Diversity and Density of Pleco (Pterygoplycthys sp) in Ciliwung River, Jakarta Indonesia

by Dewi Elfidasari

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ORAL PRESENTATION

Diversity and Density of Pleco (*Pterygoplycthys* sp) in Ciliwung River, Jakarta Indonesia

Dewi Elfidasari[1*], Hurunin Fathonah Muthmainah[2], Fahma Wijayanti[2]

[1]Department of Biology, Faculty of Science and Technology, University of Al Azhar Indonesia., Jl. Sisingamangaraja Kebayoran Baru, Jakarta Selatan 12110, Indonesia.
[2]Departement of Biology, Science and Technology Faculty Syarif Hidayatullah State Islamic University Jakarta, Jl Ir. H. Juanda No. 95 Cempaka Putih Ciputat Timur Tangerang Selatan
**Corresponding author: d_elfidasari@uai.ac.id Phone: +82 2172792753 ext 212*

Abstract

There has been a lot of information about some species of fishes, plants, insects, planktons, river quality, including heavy metal concentrations from organisms, water and sediment, from some research in Ciliwung River since 2008. But, there is still very limited data that related to the diversity and density of pleco in the Ciliwung River. Pleco is a native species from Costarica, Panama and South America and it's known as an invasive species which is potentially to reduce local biodiversity by eliminating local species of fishes in Ciliwung rivers. The aims of this study is to analyzing the diversity and density of pleco from Ciliwung River in the Jakarta area. Purposive sampling was used with a consideration that the three points represent the presence of pleco. The location of sampling was the Ciliwung river in Jakarta which flows along the Cawang-Condet. Sampling has been done using 4x2 m^2 cast nets with a 2.5-inch mesh size. The sampling activity was carried out in 09.00-15.00 AM. The results showed that the index diversity of pleco in the Ciliwung river in Jakarta was low, which was equal to H'= 0 because there is only one species of pleco was found there, *Pterygoplichthys pardalis*. The population density of pleco in the Ciliwung river in Jakarta was 58 individuals/m^2.

Keywords: *Pterygoplichthys pardalis*, native species, index diversity, population density, Ciliwung river Jakarta

Introduction

Pleco is a suckermouth armored catfish that is found in Ciliwung River in large quantities. It is an introductory species from Costarica, Panama and South America as an object of commercial ornamental fishes in Indonesia (Zworykin & Budaev, 2013). Pleco is also known as invasive species, which can be predators and competitors of local species (Hill & Lodge, 1999), potentially spread parasites and pathogens in their habitats (Torchin, et al., 2003), can cause unexpected hybridization (Mallet, 2007), and potential to reduce local biodiversity by eliminating local species of fishes (Chapin , *et al*., 2000).

The decline in number of the fish species in Ciliwung River has been happening since 2009. It is noted that there were found 20 fish species in 1910 on the river. One of the main role factors towards the decline of the fish species in Ciliwung River is the existence of pleco that is relatively able to adapt to the river's condition that is polluted and no other predators that hunt them. Pleco in Ciliwung River is categorized as introduced fish that is able to dominate the river, this is supported by its body morphology structure. It has a flat body, all covered with hard scales but its abdomen, it has a wide head and jaw. The main characteristic of this *loricariidae* group is that they have a sucker mouth. The shape of its mouth and

lips enable them to feed, breathe, and be attached to an object through sucking. The sucker mouth in pleco enables them to adhere to an object surround them, even on swift stream rivers. Its mouth and lips are also adapted to any kinds of food such as algae, invertebrate, and detritus (Geerinckx, 2007). Pleco has spiky *adifose fin,* wide back fin, and brown or grey body with black spots on its entire body (Kottelat *et al*., 1993).

Pleco has a high capability of adaptation in Ciliwung River that have high level of pollutin as it has two respiratory systems. Their main respiratory system is the gill that is used when they are in clean water. Another is a labyrinth that enables them to live in low oxygen and polluted water (Graham, 1997). The existence of pleco can be identified from holes in the form of cluster along the slopes of Ciliwung River. The holes are functioned as a place to lay their eggs (Nico *et al*., 2012).

