e-ISSN: 2987-0836 DOI: https://doi.org/10.59585/ijh

Publish: Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage: https://jurnal.agdosi.com/index.php/IJHS/index
Volume 2 | Number 2 | June 2024 |

Literature Review: Microplastic Content in the Digestive Tracts of Fish in Indonesian Waters

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Abstract

Plastic waste is the biggest problem that is happening in Indonesia. Plastic waste has resistance and the nature of Persiden. Increased production and low recovery rates cause accumulation of plastic flakes in waters called microplastic. Microplastic has the potential to be swallowed by aquatic biota that can cause internal bleeding and blockage of the digestive tract. Hue microplastic will affect humans who consume them. One of the aquatic biota that is often contaminated by microplastic is fish. Research related to microplastic contamination in the digestive tract of fish has often been carried out. This study examines the level of microplastic contamination in the digestive tract of fish in Indonesian waters refers to the available literature. The results showed that there were 5 types of microplastics contaminated in the digestive tract of fish in Indonesia, namely fiber, film/filament, fragments, pellets, rows, foam and granules.

Keywords: Microplastics, Contamination, Waters, Environment

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1. Introduction

A Indonesia has a sea area of threequarters of the total territory, with a coastline length of 95,161 km, which is the second longest after Canada (Arianto, 2020). Indonesia is the largest archipelagic country in the world and is a tropical country rich in biological

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International Journal of Health Sciences (IJHS)
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resources. The potential for fisheries biological resources from Indonesian seas reaches approximately 6.4 million tons per year (Lasabuda, 2013). However, almost all Marine waters in Indonesia are polluted by rubbish, especially plastic waste. Suryono (2019) stated that plastic with its specific density is the largest constituent of waste in the ocean, up to 90% of the total. Plastic can be found on coastlines, floating, floating in the water column or at the bottom of the ocean.

Plastic waste in the sea comes from domestic and industrial activities with low waste management (Lestari & Trihadiningrum., 2019). The presence of plastic in the sea is found in different abundances on the surface, middle and bottom of the sea (Firdaus et al., 2019). Plastic waste has durability and persistent properties. Continuously increasing production and low recovery rates have led to the accumulation of plastic debris in waters (Barnes et al., 2019).

Plastic will be degraded into microplastics and nanoplastics through physical, chemical and biological processes (Fernanda, 2021). Physical degradation of plastic polymers can occur through UV radiation and water currents (Wijaya & Trihadiningrum, 2019). Microplastics measuring less than 5 mm (Lusher et al., 2017). Microplastic sources are grouped into two, namely primary and secondary. Primary microplastics are microplastics that have been designed and produced with a size of 5 mm, such as in cleaning and beauty products, pellets for animal feed, resin powder, and plastic production feed (Ariskha, 2019). Meanwhile, secondary microplastics come from the degradation of smaller plastics after photodegradation production in the marine environment and the weathering process of other waste such as discarded plastic bags or fishing nets (Eriksen et al., 2014).

Microplastics nature toxic for environment, especially waters. Permatasari & Radityaningrum (2020) stated that microplastics also have the potential to be ingested by aquatic biota, and have the potential to cause internal bleeding and blockages in the digestive tract. Apart from that, microplastics also have negative effects in the food chain and reach humans. Microplastics can be ingested by aquatic biota accidentally in the process of looking for food. One of the aquatic biota that is often contaminated by

e-ISSN: 2987-0836 DOI: https://doi.org/10.59585/ijh

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microplastic waste is fish. Yona et al., (2020) stated that fish body organs that can be exposed to microplastics include the gills, digestive tract and stomach. The digestive tract of fish is a place where microplastic accumulation can occur. Based on research conducted by Hwang et al. (2019) presence of microplastics polypropyleneon biota can have a negative effect, plastic particles measuring <20um have the potential to increase cytokine production from immune cells in the human body. Therefore, this research was conducted to determine the microplastic content in the digestive tract of fish in various waters in Indonesia and determine its impact on humans and the surrounding environment.

