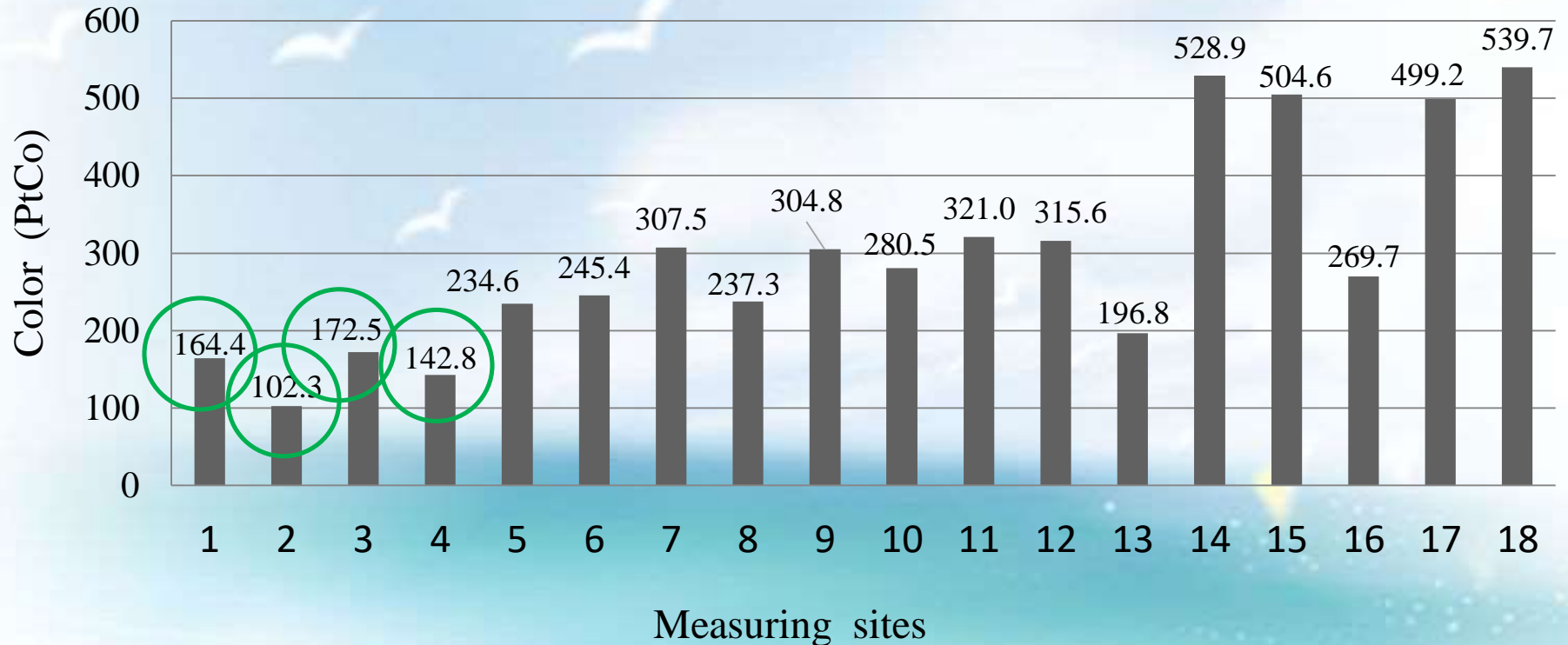
Notes:

Guideline indicating the concentration of physical and chemical parameters and level of the heavy metals refers to PERDA Kaltim no.: 02 tahun 2011 dan PP RI no.: 82 tahun 2001

FIG. 4

COLOR OF WATER (PtCo) IN THE STUDY LOCATIONS IN THE MIDDLE MAHAKAM, KUTAI KARTANEGARA DISTRICT, EAST KALIMANTAN

Color of water in the study location ranged from 102.3 to 539.7 mg/L, based on the regulation Local Government of East Kalimantan (Perda Kaltim) No.: 02 Year 2011 on water quality management and water pollution control, Class II: Permissible limit is 180 mg/L