The diversity of pleco in Ciliwung River has been researched since 2016 using some methods, such as morphology, morphometric, meristic, and molecular analysis (Elfidasari et al. 2016a, Elfidasari et al. 2016b, Qoyyimah et al. 2016, Rosnaeni et al. 2017). From the aforementioned research, there has no data with regards to diversity and density index data of pleco in the areas. Therefore, there is a need to do research to calculate the diversity and density index of pleco in Ciliwung River Jakarta.

Material and Methods

Pleco Sampling at the Ciliwung River Stream Area

Sampling have been done along Cawang-Condet area of Ciliwung River and based on the planned stations. The samples were taken using three repetitions in different weeks. The sample collection used purposive sampling method, a technique to decide samples purposively based on certain considerations. The plecos was collected using nets around 4x2 m^2 with the size of the eye nets is 2,5 inch. The nets were spread in the morning from 09.00-15.00 WIB which was refered by Nico (2010).

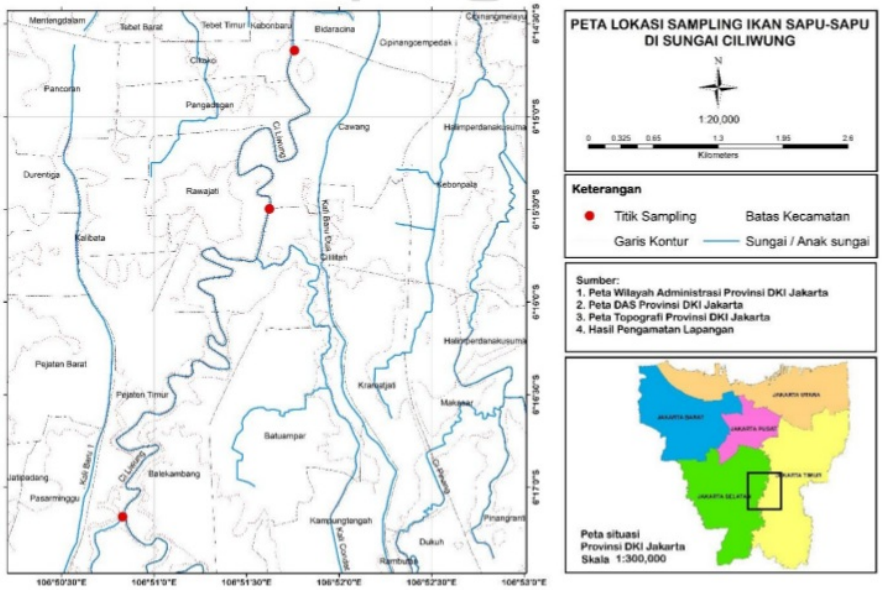

Figure 3. Three observation and sampling station along Cawang-Condet of Ciliwung River

The consideration from this method was the coordinate which represented the existence of pleco based on the information from pleco fishermen and local citizens. There were three observation stations

from each coordinate, namely S 06.244053°-E 106.862654º at the first station, S 06.25830°-E 106.86040° at the second station and S 06.28599°-E 106.84717° at the third station (Figure 3). The coordinates were determined using purposive sampling method in consideration that samples collection along Cawang-Condet of Ciliwung River is regarded as a higly polluted area. In every coordinate, samples were collected in consideration that the samples caught from the nets were placed in every coordinate.

The Identification of Pleco Species at the River Stream Area of Ciliwung

The identification has been done at the Center of Integrated Laboratory UIN Syarif Hidayatullah Jakarta by identifying morphology characteristics of pleco that have been caught by the nets. The specimen was preserved in an 70% alcohol solution. The specimen labels used its scientific names, its caught places, and its collection dates. The identification of pleco specimen at the River Stream Area of Ciliwung used some methods by looking at the patterns of head, lateral, and abdomen. This research was conducted by looking at the pattern of its abdomen which is the salient morphology characteristic of pleco. This happens because the samples have spots patterns or vermicularis on its ventral (Armbruster & Page, 2006). The pleco species identification refer to the book of fish identification from Kottelat *et al*., (1993) and other secondary data from scientific journals.

