ADI Journal on Recent Innovation (AJRI)
Vol. 6 No. 1 September 2024

p-ISSN : 2685-9106
e-ISSN : 2686-0384

Increase in the Abundance of Invasive Fish Species in the Ciliwung River, DKI Jakarta and West Java Provinces

Noer Sarifah Ainy[1], Iqbal Mujadid[2], Nestiyanto Hadi[3], Lutfiralda Sjahfirdi[4]

Biology Education Study Program, STKIP Arrahmaniyah, Depok, Indonesia[1, 2, 3]
Faculty of Mathematics and Natural Sciences, University of Indonesia, Depok, Indonesia[4]

e-mail: nursarifahainy@gmail.com, iqbal.mujadid@gmail.com, ntaybio@gmail.com, luthfiralda@sci.ui.ac.id

Author Notification
14 February 2024
Final Revised
03 May 2024
Published
06 May 2024

To cite this document:
Sarifah Ainy, N., Mujadid, I., Hadi, N., & Sjahfirdi, L. (2024). Increase in the Abundance of Invasive Fish Species in the Ciliwung River, DKI Jakarta and West Java Provinces. ADI Journal on Recent Innovation, 6(1), 17–31.
DOI: https://doi.org/10.34306/ajri.v6i1.1060

Abstract

The Ciliwung River is one of the important rivers in the Jakarta Special Capital Region (DKI Jakarta) and West Java. The existence of local fish in the Ciliwung River is threatened by the presence of invasive fish. This research aims to identify the types of invasive fish along the Ciliwung River from 2023 to 2024 and compare them with previous research in 2011. The study uses 6 segments according to Minister of Environment and Forestry Decree No. SK.298/Menlhk/Setjen/PKL.1/6/2017. Each segment consists of 3 research plots, totaling 18 research stations. The sampling method involves collecting fish using environmentally friendly fishing gear. The research results show the presence of 10 species from 5 families and 4 non-native fish orders that are invasive. The most abundant invasive fish species in the Ciliwung River are, in order, Plecostomus (Pterygoplichthys pardalis), Mosquito Fish (Gambusia affinis), Guppy (Poecilia reticulata), Platy (Xiphophorus helleri), Nile Tilapia (Oreochromis niloticus), Bristlenose Pleco (Ancistrus temminckii), Glossom (Andinoacara rivulatus), Carp (Cyprinus carpio), Red Devil (Amphilophus labiatus), and African Catfish (Clarias gariepinus). There has been a 100% increase in the number of invasive fish species in the Ciliwung River compared to the 2011 study, which identified only 5 invasive fish species.

***Keywords**: Ciliwung River, Invasive Fish, Ecological Research*

1. Introduction

A river is a freshwater ecosystem that connects the land with the ocean. Rivers have ecological roles such as providing clean water, providing biodiversity, helping nutrient cycles, maintaining regional climate balance, flood control, tourism and recreation, transportation and trade providing flood protection, irrigating agriculture, retaining nitrates, natural water purification[1].

Fish are aquatic species that are quite popular with the public, both as consumption fish and as ornamental fish. Each species of fish has its own distribution area that is influenced by biogeographic history[2]. The distribution of fish outside the biogeographic area is known as exotic fish. The distribution of these exotic fish is influenced by a wide variety of human activities that involve a variety of Transportation making it possible for fish to move from their natural distribution areas[3].

The entry of exotic fish in fresh waters can occur intentionally, such as guppies as mosquito larvae exterminators, red devil fish as ornamental fish, and unintentionally such as tilapia[4]. Invasi Spesies Amphilophus citrinellus Terhadap Ikan Lokal di Perairan Waduk Sanguling. Exotic fish can also be released into public waters accidentally due to negligence of fish keepers, or deliberately such as lack of knowledge on the release of invasive exotic fish[5]. These invasive fish can suppress the existence of native fish species, help the spread of new types of diseases and parasites carried by exotic fish, decline in biodiversity and ecosystems that cannot be restored without help, and have socio-economic impacts on fish fishermen[6].

Ciliwung River as a freshwater ecosystem is currently facing the threat of the entry of exotic fish that began to dominate in some segments of the Ciliwung River[7]. If these conditions continue, the threat of diminishing native species and local extinctions could occur in the not-too-distant future. This study seeks to explain the distribution patterns of exotic fish that become invasive in the Ciliwung River. This study is an update of exotic fish data in the Ciliwung River, updating the last data in 2011 [8]. It is hoped that this study can raise awareness among both academics and the general public to be able to jointly prevent the entry and development of invasive fish in the Ciliwung River so that native fish of the Ciliwung River can survive in their natural habitat.

2. Research Method

The Ciliwung River stretches for 120 km, the upstream part is in Cisarua, Bogor regency, and empties into North Jakarta, DKI Jakarta. The study was conducted for 5 months from the end of the dry season to the beginning of the rainy season between September 2023 and January 2024. The research locations covered 6 regencies/cities, namely Bogor Regency, Bogor City, Depok City, South Jakarta City, Central Jakarta City, and North Jakarta City in 2 provinces, namely West Java and DKI Jakarta.

The tools used are fishing gear, among others, a large rake of 80 cm, a medium rake of 40 cm, nets, fishing rods, and umbrella traps. The use of fishing gear is adjusted to the current conditions of the river. Heavy currents use nets and fishing rods, while the less fast-flowing parts of the river use droughts[9]. Fish storage containers include acrylic containers, 40 cm portable containers, drybag5 liter dry bags, gallons and 20 aquarium pieces. Water quality test equipment such as DO meters, TDS meters, pH meters and thermometers. as well as other supporting tools such as cutting pad, caliper, ruler, digital scales, portable aerator, camera and ATK[10].

Materials used include bait, fish traps, and anesthesia. Bait is used in fishing gear, namely shrimp, worms, and pellets. The fish trap used is an umbrella trap. The fish anesthesia used is intended to help the fish documentation process so that it does not move much[11].

The study was conducted along the Ciliwung River with segmentation determined based on KEPMEN LHK No. SK.298/Menlhk/Setjen/PKL.1/6/2017. Sampling was carried out in 3 river areas, namely upstream, middle and downstream. The upstream part is divided into 2 segments, namely Segment 1 and Segment 2, the middle part is divided into Segment 3 and Segment 4, and the downstream part is divided into Segment 5 and Segment 6. For each segment, determined 3 data collection plots with replications of each two sampling times are presented in Table 1. Total sampling was conducted from 18 plots representing the entire Ciliwung River ecosystem from upstream to downstream.