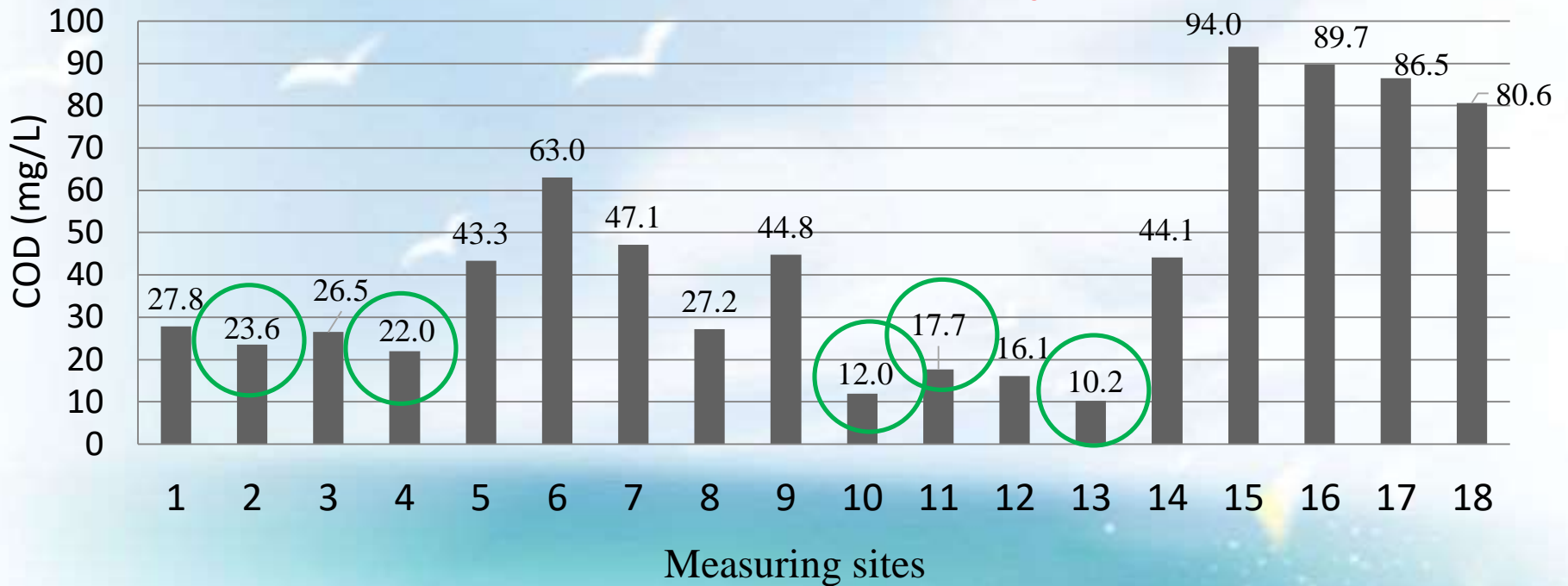
Remarks :

- 1, 2 Pela river; 3. Semayang lake; 4. Mahakam river; 5. Enggelam downstream; 6, 7 Melintang lake; 8. Enggelam river; 9. Enggelam downstream 10. Semayang lake; 11. Mahakam river; 12. Pela river; 13. Siran/Kedang Kepala downstream 14. Kedang Kepala river; 15. Siran river; 16, 17, 18 Siran lake.

FIG. 5

CHEMICAL OXYGEN DEMAND (COD) IN THE STUDY LOCATIONS IN THE MIDDLE MAHAKAM, KUTAI KARTANEGARA DISTRICT, EAST KALIMANTAN

COD in the study location ranged from 10.2 to 93.9 mg/L, based on the Local Government of East Kalimantan (Perda Kaltim) No.: 02 Year 2011 on water quality management and water pollution control, Class II: Permissible limit is 25.0 mg/L



Remarks :

1, 2 Pela river; 3. Semayang lake; 4. Mahakam river; 5. Enggelam downstream; 6, 7 Melintang lake; 8. Enggelam river; 9. Enggelam downstream 10. Semayang lake; 11. Mahakam river; 12. Pela river; 13. Siran/Kedang Kepala downstream 14. Kedang Kepala river; 15. Siran river; 16, 17, 18 Siran lake.