2. Research Method

This study is a study that contains journal articles from 2019 to 2024 using a database Google Scholar and Science Direct.This study focuses on microplastic pollution in the digestive tract of fish in Indonesian waters. The keywords "microplastic", "fish digestive tract" and "water" were used as references in searching for the percentage of microplastic types found in waters. The selection of article types is also reviewed in terms of year of publication. The article can be accessed in its entirety and discusses microplastic contamination in the fish digestive tract and its impact on the environment. It is hoped that this article can explain the state of Indonesia's marine waters.

3. Results And Discussions

1) Microplastic

Microplastics Microplastics has a small size, namely less than 5 mm (Haji et al., 2021). Microplastics can come from various sources and can contaminate the environment. Hajj et al. (2021) said that the types of microplastics based on their source are divided into 2, namely primary microplastics and secondary microplastics. Primary microplastics are microplastics that are produced in small sizes for certain purposes, while secondary microplastics are microplastics that come from the decomposition of previous, larger plastics. Azizah et al. (2020) added that microplastics have various types with variations in size, shape, color, composition and density.

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2) Type of Microplastics Based on Their Shape

Based on shape, particle microplastics categorized as become fiber/filament (thin or straight fibers), pellets (hard, jagged), foam (light like a sponge), or film (thin plane) (Ariskha, 2019). Fiber comes from clothing fibers, rigging and fishing equipment such as nets or fishing rods (Hiwari et al.,2019). Pellets are a type of primary microplastic that comes from raw materials for making plastic which are made directly by factories. Fragments are secondary microplastics that come from pieces of plastic that are strong polymers such as polypropylene, polyethylene, polystryrene (Hastuti et al.,2014). Meanwhile, foam can come from fragmentation of microplastics such as styrofoam. Film is classified as a secondary microplastic which is formed from the fragmentation of plastic and food packaging and plastic bags (Budiarsa & Ritonga, 2015). Granules are generally classified as primary types of microplastics, such as microbeads found in beauty products or hygiene products (Budiarsa & Ritonga, 2015).

3) Characteristics of Microplastics

The color characteristics of microplastics are divided into six categories, namely, blue, black, yellow, transparent, white and red. Types of plastic polymers are ethylene vinyl acetate copolymer (EVA), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC) cellophone (CP), polyvinyl acetate (PVA) and polyamide (PA) (Lithner et al., 2019). The types of polymers that are most widely used and become pollutants in coastal and marine environments are polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET) and polyvinyl chloride (PVC) (Andrady, 2019).

In 2020 researchers reported that polypropylene baby feeding bottles with contemporary preparation procedures were found to cause exposure to microplastics in babies ranging from 14,600 to 4,550,000 particles per capita per day in 48 regions. Microplastic release was higher with warmer fluids and similar to other polypropylene products such as lunch boxes (Li, 2020). Su (2021) states that baby bottle nipples made of silicone rubber degrade over time from repeated steam

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sterilization. This will release micro and nano sized silicone rubber particles. The results also estimate that using heatdegraded nipples causes babies to ingest more than 660,000 particles in a year.

Based on research conducted by Mason (2018), 93% of bottled drinking water from 11 different brands showed microplastic contamination. Researchers found an average of 325 microplastic particles in every liter of bottled drinking water. Of the brands tested, Nestlé Pure Life and Gerolsteiner bottles contained the most microplastics with 930 and 807 microplastic particles per liter (MPP/L), respectively. Compared to water from the tap, water from plastic bottles contains twice as many microplastics. Some contamination likely comes from the water bottling and packaging process.

Disposable face masks are made from polymer materials, such as polypropylene, polyurethane, polyacrylonitrile, polystyrene, polycarbonate, polyethylene, or polyester. Once damaged, disposable face masks can break down into particles smaller or less than 5 mm, which can give rise to new sources of microplastics. This occurs due to increased production and consumption, thereby adding to the list of environmental challenges caused by the increase in plastic plastics in the environment (Fadare, 2020).