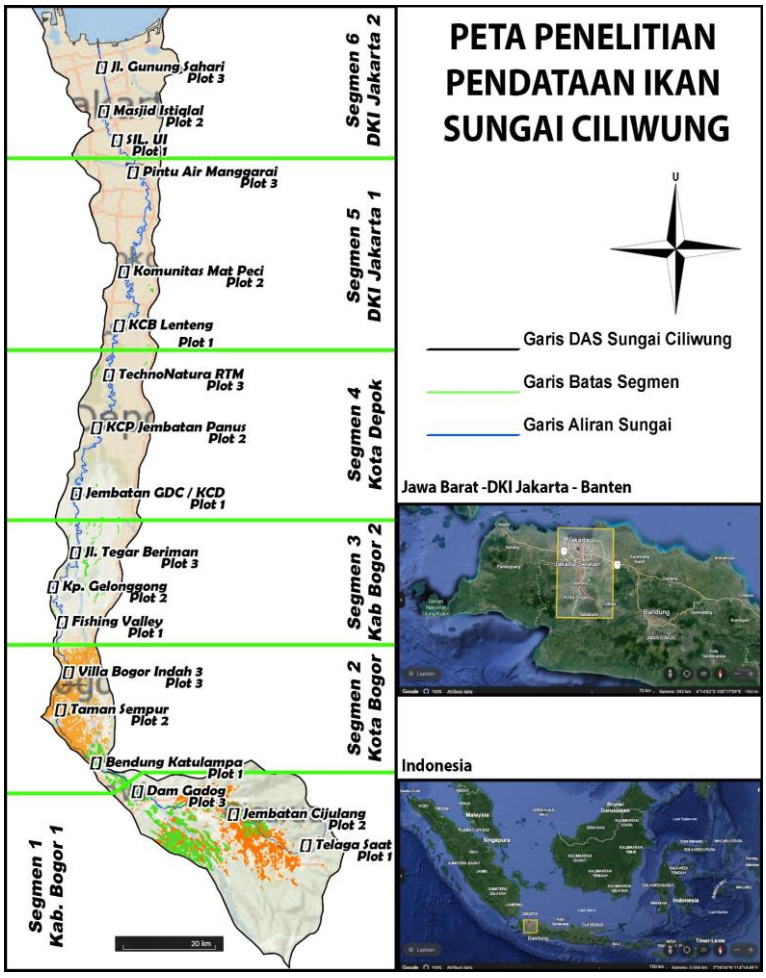

Figure 1. Map of Fish Sampling Locations in Ciliwung River

Table 1. Ciliwung River Fish Sampling Location

No	Segmen	Plot 1	Plot 2	Plot 3
1	Bogor Regency 1	Lake When	The Bridge Cijulang	Gadog Floodgates
		-6.689516, 106.993929	-6.655736, 106.895782	-6.653096, 106.869479
2	Bogor City	Weir Katulampa	River Tourism Sempur	Villa Bogor Indah 3-6

		.633423, 106.837078	-6.641672, 106.852913	-6.547731, 106.801417
3	Bogor Regency 2	*Fishing Valley*	Kampung Gelonggong	Jl. Tegar Berikmati
		-6.535700, 106.804086	-6.503391, 106.800922	-6.482678, 106.814643
4	Depok city	GDC	Bridge Panus	TechnoNatura Bridge (RTM)
		-6.411580, 106.818538	-6.400321, 106.831778	-6.366183, 106.838918
5	DKI Jakarta 1	Ciliwung Bambon	Community Mat Peci	Manggarai Water Gate
		-6.344338, 106.837183	-6.245035, 106.862158	-6.207484, 106.849066
6	DKI Jakarta 2	SIL UI	Istiqlal Mosque	Mount Sahari Istiqlal Mosque
		-6.195648, 106.844041	-6.169636, 106.831816	-6.148742, 106.834158

Fish sampling results were identified using[12]. All fish that have been identified are kept in the freshwater Laboratory of Temali Foundation. Each plot in each segment was tested for water quality to determine the carrying capacity of the environment for fish life. Water quality parameters used include oxygen levels using DO-meter,temperature using DO-mether, the amount ofdissolved solids using TDS-mether, acidity level (*pH*-mether). Data analysis is done qualitatively descriptive in the form of tables and graphs. Fish Data obtained were tabulated to determine the number of species in each research plot[13].

2.1 Literature Review

An invasive species is an organism that is not indigenous, or native, to a particular area. Invasive species can cause great economic and environmental harm to the new area, can threaten native species, impact water quality and reduce recreational use of waterbodies[14].

There are 20 types of invasive fish species in Indonesia based on the List of Introduced Fishes Species Reported from Indonesia [8]. Among the 20 species of fish, 6 species are found in the Ciliwung River, namely broomstick fish *(Pterygoplichthys pardalis)*, guppy *(Poecilia reticulata)*, Plati fish *(Xiphophorus helleri)*, Tilapia fish *(Oreochromis niloticus)*, Goldfish *(cyprinus carpio)* , and African catfish *(Clarias gariepinus)*.

Plecostomus *(Pterygoplichthys pardalis)*, is a freshwater fish native to South America, the Amazon region and the Orinoco in Brazil and Venezuela. The history of the presence of the first Broom-broom fish to Indonesia can be traced through international trade activities and a penchant for keeping ornamental fish. Broom-broom fish became popular among aquarium enthusiasts in various countries, including Indonesia[15]. This is due to its unique appearance and ability to clean algae in the aquarium.

The presence of Broom-broom fish to Indonesia is not always closely monitored so that there are some individuals who may be released into local waters accidentally or intentionally by irresponsible parties[16]. The presence of Broom-broom fish in Indonesian waters then causes ecological impacts, especially when these fish become invasive and compete with local species for feed resources and space resources. Therefore, further understanding of the history

of the arrival and spread of Broom-broom fish in Indonesia is important in conservation efforts and management of aquatic resources.

Fish *(P.pardalis)* has a distinctive and unique morphology. The morphological characteristics of the broom-broom fish are relatively flat and wide body, dorsal (dorsal) and anal (anal) fins are long and give a triangular appearance [17]. Broom-broom fish belongs to the group of fish "Armored Catfish" because its body is covered with a hard shell, similar to a substance resembling armor or armor [18]. Broom fish mouth type-a vacuum-shaped broom that allows it to suck or suck food debris and algae from the surface of objects, such as rocks and aquatic plants. Broom-broom fish have morphological adaptations that make it possible to adapt to a variety of freshwater environments, and these traits also play a role in their feeding behavior and daily life in an aquarium or a wild natural environment. P. pardalis is found in the Ciliwung River. The presence of P. high pardalis is influenced by the levels of DO, BOD, pH, ammonia, and turbidity[12].