The Diversity of Pleco Types at the River Stream Area of Ciliwung

The relationship between the number of types and individuals can be stated in Diversity Index. To determine the fish diversity, Shannon-Wiener index was employed (Ludwig dan Reynold, 1988):

$H' = -\Sigma\ pi\ ln\ pi$

Notes:

H’ = Shannon-Wiener Diversity Index
n = The number (i) of individual species
N = The number of individuals from all species

The scoring cirterion based on diversity types is:

H’ < 1 = Low diversity
1 < H’ < 3 = Moderate diversity
H’ > 3 = High diversity

The Density of Pleco at the River Stream Area of Ciliwung

The density of pleco is calculated using the following formula (Barus, 2004):

$Di = Xi / Ni$

Notes:
Di = Density (individual/m)
Xi = Total number of individual
Ni = Total number of area

Results

The diversity index calculation result towards 1.401 plecos gained from the three locations at Ciliwung River, resulted in the value of H’ equal to 0 (zero). It can be stated that the diversity of pleco in Ciliwung River is low. The Diversity Index (H’) is categorized low if, based on the identification result, it is only found one species of pleco in the three locations along the river stream area of Ciliwung River in Jakarta, namely *Pterygoplichthys pardalis*.

Morphologically, pleco’s abdomen has big white spots pattern with merged patterns that are attached together to its sucker-mouth beneath (Page & Robins, 2006). Rosnaeni, et al. (2017) research is a

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DNA analysis of *barcodes* CO1 in the fragment's length of 650bp supports the identification result of *Pterygoplichthys pardalis,* that even though there are diverse abdomen patterns of the found plecos, all is from one species that is *P. pardalis*.

Identification result of the abdomen pattern on plecos from the three locations of Ciliwung River shows matched result with the research conducted by Wu *et al*. (2011). The pleco species in Indonesia has a different abdomen pattern. *P. pardalis* has black spots abdomen pattern (in the shape of commas or dots), *P. disjunctivus* has curved patterns, meanwhile the inter-grade species has a combination pattern between inter-grade or hybrid species. The three different patterns of the abdomen can be characterized as one type of pleco in the family of *Loricariidae* that is *P. Pardalis*.

Two different patterns on its head (geometrical light stripes pattern and spots and blotches patterns) that could be identified by Armbruster and Page (2006) show that the two characteristics are the morphological characteristics of *P. Pardalis* species. The difference in the two lateral patterns (merged patterns forming chevrons (<) and separated patterns and do not create *chevrons*) also shows the morphological characteristic of *P. Pardalis* species. The result is supported by a statement that the different patterns between the abdomen patterns on pleco are not the main characters to identify the type of pleco (Rosnaeni, et al., 2017).

Density of pleco population in Ciliwung River in the three locations results in different values. At the first station, it has the density value of 58 ind/m^2, at the second station it has the density value of 80 ind/m^2 and at the third station it has the density value of 36 ind/m^2. The average number of pleco density population in Ciliwung River is 58 individu/m^2. This shows that the density of pleco in this research is higher than the number of population that was found in Halwa's research (2016) that was 22 individuals.

The biggest density value was found at the second station that is around 80 ind/m^2, meanwhile the lowest is at the third station for only 36 ind/m^2. The biggest density value at the second station is caused by the number of individual species of *Poecilia reticulate* and *Mystacoleucus marginatus* is lower than the number of individuals at the first and the third stations. It is caused by the interaction between pleco and the species of *Poecilia reticulate* and *Mystacoleucus marginatus*. An interaction occurred in a population can be in the form of competition if among organisms from the same or different type use the same resource. If an organism uses the same resources, then every organism has to compete to feed themselves to survive and to grow.