4) Impact of Microplastics on Fish

Microplastics cause contamination in all aquatic biota. Microplastics can affect aquatic organisms physically and chemically. If ingested by marine biota, microplastics can pass through the intestines or be retained in the digestive tract. The emergence of microplastics can reduce fish appetite. Because hydrophobic organic chemicals have a high rate of energy change on the surface of microplastics. It is feared that microplastics can carry chemical contaminants, both organic and inorganic. Because they do not meet food safety standards, microplastics are very dangerous for public health. Microplastics in the human body can cause intestinal inflammation and weaken the immune system (Purnama et al., 2021).

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Plastic contains dangerous substances that can cause death. Plastic that is thrown into the water will become sediment in sea water. Some metals, such as heavy metals and organic chemicals, can pollute seawater when humans eat contaminated marine biota. In addition, increased fish consumption in some countries can cause microplastic contamination in humans. The research results show that microplastic intake ranges from 112-842 microplastics/g per year, this amount varies by country. Microplastics were found in every human tissue studied by graduate students at Arizona State University. A study published in March 2022, revealed that Microplastics had also been found in 80% of 22 anonymous blood samples, meaning they can be transported throughout the human body and raising the question of whether they can transported to the brain (American Chemical Society, 2021). In December 2020, microplastic particles were found in the placentas of unborn babies for the first time (The Guardian, 2022). Exposure to microplastics ranges from 3078 microplastics per year per capita in countries with high fish consumption. As a result of the habit of coastal communities to eat the fish they catch, there is a possibility that microplastics can enter the body through the consumption of marine fish. In another study, as many as 7% of 270 fish samples contained microplastics in edible fish tissue. So, if microplastics contaminate fish consumed by coastal communities, the microplastics will enter the human body and can cause health problems if exposure is high (Aulia et al., 2023).

Food safety analysis of microplastic content is very important to ensure that fish is safe for consumption. Fish is a routine consumption item in society. Malnutrition or poor fish condition, as well as abnormal liver weight, can be caused by the absorption of toxic compounds from microplastic polymers in aquatic biota. The consequences that will occur due to the absorption of harmful substances from microplastic polymers are reduced growth rate, decreased levels of steroid hormones in the blood, stopping enzymes, reproductive disorders, as well as greater opportunities for fish exposure to plastic additives (Puspita et al., 2023). Following

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are several locations where microplastic content was found in the digestive tract of fish in Indonesian waters.

Table 1.
Distribution of microplastics in the digestive tract of fish in Indonesian waters

No	Location	Province	Types of Microplastic Content						
			Fiber/ Filament	**Film**	**Fragmen**	**Pellets**	**Line**	**Foam**	**Granule**
1	TPI Lampulo, Banda Aceh	Aceh							
2	Baai Island	Bengkulu	√	√	√				√
3	Ternate Island Waters	North Maluku	√	√	√	√	√	√	
4	Belawan Ocean Fishing Port	North Sumatera	√	√	√				
5	Remu River Waters	Papua Barat	√	√	√				
6	Liki Island	Papua	√						
7	Befondi Island	Papua	√						
8	Miossu Island	Papua	√						
9	Palu City Waters	Central Sulawesi							√
10	Bintaro Waters	DKI Jakarta	√	√	√	√		√	
11	Indah Kapuk Coast	DKI Jakarta	√	√	√				
12	Tuban Waters	East java	√		√	√			
13	Brantas River	East java	√	√	√	√			
14	Brondong Coast	East java	√	√	√				
15	Pelayaran River	East java	√	√	√				
16	Pangandaran Gulf	West Java	√		√				
17	Kedongan Waters	Bali	√	√	√				
18	Palu Gulf Waers	Central Sulawesi			√				
19	Koto Panjang Hydropower reservior	Riau	√	√	√				
20	Bengkalis Island Waters	Riau	√	√	√				
21	Dumai City Sea	Riau	√	√	√				
22	Coastal waters of the Karimun Island	Riau	√	√	√				
23	Talisayan Sea waters	East Kalimantan	√	√					

