FISH DIVERSITY IN THE DOWNSTREAM REGION OF CIPANAS RIVER INDRAMAYU, WEST JAVA INDONESIA

KEANEKARAGAMAN IKAN DI HILIR SUNGAI CIPANAS DAERAH KAWASAN INDRAMAYU, JAWA BARAT INDONESIA

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ABSTRAK

Sungai Cipanas merupakan salah satu sungai di Jawa Barat, hulunya berada di Gunung Tampomas kabupaten Sumedang, bermuara ke Laut Jawa di Kawasan Indramayu. Penelitian bertujuan untuk mengetahui keanekaragaman ikan di daerah hilir Sungai Cipanas. Penelitian menggunakan metode survey dengan tehnik pengumpulan data secara sensus, yang dilakukan di 3 stasiun yaitu di perairan sungai, Desa Santing,Tempalong dan Cemara. Parameter yang diukur terdiri dari kualitas air dan ikan. Kualitas air mengacu pada standard method, pengambilan ikan menggunakan jaring dengan ukuran mata jaring berbeda. Hasil penelitian menunjukkan bahwa kondisi kualitas air di hilir Sungai Cipanas sesuai untuk kehidupan ikan. Ikan yang tertangkap sebanyak 548 ekor terdiri dari 21 spesies, 16 genera, dan 14 familia. Keanekaragaman ikan sedang $1.6 \leq H' \leq 2.2$, struktur komunitas cukup baik, dan indek kemerataan $0.81 \leq E \leq 0.86$ yang menunjukkan distribusi merata.

Kata kunci: Sungai Cipanas, keanekaragaman, kemerataan, struktur komunitas stabil.

ABSTRACT

Cipanas River is one river in West Java where its upstream region in Tampomas Mountain, Sumedang and it is emptied into the Java Sea, Indramayu. The study was aimed to investigate fish diversity in the downstream area of Cipanas River. The study was conducted by survey methods with census data collection techniques, taken place at 3 stations of Santing, Tempalong, and Cemara of Indramayu Regency. The parameters measured consisted water quality and fish assemblages. Water quality was measured referring to standard laboratory protocol, and fish collection was made by case net with different mesh sizes. The results showed that water quality conditions of the Cipanas River downstream was suitable for inhabiting fishes. There were as many as 548 individual fishes caught belonging to 21 species, 16 genera, and 14 families. Fish diversity was categorized as medium with $1.6 \leq H' \leq 2.2$ indicating fairly good community structure, and the Evenness index was $0.81 \leq E \leq 0.86$ to show highly evenly distributed.

Keywords: Cipanas River, diversity, evenness, stable community structure.

INTRODUCTION

Cipanas River, an approximately 90 km length and 416 Km2 river stream area, is the river where its headwater comes originally from the sub-river watershed in the Tampomas Mountain Area, Buah Dua, Sumedang across Majalengka and Indramayu, and finally emptied into the Java Sea Balai Pusat Data dan Informasi Sumberdaya Air (2017). Cipanas watershed is composed by high-lying topography to the deep river valley overlaid with land use in the form of forests, gardens, rice fields and settlements. The river water is mainly functioned for irrigation, fisheries, and used for households demand living along nearby the river course Sukadi (2007).

In 2016, a dam has been built at the upstream region of Cipanas River covered an area of 1,378.16 ha. There are 5 inundated villages of Sumedang Regency (Cibubuan, Karanglayung, Ungkal, and Cibuluh Village) and Indramayu Regency (Cikawung Village). The lands being covered was largely owned

by Perhutani (National Forest Company) (962.62 ha), local communities (283.53 ha), and state land (132.01 ha), or by percentage was 69.84, 20.57, and 9.57%, respectively Balai Besar Wilayah Sungai Cimanuk-Cisanggarung (2018). The dam is functioned as flood control by reducing 475 m^3/sec discharges, irrigating 10,500 ha agricultural lands, and raw water supply of 0.50 m^3/sec, generating 2.5 Mega Watt electricity, and tourism Balai Besar Wilayah Sungai Cimanuk-Cisanggarung (2013, 2018).