The abundant number of pleco in Ciliwung River is probably due to an excellent interspecific competition in taking advantages of food resources with other fish in Ciliwung River such as *Poecilia reticulate* and *Mystacoleucus marginatus*. Supported with a statement coming from Josefsson and Andersson (2001), the aggressive characteristic to get food performed by *Pterygoplichthys pardalis* when they were present at certain locations so that they could change another community in a water area may cause the decline of fish and invertebrate populations.

According to De-Merona (2004), the fish population number is also affected by the number of food resources in the water. Pambudi et al (2016) states that there are 5.834 individuals of phytoplankton. This shows that the fish population in every station is influenced by the existence of phytoplankton in Ciliwung River. The biggest population number is gained at the second station for 80 ind/m^2 because the water condition is at its optimum point for the life of phytoplankton. The condition is influenced by the speed of the stream. At the second station, the speed of the stream is found lower than the first and third stations. According to (1988) a water area that is relatively placid is suitable for the habitat of phytoplankton. For the number of stream speed at the second station is 0,4 m/s lower than the first station for 1,5 m/s and the third for 2,1 m/s so that at the second station, it has a relatively placid stream. A research by Pambudi, et al. (2016) figures out that most phytoplantons in Ciliwung River are highly-tolerated phytoplankton such as *Navicula*, *Nitzschia*, *Synedra*, *Cymbella*, and *Fragilaria*.

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According to Krebs (1972), the existence of a fish in a water area is heavily influenced by the presence of predators. The pleco's body has several adaptations to predators that have hard bones and are able to regenerate its pectoral, so that pleco is not hunted by other fish living in Ciliwung River and become the competitor by original fish to get some food, additionally to its life cycle (Sinha, et al., 2010). The research results of Rice *et al*. (2007) and Power (1984) state that a predator from *P. pardalis* species is not from other fish type but from reptiles such as snakes and freshwater turtles, birds, and also human (Aguiar & Di-Beernardo, 2004) (Bonino *et al*., 2009) (Nico, 2010).

The cause of the high density of pleco for 80 ind/m^2 in Ciliwung River at the second station is because few local people along the riverbank to do activities of fishing or catching fishes compared to the first and third stations. For instance, the act of catching fish commercially to invasive fish of *Pterois volitans* has proven to help inhibit the *Pterois volitans* fish population growth (Barbour *et al*., 2011).

Cause of the high density of pleco in Ciliwung River at the third station is the low number of predator individuals. It is proven by a research by Rusmendero, et al (2009) that describes no finding of bird prey based on the composition analysis of bird types at Kalibata Station and at other stations in South Jakarta. The low number of pleco predators at the three stations enable pleco at the third station to have high density.

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ORAL PRESENTATION Diversity and Density of Pleco (Pterygoplycthys sp) in Ciliwung River, Jakarta Indonesia Dewi Elfidasari1*, Hurunin Fathonah Muthmainah2, Fahma Wijayanti2 1Department of Biology, Faculty of Science and Technology, University of Al Azhar Indonesia., Jl. Sisingamangaraja Kebayoran Baru, Jakarta Selatan 12110, Indonesia. 2Departement of Biology, Science and Technology Faculty Syarif Hidayatullah State Islamic University Jakarta, Jl Ir. H. Juanda No. 95 Cempaka Putih Ciputat Timur Tangerang Selatan *Corresponding author: d_elfidasari@uai.ac.id Phone: +82 2172792753 ext 212 Abstract There has been a lot of information about some species of fishes, plants, insects, planktons, river quality, including heavy metal concentrations from organisms, water and sediment, from some research in Ciliwung River since 2008. But, there is still very limited data that related to the diversity and density of pleco in the Ciliwung River. Pleco is a native species from Costarica, Panama and South America and it's known as an invasive species which is potentially to reduce local biodiversity by eliminating local