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Table 2.
List of research on microplastic content in the digestive tract of fish in Indonesian waters

No	Type of Waters	Type of Biota	Type of Mikroplastic	Abundance	Review Source
1	Baai Island, Bengkulu	Tuna	Fragmen	4,29 particel/ind	Purnama et al. (2021)
			Granul	0,42 particel/ind	
			Film	1,54 particel/ind	
			Fiber	4,31 particel/ind	
2	Brondong Coastal Waters, Lamongan	Swanggi Fish	Fragmen	4 particel/g	Labibah and Triajie (2020)
			Film	2 particel/g	
			Fiber	25 particel/g	
3	Belawan Port, North Sumatera	Mackarel	Fragmen	1,36 particel/g	Arisanti et al. (2023)
			Film	2,30 particel/g	
			Fiber	0,52 particel/g	
4	Liki Island, Papua	*M. hexagona*	Fiber	11.10 particel/g	Yona et al. (2020)
		S. caudimaculatum		28.30 particel/g	
		C. urodeta		12.17 particel/g	
5	Befondi Island, Papua	*L. kasmira*	Fiber	9.94 particel/g	Yona et al. (2020)
		B. undulatus		2.08 particel/g	
		L. gibbus		1.60 particel/g	
		S. caudimaculatum		1.57 particel/g	
6	Miossu Island, Papua	*L. xanthopinnis*	Fiber	16.50 particel/g	Yona et al. (2020)
7	Koto Panjang Hydropower Reservoir, West Sumatera	Kapiek Fish	Film	2 particel/ind	Margaretha et al. (2022)
			Fiber	13,4 particel/ind	
			Fragment	15,8 particel/ind	
8	Palu City	Mackarel	Fragment	0,022 particel/g	Hermawan et al. (2023)
		Baronang Fish	Fragmnet	0,071 particel/g	
9	Sidoarjo Cruise	Parrot Fish	Fragmen	621 particel/ind	Fatih (2021)
			Filamen	18 particel/ind	
			Fiber	2 particel/ind	
10	Remu Waters, Sorong, West Papua	Baronang Fish	Fragmen	4 particel/ind	Iriani et al. (2023)
			Filamen	11 particel/ind	
			Fiber	40 particel/ind	
11	Indah Kapuk Coastal Waters, Jakarta	*Oreochromis mossambicus*	Fiber	4.30 ± 4.7 particel/ind	Hastuti et al. (2019)
			Film	0.60 ± 0.7 particel/ind	
		Scatophagus argus	Fiber	5.22 ± 4.3 particel/ind	
			Film	0.28 ± 0.6 particel/ind	
			Fragmen	0.39 ± 0.5 particel/ind	
		Siganus canaliculatus	Fiber	17.97±5.8 particel/ind	
			Film	0.03±0.01 particel/ind	
			Fragmen	0.06±0.02 particel/ind	
		Crenimugil seheli	Fiber	8.42±11.9 particel/ind	
			Film	0.42 ± 1.1 particel/ind	
			Fragmen	0.33 ± 0.6 particel/ind	
		Mugil cephalus	Fiber	9.26 ± 6.1 particel/ind	
			Film	0.19 ± 0.6 particel/ind	