Poecilia reticulata, known as guppies, have a history of entering Indonesia originating in Central America and South America, especially in Trinidad and Tobago. Its natural habitats include fresh water and brackish water, such as rivers, ponds, and lakes. The presence of guppies because of their attractive color so much loved as ornamental fish. In addition, guppies can also be used as mosquito control. Despite its benefits as a mosquito vector controller, Guppy releases can also pose challenges regarding their impact on freshwater ecosystems and local species in some regions [19].

Morphology of fish P. reticulata is characterized by an average body length between 2 and 6 centimeters. Males tend to be smaller than females. One of the most striking features of the Guppy is the colorful colors and interesting body patterns, especially in males. Males often have a lighter color and greater color variation than females. Guppy fish can have color combinations such as red, blue, green, yellow, and black. The dorsal fin part of the Guppy fish is located in the middle or dorsal part of the body. In males, the dorsal fin can have a larger size and a more striking shape. The Guppy anal fin is located at the back of the body, and like the dorsal fin, males have a larger and more colorful anal fin than females. The caudal fin of Guppy fish can vary, including a swordtail-like shape in some varieties, which is characteristic of males [20]. The Platifish *(Xiphophorus helleri)*, also known as the “swordtail”, is native to Central America, particularly eastern Mexico. Swordfish generally live in waters that have vegetation and hiding places, such as bushes and aquatic plants. Swordfish is one of the most sought-after ornamental fish among aquarium enthusiasts due to the beauty and variety of colors it has. In the 20th century, swordfish was introduced to the international market as an ornamental fish, and then spread to various countries around the world including Indonesia. Apart from being ornamental fish, swordfish also have a role in scientific research. Several species in the genus Xiphophorus are used as models in cancer research for their ability to develop tumors, facilitating the study of cancer mechanisms. The morphology of swordfish has a body length that ranges from 5 to 12 cm, depending on gender and environmental conditions. The fish has distinctive color variations, especially in males [21].

Body color can include shades of red, blue, green, and yellow. Different varieties have been developed through selective breeding to obtain more striking colors. Females tend to have more faded colors and less noticeable body patterns. One of the most striking features of the male is the presence of a swordtail fin. The caudal fin of males can have a variety of shapes, ranging from long and pointed to shorter and rounded fins. Males generally have a slimmer body and more striking coloration than larger females[22]. The dorsal (dorsal) and anal (anal) fins of males also tend to be larger and more colorful compared to females. Adult males are equipped with gonopodium, a modification of the anal fin that is used to transfer sperm during the spawning process.

The tilapia *(Oreochromis niloticus)* is native to East and Central Africa, especially from the Nile region of Africa. Over time, tilapia spread to different regions of the world as a result of human introduction. In the last decade, this fish has been introduced in many countries outside Africa for aquaculture and aquaculture purposes[23]. Tilapia was introduced to various parts of Asia, the Americas, and other regions in the 20th century as part of efforts to increase fishery production and provide a more abundant source of protein food. Tilapia has good adaptability to various aquatic conditions and has tolerance to variations in temperature, salinity, and water quality. Its adaptability makes it a species that can be cultivated relatively easily in a variety of locations [24].

The entry of tilapia *(Oreochromis niloticus)* into Indonesia was related to efforts to develop fisheries and aquaculture in the 1970s. In that period, Tilapia was considered one of the freshwater fish species that had great potential for aquaculture and fishery production. The Program involves the introduction and cultivation of various species of fish that have fast growth and high reproduction rates[25]. Tilapia fish proved successful in cultivation in freshwater waters in Indonesia. Tilapia has fast growth, productive reproduction, and good adaptability to various aquatic conditions. Although tilapia have provided significant economic and food benefits, there are also challenges related to their impact on local freshwater ecosystems and the genetic diversity of native freshwater fish [26].

Tilapia has a morphological feature, namely a flattened and slightly elongated body. The Shape of the body is usually oval. The dorsal fin of tilapia is located in the central part of the back and has a striking color. The anal fin, located in the lower part of the body, is similar in shape to the dorsal fin. Tilapia usually have a forked tail, and in some individuals, the caudal fin can be longer. The body color of tilapia varies, including gray, turquoise, or purplish shades[27]. The color may vary depending on gender, age, and environmental conditions. Indigo males often have a more striking color with more characteristic shades, while females tend to have a softer color. The difference between males and females of IndiGo can be seen in body size and color. Males tend to have more conspicuous coloration and often have a longer anal fin [28].

Gambusia affinis, also known as "Mosquito fish" or Cere fish has a history of entering Indonesia from the United States and Mexico. Cere fish have become popular in various regions of the world as part of mosquito population control efforts with their ability to prey on mosquito larvae in water. Although it has benefits in controlling mosquito populations, it can compete with local fish species and thus disrupt the balance of freshwater ecosystems. In addition to controlling mosquitoes, cere fish are popular because they have colorful and interesting body patterns [29].

The morphology of Gambusia affinis fish has the characteristics of a small to medium body with an average length of about 3-6 cm. The body shape is relatively slender and slightly elongated, with a slightly tapered head. The dorsal (dorsal) and anal (anal) fins in such fish are located on the back of the body[30]. The dorsal fin has a characteristic shape and can be used to identify this species. The body color is generally grayish brown or grayish green. In some individuals, some patches or strips can vary, and this color can change according to the environment and health conditions. In females, the abdomen tends to be larger and rounder, especially during the reproductive period. Males are usually slimmer and have gonopodium, a modification of the anal fin used to transfer sperm during mating [31].

3. Findings

The number of invasive fish found along the Ciliwung River consists of 10 species from 5 families and 4 orders. Species found in the Ciliwung River are shown in Table 2. The presence of invasive fish was found in all research plots from upstream to downstream of the Ciliwung

River. Invasive fish species in each plot have their own characteristics, where each research station has an abundance of certain species that are more numerous than other species. Station 1, in Telaga Saat, the largest number of invasive fish encountered is Plati fish, at Station 2, 3 and 4 there are Guppy fish, Station 5, 7, 9, 10 and 11 there are Cere fish, at Station 6, 12,13,14,15,16, 17 and 18 there are Broom-broom fish, while at Station 8 has Guppy Fish and Broom-broom fish.

Plati fish is a fish with a low tolerance range. Plati fish are found in clear and calm places, such as at Station 1, Telaga Saat. Plati fish are only found in Segment 1 and Segment 2 of the Ciliwung River with good water quality conditions. Physically, Plati fish are less able to adapt to the flow with heavy currents, so the dominance is only seen in Station 1 which has calmer surface waters. Plati fish are found at Station 1 to Station 5, but at stations 2 to 4 are not the dominant fish.