The operation of Cipanas Dam is threatening fish biodiversity and the sustainability of fishery resource. This is likely, as dam has been constructed without taken into account any biological aspects of inhabiting fishes. In the absence of the fishway, the dam creates permanent barrier to migrating potamodromous fishes (the young born fishes migrate from upstream to downstream, and the adult stage migtares back to the upper river for spawn). Currently, Herawati *et al*. (2020) identified three indigenous species in this river, i.e. the butter catfish (*Ompok bimaculatus*), "the locally called beureum panon" (*Systomus orphoides*) and Sagor catfish (*Hexanematichthys sagor*). In the absence of fishway during dam operation is suspected to be significantly influential to fish distribution pattern. Widiyati and Prihadi (2007) stated that the existence of reservoirs will negatively impact on biodiversity because the permanent loss of native fish species in response to hydrological changes and river ecosystems, decreased water quality, and hampered the flow of nutrients needed by fish. Craig (2011) reported that in 66 cases of the existence of dam in the world, 73% had a negative impact on fish species diversity, and only 27% had a positive impact. Kartamihardja (2008) reported that within 40 years (1968-2007) after Djuanda Reservoir was inundated there had been a significant decreased in species number from 31 species to 18 species.

In connection to the facts above, it is necessary to study fish diversity in the downstream of Cipanas River after 5 years inundation. The results are expected would be important basic data for fisheries resource management in Cipanas River.

MATERIALS AND METHODS

The study was conducted from March to April 2019 where three stations along the lower reaches of Cipanas River were established. Fishing and water quality measurement at each station was completed in three replications (Figure 1).

Station I is located in the village of Santing, Losarang, Indramayu, West Java (Coordinates point: 6°22'02" S and 108° 08'19" E). Water depth varied between 1 - 1.5 m, shrubs and flat roads. Station II is located in the Tempalong of Village, Santing Village, Losarang, Indramayu, West Java (Coordinates point: 6°20'19" S and 108°09'10" E). Water depth was approximately 2 m with mixed substrates between gravel and mud. The plain around the river was quite gentle, and densely vegetated riverbank. A small dam is found in the middle of the river. Station III is located in the village of Cemara, Losarang, Indramayu (Coordinates point: 6°19'39.4" S and 108° 08'41.4" E). Water depth ranged from 2-3 m with mud substrates. Mangrove plants were found in the riverbank.

Fish samples were collected using a case net with mesh size of 1.5, 2.0, and 3.0 cm.

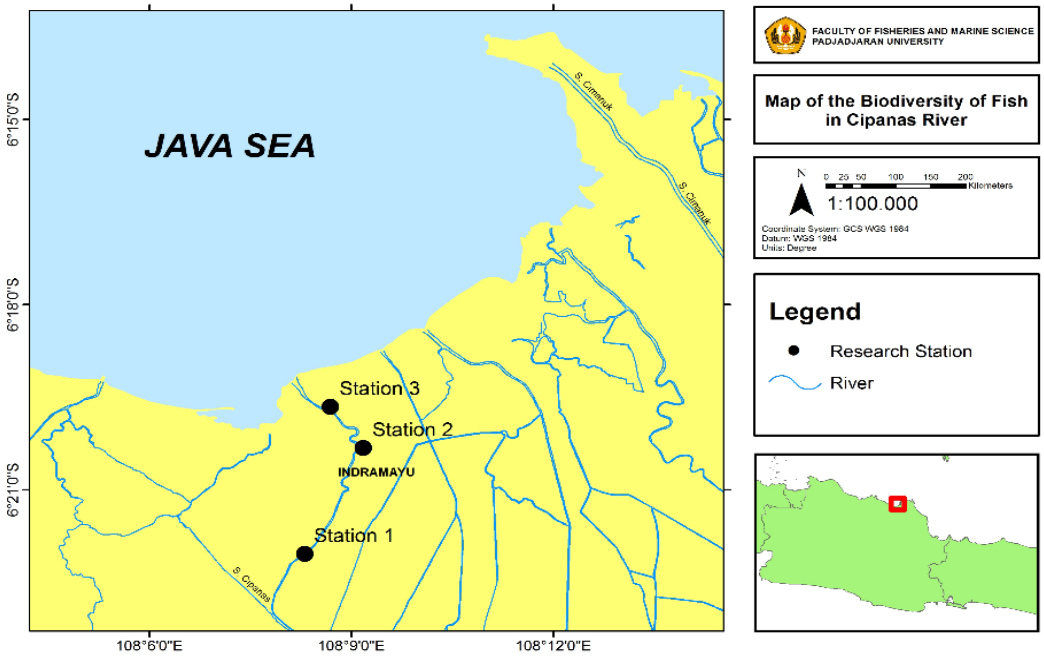

Figure 1. Map of Research Station at Cipanas River.