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			Fragmen	0.63 ± 2.3 particel/ind	
		Chanos chanos	Fiber	8.00 ± 6.3 particel/ind	
			Film	1.00 ± 1.4 particel/ind	
			Fragmen	0.70 ± 1.1 particel/ind	
		Anodontostoma chacunda	Fiber	12.50±6.7 particel/ind	
			Fragmen	1.50 ± 1.4 particel/ind	
		Sardinella fimbriata	Fiber	14.60±6.09 particel/ind	
			Film	1.80 ± 2.8 particel/ind	
			Fragmen	3.60 ± 3.7 particel/ind	
		Abalistes stellaris	Fiber	16.07±11.05 particel/ind	
			Film	0.13 ± 0.6 particel/ind	
			Fragmen	0.13 ± 0.4 particel/ind	
12	Tuban Waters, East Java	*Epinephelus areolatus* *Nemipterus japonicus* *Alepes vari* *Atropus Atropos*	Fiber Fragmen Pellet	NA	Hidayati et al. (2023)
13	Pangandaran Gulf, West Java	*Johnius* sp. *Trichiurus* sp.	Fragmen Fiber Film	NA	Ismail et al. (2019)
14	Brantas River, East Java	*Gambusia affinis*	Fragmen Fiber Film Pellet	140.74 - 5192.59 partikel/m3	Buwono et al. (2021)
15	Bintaro Waters, Jakarta	*Naso thymnoides* *Auxis rochei* *Caesio teres*	Fiber Film Foam Fragmen Pellet	18.17±7.93 MPs/100 g 21.60±8.70 MPs/100 g 7.07 MPs/100 g	Widyastuti et al. (2023)
16	Ternate Waters Island	*Epinephelus fuscogutattus* *E. coioides* *E. suillus* *Siganus canaliculatus* *Synanceia* *Scarus Psittacus*	Fragmen Film Foam Fiber Line Pellet	NA	Muhdhar et al. (2021)
17	Kedongan Island, Bali	*Lutjanus malabaricus*	Fragmen Fiber Film	7,86 MPs/ikan	Panjaitan et al. (2021)
		Lutjanus gibbus	Fragmen Fiber Film	4,46 MPs/fish	
18	Palu Gulf, Central Sulawesi	*Rastrelliger neglectus*	Fragmen	1,84±0,35 MPs/g	Hermawan et al. (2022)
		Carangoides coeruleopinnatus		1,67 MPs/g	
				3,58 ± 0,36 MPs/g	

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		Upeneus sulphureus			
		Caranx Latus		0	
		Caranx ignobilis		0	
19	TPI Lampulo Banda Aceh	*Euthynnus affinis* C.	NA	0	Yumni et al (2020)
		Sardinella lemuru		0	
20	Bengkalis Island, Riau	*Arius maculatus* *Harpodon nehereus* *Setipinna breviceps*	Fiber Film Fragmen	63 MPs/Fish	Amin et al. 2020
21	Dumai Waters, Riau	*Eleutheronema tetradactylum*	Film Fiber Fragmen	966 particel/individu	Mirad et al. 2020
22	Karimun Besar Island, Riau	*Polydactylus octonemus*	Film Fiber Fragmen	2 particel/ind 11 particel/ind 2 particel/ind	Munandar et al. 2021
23	Talisayan Waters Sea, Kalimantan Timur	*Stolephorus* spp	Film Fiber	366 ± 3,51 particel/individu	Ningrum et al, 2019