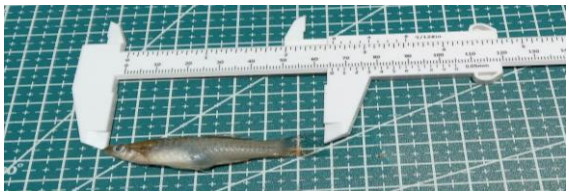

Figure 2. Cross-section of Plati Fish *(Xiphophorus helleri)*

Plati fish (Figure 2) has a fan-shaped tail fin that is less than ideal for living in waters with fast currents. Fish with a fan-shaped caudal fin are better suited to a calm water surface. Unlike the case with fast water fish that tend to have a type of forked fins. Compare with Figure 3, Kehkel fish as one of the local fish with forked fins. Forked fins are suitable for fast current waters due to their more hydrodynamic nature.

Figure 3. Branched Fins of the Kehkel Fish *(Glytothorax platypogon)*

Guppy fish (Figure 3) are mostly found in Segment 1 to Segment 4, namely Station 1 to Station 12. When viewed, *the Guppy* fish dominates in the upstream area where the water conditions are still clear, but there are already many residents, namely at Station 2 and Station 4. The number of residents in the area gives organic wasteparticles that become food from *guppy Fish*. In the middle segment of the Ciliwung River, Guppy fish does not become the dominant fish. This is due to the fact that the water in the middle segment has begun to decline in quality *Guppy fish* have the ability to adapt to new environments by associating with native taxa that occupy the same niche. This makes *Guppy* a migrant fish that is easy to survive and is found almost everywherein the world except Antarctica. [24]

Table 2. Invasive Fish Tabulation in Ciliwung River

Segments		Plot Segment	Of Station		*G. affinis*	*P. reticulata*	*P. pardalis*	*A. temminckii*	*O. niloticus*	*X. helleri*	*A. rivulatus*	*C. carpio*	*C. garie pinus*	*A. labiatus*	Jumlah Spesies	Spesies/Segmen	Jumlah Individu	Individu/ Segmen
					Cere	*Guppy*	Sapu-sapu	Bristlenose	Nila	Plati	Glosom	Mas	Lele Dumbo	Red Devil				
1	Bogor Regency 1	Plot 1	1	Telaga Saat	7	9	9		5	40		4			6		74	
		Plot 2	2	Jembatan Cijulang	5	22		2	2	6	16				6	18	53	157

		Plot 3	3	Pintu Air Gadog	4	12		11	1	1	1				6		30	
2	Bogor City	Plot 1	4	Bendung Katulampa	3	30		7	3	3					5		46	
		Plot 2	5	Ciliwung Sempur	22	9	3	3		1					5		38	
		Plot 3	6	Villa Bogor Indah 3			11	1							2	12	12	96
3	Bogor Regency 2	Plot 1	7	Fishing Valley	11	4	1								3		16	
		Plot 2	8	Kp. Gelonggong	4	6	6								3		16	
		Plot 3	9	Jl. Tegar Beriman	11	2	6	2							4	10	21	53
4	Depok City	Plot 1	10	Jembatan GDC	12	6	9		2						4		29	
		Plot 2	11	Jembatan Panus	43	15	11		3						4		72	
		Plot 3	12	TechnoNatura	10	3	44		2						4	12	59	160
5	DKI Jakarta 1	Plot 1	13	Ciliwung Bambon	23		46		16			1		4	5		90	
		Plot 2	14	Komunitas Mat Peci			30								1		30	
		Plot 3	15	Pintu Air Manggarai	20		40								2	8	60	180
6	DKI Jakarta 2	Plot 1	16	SIL UI			25								1		25	
		Plot 2	17	Masjid Istiqlal	14		44						2		3		60	
		Plot 3	18	Jl. Gunung Sahari			11								1	5	11	96
number of existing species in Ciliwung River					189	118	296	26	34	51	17	5	2	4			742	742

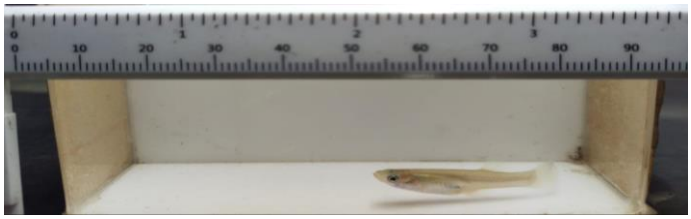

Figure 4. Cere fish *(Gambusia affinis)*

Cere fish (Figure 4) is found in the middle segment of the Ciliwung River. Cere fish likes waters that are not too heavy, with water quality that is still quite good.

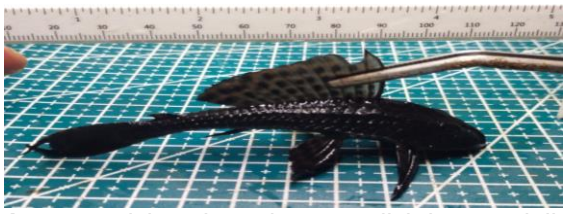

Figure 5. Fish Rubom *(Pterygoplichthys pardalis)*

Fish Rubom (Figure 5) is found in the middle segment and downstream segments. Broom-broom fish likes waters that are not too heavy with the ability to tolerate water quality is quite wide. Starting at Station 12 in Techno Natura, Coconut two water quality conditions began

to decline. The quality of water downstream is decreasing. This is visible to the naked eye, as well as through data on water quality test results. At Station 14, Mat Peci community, water conditions began to change greatly where the consistency of water is more concentrated and viscous. In poor water conditions, Broom-broom fish are found very much and even dominate the place. This is clear evidence that the broom-broom Fish has a tolerance for low water quality.

The presence of broom carp in aquatic habitats has a negative impact. The study states that the broom broom fish has an impact on the existence of aquatic biodiversity in Lake Sindereng and reduce the catches of local fishermen [25] the number of invasive fish individuals recorded in this study was as many as 742 individuals (Table 2). The three locations with the most abundance were obtained successively in Segment 5 (DKI Jakarta 1), Segment 4 (Depok City), and Segment 1 (Telaga Saat).