Water quality parameter measured in situ including temperature, dissolved oxygen (DO), pH, and light penetration; temperature, dissolved oxygen were measured using oxygen meter DO-5510, pH was measured using pH meter Hanna, and light penetration was measured using sechi disc. Other parameter such as total suspended solid (TSS), total dissolved solid (TDS) and chemical oxygen demand (COD) were analyzed in the laboratory of Water and Environmental Research and Development, Ministry of Public Works and Public Housing Bandung. The collected fishes were identified with referred to Kottelat *et al*. (1993). Sample analysis was conducted at Zoology and Biology Research Center, Indonesian Institute of Sciences, Cibinong, Bogor. Data were analyzed using quantitative descriptive analysis based on the indices of diversity, evenness, richness index, and abundance.

Species diversity index

Fish species diversity index is calculated with the formula (Shannon and Weaner in Odum 1971):

$$H = - \sum pi \ln pi$$

Where:

H = Species diversity index

$$P_i = \frac{n_i}{N}$$

ni = Number of ith individual

N = Total individual number

Criteria for diversity index:

H' ≤ 1 = Low diversity;

1 ≤ H' ≤ 3 = Medium diversity;

H' ≥ 3 = High diversity.

Evenness index (Evennes in Odum 1971)

Evenness index is calculated with the formula:

$$E = \frac{H}{\ln S}$$

Explanation :

E = Evenness index

H' = Species diversity index

S = Number of species

Criteria for evenness index:

0 < E < 0,4 = low uniformity, depressed community

0,4 < E < 0,6 = medium uniformity, unstable community

0,6 < E < 1,0 = High uniformity, stable community

Species richness index (Species richness in Odum 1971)

Species richness index with formula:

$$d = \frac{S - 1}{\ln N}$$

Where:

d = Species richness index

S = Number of species

N = The total number of individuals.

Relative abundance

Relative abundance of fish populations can be calculated using the formula (Odum 1993) as folows:

$$KR = \frac{n_i}{N} \times 100\%$$

Explanation :

KR = Relative abundance (%);

ni = Number of individuals of each type;

N = Total individual number

RESULTS AND DISCUSSION

Water Quality

Water Quality at Downstream of the Cipanas River. Table 1 provided results of physical and chemical characteristics of water quality conditions. It is all shown that water quality conditions in the downstream of Cipanas River was generally in good quality supporting fish and fisheries, but the residual dissolved at village of Cemara (station 3) and ammonia levels in village of Santing, village of Tempalong, and village of Cemara.

Species Diversity

There were 549 individual fishes collected in the downstream of Cipanas river. Those consisted of 21 species belongs to 16 genera and 14 families (Table 2).

The results showed a higher species composition compared to other locations. For example with Luk Ulo River of Kebumen Regency, Central Java with 13 species, 7 tribes, 13 genera and 72 individuals (Wahyu & Zakaria 2018) and the lower reaches of Ciporeang and Cipangisikan River in Leuweung Sancang

Table 1. Water Quality of downstream Cipanas River.

Parameter	Method	Station 1	Station 2	Station 3
Water Temperature (°C)	Potentio metric	28	28	30
Water Depth (m)	Measuring pole	1 - 1.5	1 - 1.2	2 - 3
pH	Potentio metric	7.6	7.8	7.9
Dissolved Oxygen (mgL^{-1})	Potentio metric	7.3	6.8	6.5
Salinity (ppt)	Refracto salino meter	0	2	28
COD (mgL^{-1})	SNI 6989 2 2009	11	17	-
Dissolved residue (mgL^{-1})	APHA-AWWA-WEF 2540-C-2017	193	1425	22279
Suspension residue (mgL^{-1})	APHA-AWWA-WEF 2540-D-2017	71	42	136
Ammonia (mgL^{-1})	SNI 06-2479-1991	0.212	0,722	0.370

Table 2. Fish diversity in the Cimanuk river downstream during the research.