species of fishes in Ciliwung rivers. The aims of this study is to analyzing the diversity and density of pleco from Ciliwung River in the Jakarta area. Purposive sampling was used with a consideration that the three points represent the presence of pleco. The location of sampling was the Ciliwung river in Jakarta which flows along the Cawang-Condet. Sampling has been done using 4x2 m2 cast nets with a 2.5-inch mesh size. The sampling activity was carried out in 09.00-15.00 AM. The results showed that the index diversity of pleco in the Ciliwung river in Jakarta was low, which was equal to H'= 0 because there is only one species of pleco was found there, Pterygoplichthys pardalis. The population density of pleco in the Ciliwung river in Jakarta was 58 individuals/m2. Keywords: Pterygoplichthys pardalis, native species, index diversity, population density, Ciliwung river Jakarta Introduction Pleco is a suckermouth armored catfish that is found in Ciliwung River in large quantities. It is an introductory species from Costarica, Panama and South America as an object of commercial ornamental fishes in Indonesia (Zworykin & Budaev, 2013). Pleco is also known as invasive species, which can be predators and competitors of local species (Hill & Lodge, 1999), potentially spread parasites and pathogens in their habitats (Torchin, et al., 2003), can cause unexpected hybridization (Mallet, 2007), and potential to reduce local biodiversity by eliminating local species of fishes (Chapin , et al., 2000). The decline in number of the fish species in Ciliwung River has been happening since 2009. It is noted that there were found 20 fish species in 1910 on the river. One of the main role factors towards the decline of the fish species in Ciliwung River is the existence of pleco that is relatively able to adapt to the river's condition that is polluted and no other predators that hunt them. Pleco in Ciliwung River is categorized as introduced fish that is able to dominate the river, this is supported by its body morphology structure. It has a flat body, all covered with hard scales but its abdomen, it has a wide head and jaw. The main characteristic of this loricariidae group is that they have a sucker mouth. The shape of its mouth and lips enable them to feed, breathe, and be attached to an object through sucking. The sucker mouth in pleco enables them to adhere to an object surround them, even on swift stream rivers. Its mouth and lips are also adapted to any kinds of food such as algae, invertebrate, and detritus (Geerinckx, 2007). Pleco has spiky adifose fin, wide back fin, and brown or grey body with black spots on its entire body (Kottelat et al., 1993). Pleco has a high capability of adaptation in Ciliwung River that have high level of pollutin as it has two respiratory systems. Their main respiratory system is the gill that is used when they are in clean water. Another is a labyrinth that enables them to live in low oxygen and polluted water (Graham, 1997). The existence of pleco can be identified from holes in the form of cluster along the slopes of Ciliwung River. The holes are functioned as a place to lay their eggs (Nico et al., 2012). The diversity of pleco in Ciliwung River has been researched since 2016 using some methods, such as morphology, morphometric, meristic, and molecular analysis (Elfidasari et al. 2016a, Elfidasari et al. 2016b, Qoyyimah et al. 2016, Rosnaeni et al. 2017). From the aforementioned research, there has no data with regards to diversity and density index data of pleco in the areas. Therefore, there is a need to do research to calculate the diversity and density index of pleco in Ciliwung River Jakarta. Material and Methods Pleco Sampling at the Ciliwung River Stream Area Sampling have been done along Cawang-Condet area of Ciliwung River and based on the planned stations. The samples were taken using three repetitions in different weeks. The sample collection used purposive sampling method, a technique to decide samples purposively based on certain considerations. The plecos was collected using nets around 4x2 m2 with the size of the eye nets is 2,5 inch. The nets were spread in the morning from 09.00-15.00 WIB which was refered by Nico (2010). Figure 3. Three observation and sampling station along Cawang-Condet of Ciliwung River The consideration from this method was the coordinate which represented the existence of pleco based on the