Segment 5 has a fairly high abundance of invasive fish resulting from the inlet of a series of lakes originating from the University of Indonesia. Lake UI provides food, fresher water, and fish that are carried and live in the Ciliwung River. For example, glass fish (Prambasis sp.) Shooting Fish (Helostoma temminckii), and Betta Fish (Trichopsis pitata). The three fish above are not commonly found in Lotic waters, but are more commonly found in tapering waters. The existence of the three species above in Segment 5 is very large from the inlet of Lake UI. Segment 4 ranks second in invasive fish abundance. Segment 4 (Depok City) most of the border of Ciliwung River is still natural. There is no concreting of the river boundary on Segment 4. This provides a good microclimate for the waters. It is suitable for supporting the life cycle of fish, where fish nest, grow, settle, forage and breed.

Segment 1, Telaga Saat is currently managed by the community for tourism. In the lake when the fish are released by the manager and there is a strict ban on catching fish. This causes the fish in the lake when found in quite diverse quantities.

The abundance of invasive fish in the Ciliwung River is dominated by broomstick fish *(Pterogoplichthys pardalis),* cere fish *(Gambusia affinis)*, and guppy fish *(Poecilia reticulata)*. These three species are found in almost all research stations (Figure 6). The distribution pattern of broom-broom fish *(Pterogoplichthys pardalis)* is more to the middle and lower segments, guppy fish *(Poecilia reticulata)* is more to the upper and middle segments, while cere fish *(Gambusia affinis)* is found in all segments from upstream to downstream.

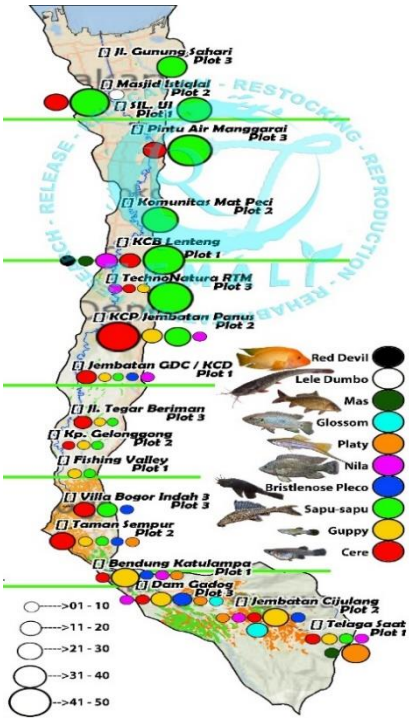

Figure 6. Abundance of invasive fish species in Ciliwung River in each research Plot

p-ISSN : 2685-9106
e-ISSN : 2686-0384

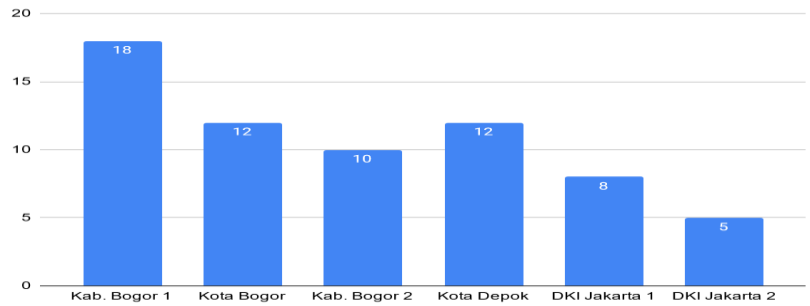

Figure 7. Number of Invasive Fish Species per Segment in Ciliwung River

Table 3. Ciliwung River Water Quality Parameter Data In 2023

Segment	Plots	DO (ppm)	pH	Temperature (^{0}C)	TDS (PPT)
Bogor Regency 1	1	6.11	7.60	24.9	47,00
	2	6.75	7.64	29.2	82,00
	3	6.42	7.56	29.4	71,00
Bogor City	1	5.89	7.75	29.7	68.00
	2	5.74	7.21	31.1	86,00
	3	5.20	7.10	29.6	91,00
Bogor Regency 2	1	5.20	7.60	24.8	90,67
	2	4.97	7.64	24.8	102,67
	3	4.74 7.56	7.56	24.9	114,67
Depok City	1	6.21	6.96	29.9	92,00
	2	6.50	7.15	30.0	102,00
	3	5.38	7.60	28.4	90,67
DKI Jakarta 1	1	5.31	7.64	28.9	102,67
	2	5.24	7.56	29.4	114,67
	3	5.17	7.75	29.9	68.01
Jakarta 2	1	5.10	7.21	30.3	107.57
	2	5.03	8.10	30.8	110,21
	3	4.96	7.60	31.3	112,86

Based on the abundance of individuals, the most invasive fish encountered in a row (Figure 8) is in Segment 5 (JAKARTA 1), Segment 4 (Depok City), Segment 1 (Bogor 1), Segment 2 (Bogor City), Segment 6 (Jakarta 2), and Segment 3 (Bogor Regency 2).

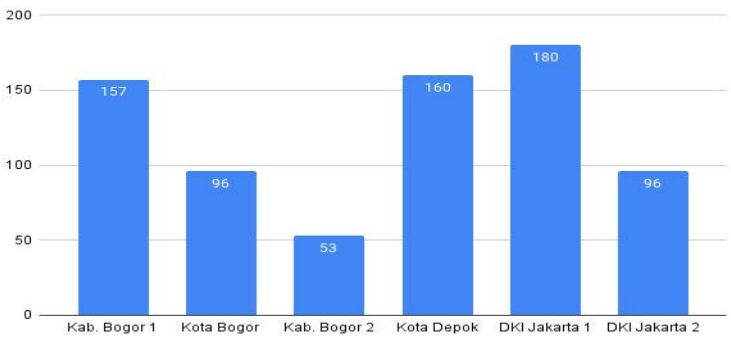

Figure 8. Abundance of invasive fish per segment in Ciliwung River

Fish *(P.pardalis)* is quite dominant in Segment 5. This fish can adapt to moderate to marginal water quality. Research [26] showed that segment 5 of the Ciliwung River has a water quality index of 59 in Manggarai sluice and 35.5 in Ciliwung Condet area. In Chapter 6, fish *(P.pardalis)* the number is decreasing due to the value of the water quality index is also decreasing. The study showed the value of Water Quality Index in Ciliwung Gunung Sahari area, which is Segment 6 into the number 50.3 which is classified as a marginal category [26]. The lower the value of the water quality index, the fish that can adapt such as Broom-broom fish *(P. pardalis)* is also the lower the ability to survive. The low abundance of invasive fish (Figure 8) and the number of species encountered (Figure 7) in Segment 6 are influenced by the Lower Water Quality Index in the area.