Family	Scientific name	Station 1					Station 2					Station 3				
		I	II	III	IV	N	I	II	III	IV	N	I	II	III	IV	N
Cyprinidae	*Barbonymus balleroides*	2	3	9	4	18	0	0	3	0	3	0	0	0	0	0
	B. gonionotus	1	0	5	3	9	0	0	0	0	0	0	0	0	0	0
	B. schwanenfeldii	0	0	6	3	9	0	0	0	0	0	0	0	0	0	0
	Systomus orphoides	0	0	4	2	6	0	0	0	0	0	0	0	0	0	0
	Rasbora aprotaenia	7	0	3	2	12	0	0	0	0	0	0	0	0	0	0
Cichlidae	*Oreochromis niloticus*	11	4	54	4	73	54	0	0	0	54	0	0	0	0	0
	O. mossambicus	0	0	6	3	9	0	0	0	0	0	0	0	0	0	0
Osphronemidae	*Trichopodus pectoralis*	37	5	4	3	49	0	0	0	0	0	0	0	0	0	0
Anabantidae	*Anabas testudineus*	2	14	3	5	24	0	0	0	0	0	0	0	0	0	0
Ambassidae	*Ambassis* sp1.	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
	Ambassis sp2.	0	0	0	0	0	0	0	0	0	0	1	0	7	3	11
Poeciillidae	*Poecilia velifera*	0	10	0	0	10	10	16	5	0	31	3	0	0	0	3
Megalopidae	*Megalops cyprinoides*	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0
Ariidae	*Hexanematichthys sagor*	21	10	4	8	43	8	22	16	5	51	3	0	2	5	10
Channidae	*Channa striata*	1	0	0	4	5	0	0	0	0	0	0	0	0	0	0
Gobiidae	*Glossogobius giuris*	2	3	3	5	13	2	1	4	0	7	0	0	0	0	0
Eleotridae	*Butis koilomatodon*	0	0	0	0	0	0	0	0	0	0	5	3	1	1	10
	B. humeralis	0	0	0	0	0	0	0	0	0	0	15	14	2	3	34
Terapontidae	*Terapon jarbua*	0	0	0	0	0	0	0	0	0	0	3	1	1	2	7
Mugillidae	*Planiliza subviridis*	0	0	0	0	0	0	0	6	21	27	0	0	11	4	15
Tetraodontidae	*Tetraodon* sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1

Note: I, II, III, and IV is sampling time; I= March 24, 2019; II= March 30, 2019; III= April 24, 2019; and IV= April 30, 2019; N= number of individuals.

Garut Nature Reserve, with only 61 individual fishes belong to 6 genera and 5 families (Wahyudewantoro *et al*. 2005). Seeing these results it was suspected that Cipanas River might be in better conditions than those three different streams. The difference diversity in the three rivers is suspected due to difference in habitat or pollution. According to Dias & Garro (2010) that the declined in freshwater fish population is caused by anthropogenic activities, such as water pollution. It is suspected that the fish habitat in the Cipanas river is better, like temperature, dissolved oxygen, pH, salinity, and chemical oxygen demand supports fish growth and breeding; A higher fish diversity in the downstream Cipanas River in comparison to its upper stream is caused by the additional estuarine fishes entering the lower river. The fishes

include *Megalops cyprinoides, Butis koilomatodon, B. humeralis, Terapon jarbua, Planiliza subviridis,* and *Tetraodon* sp.

By species basis, the downstream is in higher species composition compared to the upstream region. Very recently, Herawati *et al*. (2020) recorded 243 individuals belong to 15 species, 10 genera and 7 families. The fishes were barb (*Barbonymus balleroides*), tinfoil barb (*Barbonymus schwanenfeldii*), common barb (*Mystacoleucus marginatus*), java barb (*Systomus orphoides*), silver barb (*Barbonymus gonionotus*), silver rasbora (*Rasbora argyrotaenia*), java rasbora (*Rasbora aprotaenia*), nile tilapia (*Oreochromis niloticus*), mozambique cichlid (*Oreochromis mossambicus*), river catfish (*Mystus nemurus*), two spots catfish (*Mystus micracanthus*), two spots butter catfish (*Ompok bimaculatus*), stripped snakehead (*Channa striata*), climbing gourami (*Anabas testudines*), and barred loach (*Nemachillus fasciatus*). The lower species richness in the upper compared to lower river is suspected to be influenced by the hampered fish migration which blocked by the dam, and in the ansence of fishway.

Santing station (station one) showed 6 species which was evenly distributed throughout the sampling time. They are the locally name lalawak, barb (*Barbonymus balleroides*), nile tilapia (*Oreochromis niloticus*), *Trichopodus trichopterus*, climbing perch (*Anabas testudineus*), sagor catfish (*Hexanematichthys sagor*) and tank goby (*Glossogobius giuris*). At station two of Tampolang village, sagor catfish was dominant throughout sampling period. At station three of Cemara village, the dominant fish species was *Butis koilomatodon*, *B. humeralis* and Crescnet grunter *Terapon jarbua*.