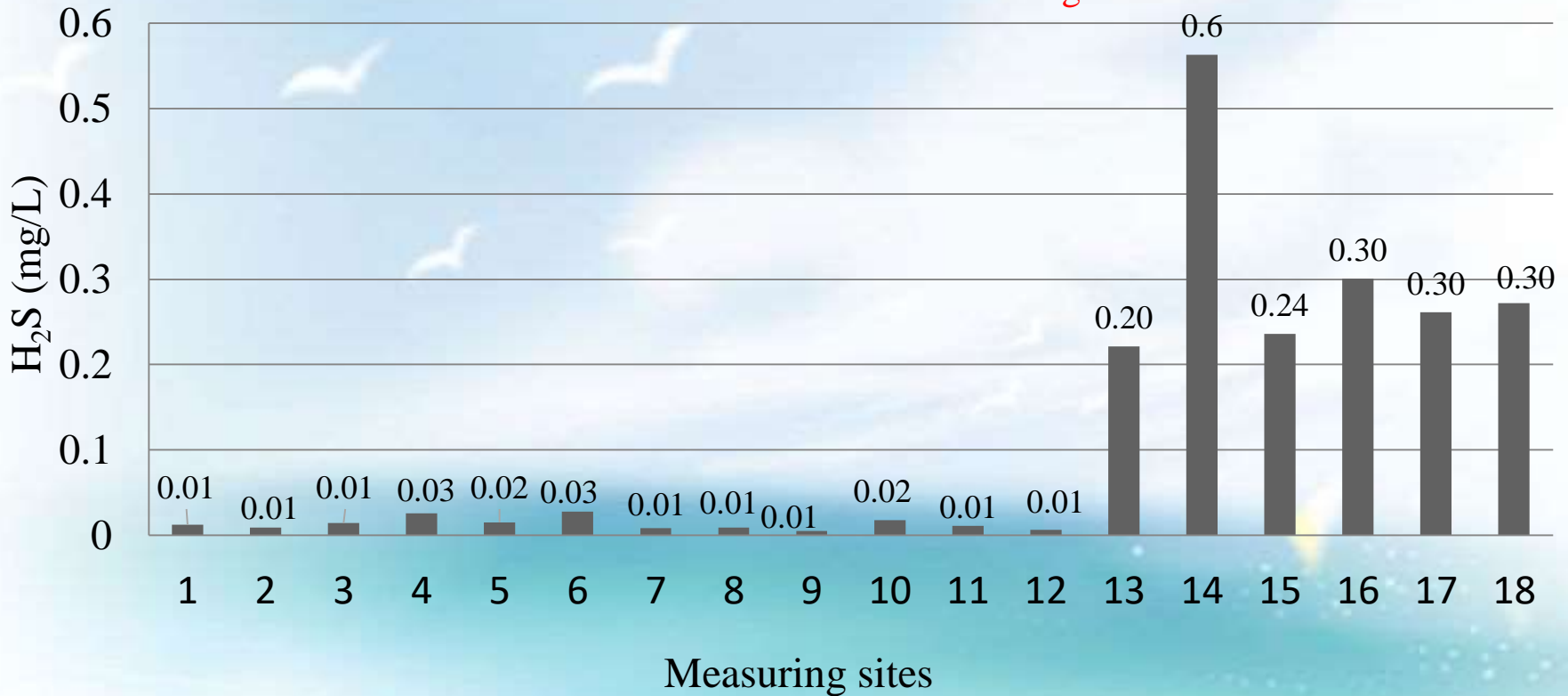
Notes :

Pela R, Semayang L, Enggelam R, Melintang L, Enggelam R and Enggelam downstream. Polluted watr may reach 200,0 mg/L (UNESCO/WHO/UNEP, 1992 dalam Effendi, 2000)

FIG. 6

HYDROGEN SULPHIDE (H₂S) IN THE STUDY LOCATIONS IN THE MIDDLE MAHAKAM, KUTAI KARTANEGARA DISTRICT, EAST KALIMANTAN

H₂S in the study location ranged from 0.01 to 0.60 mg/L, based on the Local Government of East Kalimantan (Perda Kaltim) No.: 02 Year 2011 on water quality management and water pollution control, Class II: Permissible limit is 0.002 mg/L