information from pleco fishermen and local citizens. There were three observation stations from each coordinate, namely S 06.244053°-E 106.862654º at the first station, S 06.25830°-E 106.86040° at the second station and S 06.28599°-E 106.84717° at the third station (Figure 3). The coordinates were determined using purposive sampling method in consideration that samples collection along Cawang- Condet of Ciliwung River is regarded as a higly polluted area. In every coordinate, samples were collected in consideration that the samples caught from the nets were placed in every coordinate. The Identification of Pleco Species at the River Stream Area of Ciliwung The identification has been done at the Center of Integrated Laboratory UIN Syarif Hidayatullah Jakarta by identifying morphology characteristics of pleco that have been caught by the nets. The specimen was preserved in an 70% alcohol solution. The specimen labels used its scientific names, its caught places, and its collection dates. The identification of pleco specimen at the River Stream Area of Ciliwung used some methods by looking at the patterns of head, lateral, and abdomen. This research was conducted by looking at the pattern of its abdomen which is the salient morphology characteristic of pleco. This happens because the samples have spots patterns or vermicularis on its ventral (Armbruster & Page, 2006). The pleco species identification refer to the book of fish identification from Kottelat et al., (1993) and other secondary data from scientific journals. The Diversity of Pleco Types at the River Stream Area of Ciliwung The relationship between the number of types and individuals can be stated in Diversity Index. To determine the fish diversity, Shannon-Wiener index was employed (Ludwig dan Reynold, 1988): H' = -Σ pi ln pi Notes: H’ = Shannon-Wiener Diversity Index n = The number (i) of individual species N = The number of individuals from all species The scoring cirterion based on diversity types is: H’ < 1 = Low diversity 1 < H’ < 3 = Moderate diversity H’ > 3 = High diversity The Density of Pleco at the River Stream Area of Ciliwung The density of pleco is calculated using the following formula (Barus, 2004): Di = Xi / Ni Notes: Di = Density (individual/m) Xi = Total number of individual Ni = Total number of area Results The diversity index calculation result towards 1.401 plecos gained from the three locations at Ciliwung River, resulted in the value of H’ equal to 0 (zero). It can be stated that the diversity of pleco in Ciliwung River is low. The Diversity Index (H’) is categorized low if, based on the identification result, it is only found one species of pleco in the three locations along the river stream area of Ciliwung River in Jakarta, namely Pterygoplichthys pardalis. Morphologically, pleco’s abdomen has big white spots pattern with merged patterns that are attached together to its sucker-mouth beneath (Page & Robins, 2006). Rosnaeni, et al. (2017) research is a DNA analysis of barcodes CO1 in the fragment’s length of 650bp supports the identification result of Pterygoplichthys pardalis, that even though there are diverse abdomen patterns of the found plecos, all is from one species that is P. pardalis. Identification result of the abdomen pattern on plecos from the three locations of Ciliwung River shows matched result with the research conducted by Wu et al. (2011). The pleco species in Indonesia has a different abdomen pattern. P. pardalis has black spots abdomen pattern (in the shape of commas or dots), P. disjunctivus has curved patterns, meanwhile the inter-grade species has a combination pattern between inter-grade or hybrid species. The three different patterns of the abdomen can be characterized as one type of pleco in the family of Loricariidae that is P. Pardalis. Two different patterns on its head (geometrical light stripes pattern and spots and blotches patterns) that could be identified by Armbruster and Page (2006) show that the two characteristics are the morphological characteristics of P. Pardalis species. The difference in the two lateral patterns (merged patterns forming chevrons (<) and separated patterns and do not create chevrons) also shows the morphological characteristic of P. Pardalis species. The result is supported by a statement that the different patterns between the abdomen patterns on pleco are not