The six species found at station one is thought to fairly high adaptability to the environment. Barb is widely distributed throughout Java, as common species, for instance, in Cimanuk and Cipunegara rivers, Sumedang (Haryono *et al*. 2018; Luvi 2000; Rahardjo & Sjafei 2004; Herawati 2017). Nile tilapia is originally from Africa, able to invade in almost fresh waters in Indonesia (Wahyudewantoro & Rachmatika 2016). Then, *Trichipodus trichopterus* is highly adapted to waters even with depleted oxygen as they have additional breathing apparatus enabling to extract oxygen directly from air (Kottelat *et al*. 1993; Mustakim 2008; Ernawati *et al*. 2009). Sagor catfish is found widely in Sumatra, Java and Kalimantan, they are found in rice fields and vegetated aquatic ecosystem and highly consumed by human (Kottelat *et al*. 1993). At estuary site, tank goby, was found where this fish is generally seen swimming among rocks or among aquatic plants. Alike situation was found at station two, where Sagor catfish was outcompete other fishes. This is likely as its lengthened body so they are able to move freely in the water column. The dominant species composition at village of Cemara, differed with other stations by the catch of *Butis koilomatodon* and Terapon *jarbua*, because this location is linked to mangrove-vegetated estuary (Kottelat *et al*. 1993; Wahyudewantoro 2009).

Family Cyprinidae was found highest in taxon member with 5 species, followed by Cichlidae, Eleotridae and Ambassidae each with 2 species. Beamis *et al*. (2006) and Murni *et al*. (2014) stated that cyprinids is

the most widely distributed freshwater fish family found in many tropical world's rivers. Barb has a wide spread ability from the upper station 1 to station 2, while *B. gonionotus*, *B. schwanenfeldii* and *Systomus orphoides* spread from upstream to station 1. Cichlidae is high adapted and and extensively distributed worldwide. It was introduced from Africa (Kottelat *et al*. 1993; Wahyudewantoro & Rachmatika 2016). The existence of Eleotridae family (gudgeon fish) in this study was closely related to habitat conditions at station three, which were more downstream. Eleotrids are small family in order Gobioidea that inhabiting marine water, estuary and brackish water. The existence of Ambassidae is thought to be related to high adaptation of this family that adaptive to both fresh and marine waters (Kottelat *et al*. 1993).

Comparison Among Stations

Table 3 showed that the fish diversity in Cipanas River is categorized as medium diversity with H' index ranged between 1.57 to 2.21 . Station one was the highest in H' index, while the lowest one was at station two. This was presumably influenced by better habitat conditions in the absence of community settlement. The existence of settlements around might impact negatively caused by organic materials pollution. Ibisch *et al*. (2009) argued that the quality of river water in an area was influenced by human activities, especially those around the river.

The evenness fish index at three locations ranged from 0.805 to 0.863 (Table 2). Station one was the highest in index E, while station two was the lowest. It was assumed that this was caused by the condition that at station one there was no concentration of certain species as found in station two. According to Odum (1971), the value of E index is high if it is not concentrated in certain types of fish. Tilapia and sagor catfish showed the highest individual number compared to the rests species.

Species richness index in all three locations ranged from 1.162 to 2.130 (Table 2), where at station one the species was the richest and station two the poorest. This could be seen from the previous H and E values that station 1 had the highest index value. This was in line with the opinion of Ludwig and Reynolds (1988) that the diversity of a community was determined by two different factors, they were the number or richness of species and the value of species equality. The station one observed that the condition of its habitat was still relatively natural and there tended to be no settlement. While at station two, a small dam was seen in the middle of the river and a settlement. The existence of a small dam is considered to reduce the composition of fish species as fish movement will be restricted. As expressed by Widiyati and Prihadi (2007)

Table 3. Analysis of species diversity index (H), evenness index (E) and species richness index (d) at the study site.

Indeks	Station 1	Station 2	Station 3
Diversity index (H)	2.212	1.567	1.850
Evensess index (E)	0.863	0.805	0.842
Species richness (d)	2.130	1.162	1.761

that dams or reservoirs cause a decreased in the diversity of inhabiting fish species. In terms of settlement, according to Yogafanny (2015) that active participation of residents was needed in preserving the environment around the river, so that the water quality and the number of biota or aquatic fauna were maintained properly.

CONCLUSION

During the study, total number of 549 individual fishess were collected belong to 21 species , 16 genera, and 14 families. Fish diversity including medium diversity index ranged from $1.6 \leq H' \leq 2.2$; high community structure, stable community Evenness index ranged from $0.81 \leq E \leq 0.86$. The highest diversity index was at village of Santing, and the lowest was at village of Tampolang and Cemara; the highest diversity of fish in Santing village due to all water quality parameters meeting the requirements for fisheries and with substrate composed by sandy gravel intersphered large stones, around the river is overgrown with plant vegetation; fish diversity in the villages of Tempalong and Cemara is relatively low due to the alleged high levels of dissolved residues and ammonia, here the chances of a high solute residue occur because the substrate consists of mud. For the type of dominance of each station there was a slight difference due to different habitat conditions.

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