Note: NA = Not Available

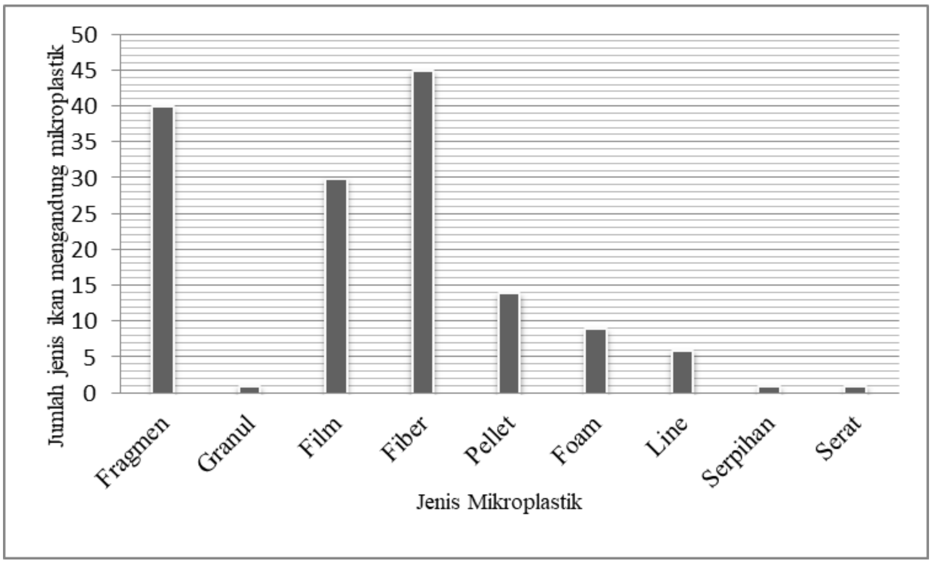

Figure 1.Number of fish species containing microplastics in Indonesian waters

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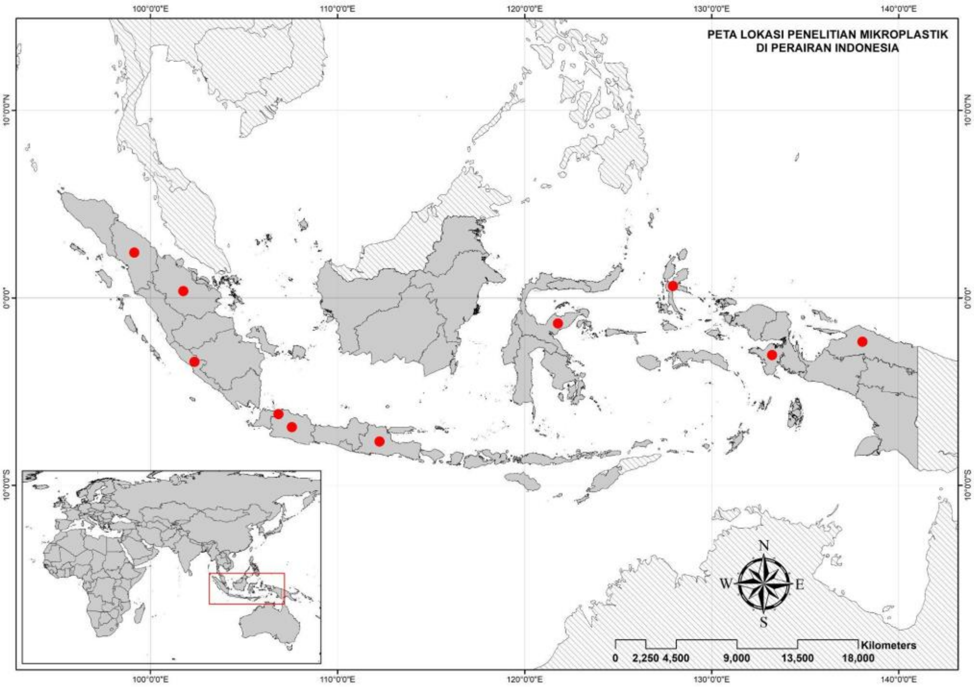

Figure 2.Map of research locations for microplastic content in fish in Indonesian waters

4. Conclusion

Based on literature studies that have been carried out, it is indicated that research on microplastic contamination in the digestive tract of fish in Indonesian waters is still limited. This shows that of the 38 provinces in Indonesia, only 10 provinces have conducted research on microplastic contamination in the digestive tract of fish. From 10 provinces in Indonesia, a total of 6 types of microplastics were found in the fish digestive tract, namely fiber, film/filament, fragment, pellet, foam, line and granule. The fiber type of microplastic is the microplastic that is most often found in the digestive tract of fish in Indonesian waters in the 10 provinces that have been studied. Microplastics in the fish's digestive tract have a negative impact on humans who consume them because the microplastics are not just excreted directly into the human body but can also through consumed fish and cause various health problems if exposure is high.

Research about contamination more microplastics in the digestive tract of fish in Indonesian waters need to be done to ensure regional management and to preserve marine biota, especially fish which are often consumed by the public.