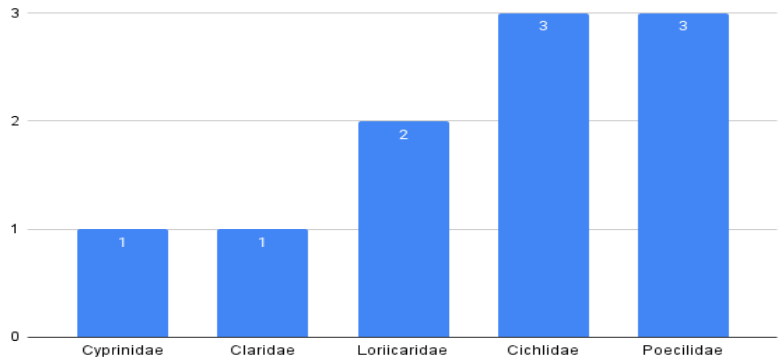

Figure 9. Number of species per family

The most invasive fish families found in the Ciliwung River come from Cichlidae and Poecilidae (Figure 11). The Cichlidae family includes Tilapia Fish *(Oreochromis niloticus)*, Glossom Fish *(Andinocara rifulatus)*, and Red Devil Fish *(Amphilopus labiatus)*. The Poeciliidae family includes Cere Fish *(Gambusia affinis)*, Guppy Fish *(Poecilia reticulata)* and Platis Fish *(Xiphophorus heleri)*.These two families are the most adaptive fish families. This is due to the ability of fish in this family to water quality. The cichlidae family has a wide range of tolerance to water salinity, from zero salinity to over 30 ppm.

The family Poecilidae tolerates a wide range of temperatures. This Poecilidae is found in the upper reaches, namely the Platis fish *(Xiphophorus heleri)*. Cere fish *(Gambusia affinis)* and Guppy fish (Poecilia reticulata) are found from the Highlands upstream to downstream.
Family The second most common family is Loriicaridae. The Loriicaridae family includes the Broomstick Fish *(Pterygoplichthys pardalis)* and the Brushfish *(Ancistrus sp)*. Broom-broom fish are known as fish that are able to adapt to polluted waters. These fish are found in segments 2 through 6.The fish are found in segments 1 and 2. Research [27] has not found the presence of brush-broom fish. This brush-broom fish present in the Ciliwung River is thought to be from ornamental fish that escaped into public waters and then developed adaptations in the area.

This brush-broom fish is also proven to be able to enlarge its distribution area up to Segment 2. This is related to the discovery of the presence of this fish in the study [28] which found this fish in Segment 1. Based on local sources, this fish was not found in other segments of the Ciliwung River in 2019. However, this study shows the presence of the species Ancistrus sp. in segments 1 and 2.

This brush-broom fish is able to fill the niches of the broom-broom fish in upstream areas that cannot be reached by the fish. Species P. pardalis is known to be better able to live in water with high pollutant levels, while Ancistrus temminckii is found upstream of the Ciliwung River which has better water quality. A. Temminckii are more adaptable to Rocky and fast-flowing structures. *A. Temminckii* has a more flattened body structure horizontally and hydrodynamically. It is associated with the ability to withstand and resist currents. *Ancistrus Temminckii* also has a unique body feature in the form of several spines located in the gill cover. These spines can open if the fish is in a threatened position. These spines pose more of a threat to their prey species, such as predatory fish, water birds, snakes and monitor lizards. The presence of these thorns can cause choking to cause the death of the predator.

p-ISSN : 2685-9106
e-ISSN : 2686-0384

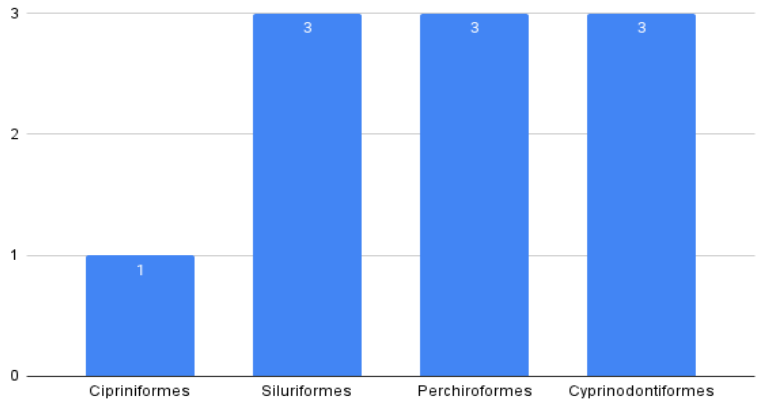

Figure 10. Number of species per order

There are four orders of invasive fish in the Ciliwung River, namely Cypriniformes, Siluriformes, Perchiroformes and Cyprinodontiformes. When compared with the List of Introduced Fishes Reported from Indonesia [8], there are an additional number of orders, namely the orders Perchiroformes and Cyprinodontiformes

3.1 Problem

Research on the abundance of individuals and species of fish in the Ciliwung River there is not enough adequate literature data. Research related to the Ciliwung River is usually onlya related to the study of one species of fish only. Recent relevant research that can be juxtaposed only from [7]. The data of this study when compared with [7] showedthat there were changes in invasive fish species in the Ciliwung River. A total of 6 new species of invasive fish were found in the Ciliwung River from upstream to downstream. Differences in fish species encountered in the study [27] and this study is presented in Table 4.

Table 4. Difference between invasive fish species in Ciliwung River in 2011 and 2023

No.	Fish Name	Research result (2023-2024)	Hadiaty (2011)
1.	Plecostomus (*Pterygoplichthys pardalis*)	√	√
2.	Mosquito Fish (*Gambusia affinis*)	√	-
3.	*Guppy* (*Poecilia reticulata*)	√	√
4.	Platy (*Xiphophorus helleri*)	√	√
5.	Nile Tilapia (*Oreochromis niloticus*)	√	√
6.	Bristlenose Pleco (*Ancistrus temminckii*)	√	-
7.	Glossom (*Andinoacara rivulatus*)	√	-
8.	Carp (*Cyprinus carpio*)	√	-
9.	Red Devil (*Amphilophus labiatus*)	√	-
10.	African Catfish (*Clarias gariepinus*)	√	-
11.	*Guppy* (*Poecilia latipiima*)	-	√