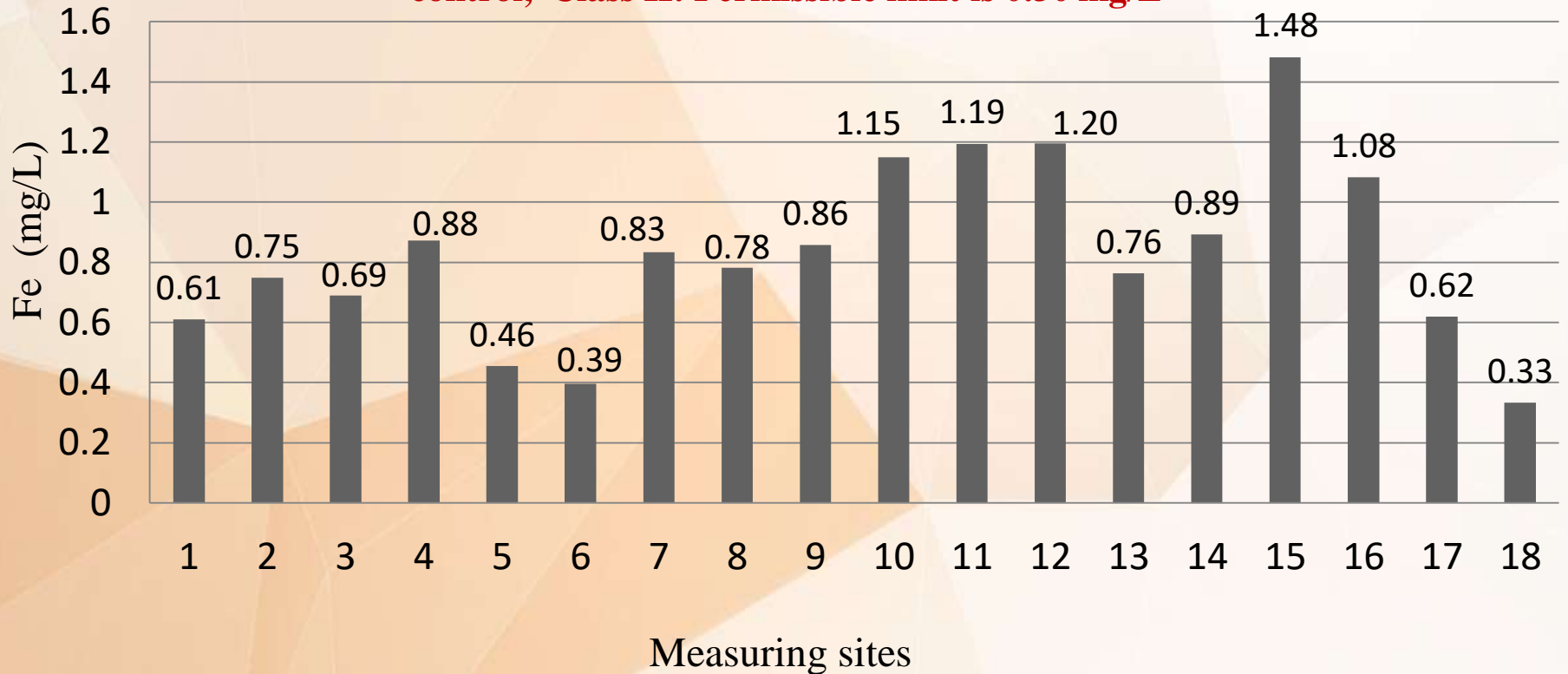
Remarks :

1, 2 Pela river; 3. Semayang lake; 4. Mahakam river; 5. Enggelam downstream; 6, 7 Melintang lake; 8. Enggelam river; 9. Enggelam downstream 10. Semayang lake; 11. Mahakam river; 12. Pela river; 13. Siran/Kedang Kepala downstream 14. Kedang Kepala river; 15. Siran river; 16, 17, 18 Siran lake.

FIG. 7

IRON (Fe) IN THE STUDY LOCATIONS IN THE MIDDLE MAHAKAM, KUTAI KARTANEGARA DISTRICT, EAST KALIMANTAN

IRON in the study location ranged from 0.33 to 1.48 mg/L, based on the Local Government of East Kalimantan (Perda Kaltim) No.: 02 Year 2011 on water quality management and water pollution control, Class II: Permissible limit is 0.30 mg/L



Remarks :

1, 2 Pela river; 3. Semayang lake; 4. Mahakam river; 5. Enggelam downstream; 6, 7 Melintang lake; 8. Enggelam river; 9. Enggelam downstream 10. Semayang lake; 11. Mahakam river; 12. Pela river; 13. Siran/Kedang Kepala downstream 14. Kedang Kepala river; 15. Siran river; 16, 17, 18 Siran lake.

CONCLUSION

- 1) The present study recovered 50 species or, 34% of 147 species which were identified by Cristensen (1992), 29 years ago.
- 2) Fish richness was higher in floodplain areas/streams than lake.
- 3) Fish species found in peat land water and stream/river, they also were found in lake.
- 4) Two species recognized in the study *Macrochirichthys macrochirus* and *Bagarius yarelli* have been listed in the IUCN Red List of Threatened Species (2019 and 2020)
- 5) Anco/lift net, the type of gear that captured the most of fish with small size
- 6) Heavy metal iron/Fe was extremely higher the allowable limit.

Thank
you