the main characters to identify the type of pleco (Rosnaeni, et al., 2017). Density of pleco population in Ciliwung River in the three locations results in different values. At the first station, it has the density value of 58 ind/m2, at the second station it has the density value of 80 ind/m2 and at the third station it has the density value of 36 ind/m2. The average number of pleco density population in Ciliwung River is 58 individu/m2. This shows that the density of pleco in this research is higher than the number of population that was found in Halwa's research (2016) that was 22 individuals. The biggest density value was found at the second station that is around 80 ind/m2, meanwhile the lowest is at the third station for only 36 ind/m2. The biggest density value at the second station is caused by the number of individual species of Poecilia reticulate and Mystacoleucus marginatus is lower than the number of individuals at the first and the third stations. It is caused by the interaction between pleco and the species of Poecilia reticulate and Mystacoleucus marginatus. An interaction occurred in a population can be in the form of competition if among organisms from the same or different type use the same resource. If an organism uses the same resources, then every organism has to compete to feed themselves to survive and to grow. The abundant number of pleco in Ciliwung River is probably due to an excellent interspecific competition in taking advantages of food resources with other fish in Ciliwung River such as Poecilia reticulate and Mystacoleucus marginatus. Supported with a statement coming from Josefsson and Andersson (2001), the aggressive characteristic to get food performed by Pterygoplichthys pardalis when they were present at certain locations so that they could change another community in a water area may cause the decline of fish and invertebrate populations. According to De-Merona (2004), the fish population number is also affected by the number of food resources in the water. Pambudi et al (2016) states that there are 5.834 individuals of phytoplankton. This shows that the fish population in every station is influenced by the existence of phytoplankton in Ciliwung River. The biggest population number is gained at the second station for 80 ind/m2 because the water condition is at its optimum point for the life of phytoplankton. The condition is influenced by the speed of the stream. At the second station, the speed of the stream is found lower than the first and third stations. According to (1988) a water area that is relatively placid is suitable for the habitat of phytoplankton. For the number of stream speed at the second station is 0,4 m/s lower than the first station for 1,5 m/s and the third for 2,1 m/s so that at the second station, it has a relatively placid stream. A research by Pambudi, et al. (2016) figures out that most phytoplantons in Ciliwung River are highly- tolerated phytoplankton such as Navicula, Nitzschia, Synedra, Cymbella, and Fragilaria. According to Krebs (1972), the existence of a fish in a water area is heavily influenced by the presence of predators. The pleco's body has several adaptations to predators that have hard bones and are able to regenerate its pectoral, so that pleco is not hunted by other fish living in Ciliwung River and become the competitor by original fish to get some food, additionally to its life cycle (Sinha, et al., 2010). The research results of Rice et al. (2007) and Power (1984) state that a predator from P. pardalis species is not from other fish type but from reptiles such as snakes and freshwater turtles, birds, and also human (Aguiar & Di-Beernardo, 2004) (Bonino et al., 2009) (Nico, 2010). The cause of the high density of pleco for 80 ind/m2 in Ciliwung River at the second station is because few local people along the riverbank to do activities of fishing or catching fishes compared to the first and third stations. For instance, the act of catching fish commercially to invasive fish of Pterois volitans has proven to help inhibit the Pterois volitans fish population growth (Barbour et al., 2011). Cause of the high density of pleco in Ciliwung River at the third station is the low number of predator individuals. It is proven by a research by Rusmendero, et al (2009) that describes no finding of bird prey based on the composition analysis of bird types at Kalibata Station and at other stations in South