The new type of invasive fish species discovered in this research is Bristlenose Pleco *(Ancistrus temminckii)*, Glossom *(Andinoacara rivulatus),* Carp *(Cyprinus carpio)*, Red Devil *(Amphilophus labiatus)*, African Catfish (Clarias gariepinus), dan guppy *(Poecilia latipiima)*. Guppy fish species found in the Study [7] are different from those found in this study. Research [7] found the species Poecilia reticulate, while this species was not found in this study. Type guppy encountered in this study is the species Poecilia latipiima. If you look at Table 4, the number of species that increase is 6 species, with one with the same surname, then it can be

said that there is an increase in the number of invasive fish species in the Ciliwung River by 100%. The increase in the number invasifof invasive fish in terms of species shows that this is a threat to the Ciliwung River, especially a threat to local fish. Threats include tougher competition for local fish for living space, as well as the ability to get food. Threats of the Bristlenose Pleco fish *(A. temminckii)* arrangement of forward-facing spines on the cover of the gill. This is a threat to predators that can cause the predator to die from choking in the throat. Glossom Threat *(A. rivulatus)* that this fish is predatory for local fish, Aggressive has the characteristics of mating season and spawning season. Red Devil Threat (A. labiatus) have a predatory and aggressive nature, with tingkat agresivitasa higher degree of aggressiveness compared to the Glossom. The Threat Of G. affinis that this fish has the ability to reproduce very quickly in all seasons and has a wide tolerance to fluctuations in water quality. Fish G. affinis is found both in clean water conditions, and water conditions with poor quality, such as in ecosystems with pesticide and heavy metal contamination conditions [29]. G. affinis has good tolerance to salinity, as well as exposure to ammonia and nitrites [30], lead[31], and mercuric chloride [32].

Another problem is found in invasive fish species which is a type of fish consumed in the Ciliwung River. Types are tilapia, carp and catfish dumbo. The three fish are not native to the Ciliwung River. This fish was found to be present at the sampling was possible because it was released, either intentionally, or accidentally. These three fish are cultivated fish that are favored by the community. Control is possible due to the presence of communities that fish these fish for consumption. Other types of fish consumed, although Limited are the broom broom fish.

3.2 Research Implementation

This research can provide input to fishbase about invasive fish species in Indonesia. There are four invasive fish species added in this study that have not been found on the List of Introduced Fishes Species Reported from Indonesia [8]. This species is the Bristlenose Pleco *(Ancistrus temminckii)*, Glossom *(Andinoacara rivulatus)*, Red Devil *(Amphilophus labiatus)*, and Gambusia affinis. Updating data on Fishbase can be updated with the findings of new species in this study.

The results of the study that there is an increase in the number of invasive species as much as 100% from 2011 indicates the need for the government and related parties conservation Ciliwung River to pay more attention to the potential development of invasive fish that can affect native fish Ciliwung River. If this condition is left unchecked and land clearance for human activities is wider, as well as the influence of pollutants that enter the Ciliwung River, then the combination of these conditions can allow the potential for reduced local fish diversity and the development of invasive fish in the Ciliwung River.

Things that can be done to maintain the presence of native Ciliwung fish include maintaining green areas in the Ciliwung watershed in segments 1-4, and maintaining good water quality. The existence of more and more invasive fish in the Ciliwung River needs to be found ways to use these invasive fish to control the population. It is also necessary to make awareness efforts to the general public not to release invasive fish into public waters. Invasive fish pose a threat to local fish because there will be a struggle for habitat and food. Efforts to suppress invasive fish populations can be done together with the government and the community to avoid the local extinction of fish in the Ciliwung River.

4. Conclusion

The presence of invasive fish species in the Ciliwung River poses a significant threat to the local aquatic ecosystem. With 10 species identified across 5 families and 4 orders, including dominant species such as Plecostomus *(Pterygoplichthys pardalis)*, Mosquito Fish *(Gambusia affinis)*, and Guppy *(Poecilia reticulata)*, the river faces a substantial challenge in maintaining its biodiversity. Moreover, the discovery of six new invasive species further exacerbates the situation, including Bristlenose Pleco *(Ancistrus temminckii)*, Glossom *(Andinoacara rivulatus)*, Carp *(Cyprinus carpio)*, Red Devil *(Amphilophus labiatus)*, African Catfish *(Clarias gariepinus)*, and Guppy *(Poecilia latipiima)*. To mitigate the escalating threat posed by invasive fish, urgent

actions are required to preserve the water quality of the Ciliwung River. Additionally, strategies to utilize invasive fish for population control measures must be explored. Public awareness campaigns are essential to educate communities about the risks associated with releasing invasive species into public waters. Without concerted efforts to curb the proliferation of invasive fish populations, the native fish species in the Ciliwung River face the imminent risk of extinction. In conclusion, proactive measures are imperative to safeguard the ecological balance of the Ciliwung River and prevent the displacement of indigenous fish species by invasive counterparts.

References

[1] H. M. Manullang and K. Khairul, "Monitoring Biodiversitas Ikan Sebagai Bioindikator Kesehatan Lingkungan Di Ekosistem Sungai Belawan," *J. Ilmu Alam dan Lingkung.*, vol. 11, no. 2, 2020.

[2] M. Brauns *et al.*, "A global synthesis of human impacts on the multifunctionality of streams and rivers," *Glob. Chang. Biol.*, vol. 28, no. 16, pp. 4783–4793, 2022.

[3] G. W. Dewantoro and I. Rachmatika, "Jenis ikan introduksi dan invasif asing di Indonesia," 2020.

[4] M. S. Dadiono, "Invasi Spesies Amphilophus citrinellus Terhadap Ikan Lokal di Perairan Waduk Sanguling," *Nekton*, vol. 3, no. 2, pp. 116–121, 2023.

[5] J. R. Britton, "Contemporary perspectives on the ecological impacts of invasive freshwater fishes," *J. Fish Biol.*, vol. 103, no. 4, pp. 752–764, 2023.

[6] A. F. Taybi, Y. Mabrouki, and I. Doadrio, "The occurrence, distribution and biology of invasive fish species in fresh and brackish water bodies of NE Morocco," 2020.

[7] I. Handayani, D. Apriani, M. Mulyati, N. A. Yusuf, and A. R. A. Zahra, "A Survey on User Experience of Blockchain Transactions: Security and Adaptability Issues," *Blockchain Front. Technol.*, vol. 3, no. 1, pp. 160–168, 2023.

[8] K. P. Bandjolu *et al.*, "Checklist of endemic (Adrianichthyidae, Gobiidae, Zenarchopteridae) and introduced fish in Lake Poso, Sulawesi, Indonesia," in *IOP Conference Series: Earth and Environmental Science*, 2021, vol. 869, no. 1, p. 12060.

[9] I. Handayani, D. Apriani, M. Mulyati, A. R. A. Zahra, and N. A. Yusuf, "Enhancing Security and Privacy of Patient Data in Healthcare: A SmartPLS Analysis of Blockchain Technology Implementation," *IAIC Trans. Sustain. Digit. Innov.*, vol. 5, no. 1, pp. 8–17, 2023.

[10] R. Heriyanto, T. Mariyanti, and A. R. A. Zahra, "Microfinance Management Strategy Using Poverty Reduction Technology," in *2023 11th International Conference on Cyber and IT Service Management (CITSM)*, 2023, pp. 1–5.

[11] D. Jonas, N. A. Yusuf, and A. R. A. Zahra, "Enhancing Security Frameworks with Artificial Intelligence in Cybersecurity," *Int. Trans. Educ. Technol.*, vol. 2, no. 1, pp. 83–91, 2023.

[12] D. Elfidasari, H. Haninah, H. D. Putri, and I. Sugoro, "The concentration of heavy metals Cd, Hg, Pb in processed food products based Pterygoplichthys pardalis (Castelnau, 1855) from Ciliwung River Jakarta Region," *Bioeduscience*, vol. 6, no. 1, pp. 73–83, 2022.

[13] S. A. Soliman, B. M. Kamal, A. S. Abuo-Elhmad, and H. H. Abd-Elhafeez, "Morphological and histochemical characterization of the dermal plates of pleco (Hypostomus plecostomus)," *Microsc. Microanal.*, vol. 26, no. 3, pp. 551–566, 2020.

[14] A. R. A. Zahra, D. Jonas, I. Erliyani, and N. A. Yusuf, "Assessing Customer Satisfaction in AI-Powered Services: An Empirical Study with SmartPLS," *Int. Trans. Artif. Intell.*, vol. 2, no. 1, pp. 81–89, 2023.

[15] A. Pambudi, N. Lutfiani, M. Hardini, A. R. A. Zahra, and U. Rahardja, "The Digital Revolution of Startup Matchmaking: AI and Computer Science Synergies," in *2023*

Eighth International Conference on Informatics and Computing (ICIC), 2023, pp. 1–6.

[16] E. A. Beldiq, B. Callula, N. A. Yusuf, and A. R. A. Zahra, "Unlocking Organizational Potential: Assessing the Impact of Technology through SmartPLS in Advancing Management Excellence," *APTISI Trans. Manag.*, vol. 8, no. 1, pp. 40–48, 2024.

[17] M. Herdegen-Radwan, S. Cattelan, J. Buda, J. Raubic, and J. Radwan, "What do orange spots reveal about male (and female) guppies? A test using correlated responses to selection," *Evolution (N. Y).*, vol. 75, no. 12, pp. 3037–3055, 2021.

[18] I. N. Y. Parawangsa, M. F. Rahardjo, and C. P. H. Simanjuntak, "Reproduction aspect of green swordtail, Xiphophorus hellerii Heckel 1848 in Tamblingan Lake, Bali," *J. Iktiologi Indones.*, vol. 20, no. 1, pp. 81–92, 2020.

[19] J. A. Rocamontes-Morales, C. Gutiérrez-Rodríguez, O. Rios-Cardenas, and P. C. Hernandez-Romero, "Genetic and morphological differentiation in the green swordtail fish, Xiphophorus hellerii: The influence of geographic and environmental factors," *Hydrobiologia*, vol. 848, pp. 4599–4622, 2021.

[20] M. G. Hardini, N. A. Yusuf, and A. R. A. Zahra, "Convergence of Intelligent Networks: Harnessing the Power of Artificial Intelligence and Blockchain for Future Innovations," *ADI J. Recent Innov.*, vol. 5, no. 2, pp. 200–209, 2024.

[21] N. JE and G. UU, "Size Variation Survey of the Family of Cichlids in Lower River Benue," *Asian J. Res. Zool.*, vol. 7, no. 2, pp. 36–41, 2024.

[22] D. Bennet, L. Maria, Y. P. A. Sanjaya, and A. R. A. Zahra, "Blockchain technology: Revolutionizing transactions in the digital age," *ADI J. Recent Innov.*, vol. 5, no. 2, pp. 194–199, 2024.

[23] N. Hadi, N. S. Ainy, and M. Rais, "Konservasi Hulu Sungai Ciliwung Dengan Kegiatan Restocking Ikan Asli (Indigenous Species)," *J. Pengabdi. Masy. Ilmu Kegur. dan Pendidik.*, vol. 3, no. 1, pp. 18–23, 2020.

[24] N. R. Buwono, Y. Risjani, and A. Soegianto, "Spatio-temporal patterns of occurrence of microplastics in the freshwater fish Gambusia affinis from the Brantas River, Indonesia," *Environ. Pollut.*, vol. 311, p. 119958, 2022.

[25] H. Effendi, M. Aprilia, P. A. Permatasari, and L. F. Amalo, "Aquatic eDNA for monitoring fish biodiversity in Ciliwung River, Indonesia," *Aquac. Aquarium, Conserv. Legis.*, vol. 15, no. 6, pp. 3311–3318, 2022.

[26] D. Ratnaningsih, R. P. Lestari, E. Nazir, R. Fauzi, and B. Kurniawan, "Penggunaan IKA-INA dalam Penilaian Kualitas Air dengan Dua Skenario Kurva Sub-Indeks," *Ecolab*, vol. 14, no. 2, pp. 125–135, 2020.

[27] M. R. Rahmat, "Pengaruh ledakan populasi ikan sapu-sapu (Pterygoplichthys spp) terhadap produksi hasil tangkapan jaring insang di Perairan Danau Sidenreng," *ALBACORE J. Penelit. Perikan. Laut*, vol. 4, no. 1, pp. 13–19, 2020.

[28] Y. S. Dewi, "Influence of Type and Dose of Coagulants on Vehicle Wash Wastewater," *ADI J. Recent Innov.*, vol. 6, no. 1, pp. 8–16, 2024.

[29] E. E. Djajasasana and J. R. K. Bokau, "Utilization of Micro Influencers and Engagement in Social Media to Gain Cadet Candidates," *ADI J. Recent Innov.*, vol. 6, no. 1, pp. 1–7, 2024.

[30] P. E. Jones *et al.*, "The use of barriers to limit the spread of aquatic invasive animal species: A global review," *Front. Ecol. Evol.*, vol. 9, p. 611631, 2021.

[31] D. Agustina, E. Nursa'adah, and A. Ruyani, "Morfometrik Ikan Cere (Gambusia affinis) dan Ikan Putian (Rasbora argyrotaeni) yang Terpapar Merkuri di Sungai Tambang Saweak Kabupaten Lebong," *Biosci. J. Ilm. Biol.*, vol. 11, no. 1, pp. 551–560, 2023.