Jakarta. The low number of pleco predators at the three stations enable pleco at the third station to have high density. Acknowledgements Thank you to the Ministry of Research and Higher Education that has funded the University Excellent Applied Research in the year of 2018 and University of Al Azhar Indonesia Grant International Seminar 2019 that has funded to become presenter in BioEco 2019 Symposium in Istanbul Turki. Thank you to all parties that have helped out the research from the beginning of the research until the sampling activity and also this paper writing. References Barbour A B, Allen S M, Frazer K T, Sherman D K. 2011. Evaluating the Potential Efficacy of Invasive Lionfish (Pterois volitans) Removals. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0019666 Bonino M, Lescano N J, Haro G J & Leynaud C G. 2009. Diet of Hydromedusa tectifera (Testudines- Chelidae) in a mountain stream of Córdoba province, Argentina. Amphibia-Reptilia 30(4):545-554 Armbruster, J.W., Page, L.M. (2006):Redescription of Pterygoplichthyspunctatusand description of a new species of Pterygoplichthys(Siluriformes: Loricariidae). Neotropical Ichthyology.4(4): 401-409 Barus, T. A. 2004. Pengantar Limnologi Studi Tentang Ekosistem Air Daratan. Medan: USU Press. Chapin F S, Sala O. E, Bruke C I & Roy J. 2000. Ecosystem Consequences of Changing Biodiversity. BioScience 48(1). Elfidasari D, Qoyyimah D F, Fahmi R M. 2016. Morphometric And Meristic Of Common Pleco (Loricariidae)On Ciliwung River Watershed South Jakarta Region. International Journal of Advanced Research 4(12):57-62. Geerinckx T, Brunain M, Herrel A, Adriaens D. 2007. A head with a suckermouth: A functional- morphological study of the head of the suckermouth armoured catfish Ancistrus cf. triradiatus (Loricariidae, Siluriformes). Belgian Journal of Zoology 137(1). Hill, A. M & Lodge, D.M. 1999. Replecemant of resident crayfishes by an exotic predation in species replacemat among crayfish. Ecological Application 9 678-690. Josefsson and Andersson (2001), Kottelat, M., A.J. Whitten, S.N. Kartikasari and S. Wirjoatmodjo, 1993. Freshwater fishes of Western Indonesia and Sulawesi. Periplus Editions. Krebs. 1972. Krebs, C.J. 1972. Ecology. The Experimental Analysis of Distribution and Abundance. Harper and Row, New York. 694. Ludwig, J.A. and Reynolds, J.F. (1988) Statistical Ecology A Primer on Methods and Computing. Wiley- Interscience Pub., New York. Mallet J. 2007. Hybrid speciation. Nature 446:279–283 (15 March 2007) Nico LG, Butt PL, Johnston GR, Jelks HL, Kail M, Walsh SJ. 2012. Discovery of South American armored catfish (Loricariidae, Pterygoplichthys spp.) in The Santa Fe River drainage, Suwannee River Basin, USA. BioInvasions Record. 3 :179-200. Page, L.M., Robins, R.H. (2006): Identification of sailfin catfishes (Teleostei:Loricariidae) in south- eastern Asia. The Raffles Bulletin of Zoology. 54(2):455-457. Qoyyimah, F.D., Elfidasari, E., Fahmi, M.R. (2016): Identifikasi ikan sapu-sapu (Loricariidae) berdasarkan karakter pola abdomen di perairan Ciliwung. Jurnal Biologi., 20(1). Rice. 2007. Rosnaeni, Elfidasari D, Fahmi R M. 2017. Dna Barcodes Of The Pleco (Loricariidae, Pterygoplichthys) In The Ciliwung River. International Journal Of Advanced Research 5(2):33-45 Torchin M, Lafferty K, Dobson A P & Kuris A. 2003. Introduced species and their missing parasites. Nature 421(6923):628-30 Wu, L.W., Liu, C.C., Lin, S.M. (2011): Identification of exotic Sailfin Catfish species (Pterygoplichthys, Loricariidae) in Taiwan based on morphology and mtDNA sequences. Zoological Studies. 50(2):235-246. Zworykin & Budaev. 2013. Non-indigenous armoured catfish in Vietnam: Invasion and systematics. Ichthyological Research 60(4):327-333. BioEco2019- International Biodiversity & Ecology Sciences Symposium ISBN: 978-605-80198-0-5 Publication of e-book date: 22.10.2019 BioEco2019- International Biodiversity & Ecology Sciences Symposium ISBN: 978-605-80198-0-5 Publication of e-book date: 22.10.2019 BioEco2019- International Biodiversity & Ecology Sciences Symposium ISBN: 978-605-80198-0-5 Publication of e-book date: 22.10.2019 BioEco2019- International Biodiversity & Ecology Sciences Symposium ISBN: 978-605-80198-0-5 Publication of e-book date:

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