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References

1. Amin, B., Febriani, I. S., Nurrachmi, I., dan Fauzi, M., (2020), Microplastics in Gastrointestinal Track of Some Commercial Fishes from Bengkalis Waters, Riau Province Indonesia. Journal of Physics: Conference Series, 1655(1), 012122.
2. Andrady, A. L. 2019. Microplastics in the marine environment. Marine Pollution Bulletin, 62(8), 1596– 1605.
3. Arianto, M. F. (2020). Potensi wilayah pesisir di negara Indonesia. Jurnal Geografi, 20 (20), 1-7.
4. Ariyanto, D. 2020. Analisis keragaman bentuk tubuh ikan nila strain gift pada tingkatan umur yang berbeda. Jurnal Perikanan Universitas Gadjah Mada, 4 (1), 1926.
5. Arisanti, G., Yona, D., & Kasitowati, R. D. (2023). Analisis Mikroplastik pada Saluran Pencernaan Ikan Kembung (Rastrelliger sp.) di Pelabuhan Perikanan Samudera Belawan, Sumatera Utara. PoluSea: Water and Marine Pollution Journal, 1 (1), 45-60.
6. Ariskha, P. T. 2019. Studi Kandungan Micro Debris Pada Sistem Distribusi Air Minum Daerah Surabaya Timur Di IPAM Ngagel III. Skripsi, Institut Teknologi Sepuluh Nopember. Surabaya.
7. Aulia, A., Aziziah, R., Sulistyorini, L., & Rizaldi, M. A. (2023). Literature Review: Dampak Mikroplastik Terhadap Lingkungan Pesisir, Biota Laut dan Potensi Risiko Kesehatan. Jurnal Kesehatan Lingkungan Indonesia, 22(3), 328-341.
8. Azizah, P., Ridlo, A., & Suryono, C. A. (2020). Mikroplastik pada sedimen di Pantai Kartini Kabupaten Jepara, Jawa Tengah. Journal of Marine Research, 9(3), 326-332.
9. Budiarsa, A., & Ritonga, I. R. (2015). Distribution of microplastic at sediment in the Muara Badak Subdistrict, Kutai Kartanegara Regency-Indonesia. http://dx.doi.org/10.13170/depik.4.3.2888
10. Buwono, N. R., Risjani, Y., & Soegianto, A. (2021). Contamination of microplastics in Brantas River, East Java, Indonesia and its distribution in gills and digestive tracts of fish Gambusia affinis. Emerging Contaminants, 7(1), 172-178.
11. Barnes, D. K. A., Galgani, F., Thompson, R. C., & Barlaz, M. 2009. Accumulation and fragmentation of plastic debris in global environments. Philosophical Transactions of the Royal Society B: Biological Sciences, 364(1526), 1985–1998.
12. Dikmenli, M., & Gaffar, S., (2010). Misconceptions of cell division held by student teachers in biology: A drawing analysis. Scientific Research and Essay, 5(2), 235–247.
13. Eriksen, M., Lebreton, L. C. M., Carson, H. S., Thiel, M., Moore, C. J., Borerro, J. C., Galgani, F., Ryan, P. G., & Reisser, J. 2014. Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons.

e-ISSN: 2987-0836 DOI: https://doi.org/10.59585/ijh

Publish: Association of Indonesian Teachers and Lecturers
International Journal of Health Sciences (IJHS)
Journal Homepage: https://jurnal.agdosi.com/index.php/IJHS/index
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14. Fatih, A. F. (2021). Identifikasi Mikroplastik Pada Sistem Pencernaan Ikan Nila (Oreochromis niloticus) di Kali Pelayaran Kabupaten Sidoarjo. Environmental Pollution Journal, 1(3), 237-244.
15. Firdaus, M., & Mazlan. (2020). Species Diversity And Conservation Status Of Ray Fish (Elasmobranchii) In Tarakan Water. Jurnal Harpodon Borneo, 13(1).
16. Firdaus, M., Trihadiningrum, Y., Lestari, P. 2019. Microplastic pollution in the sediment of Jagir Estuary, Surabaya City, Indonesia. Marine Pollution Bulletin, 150, 110790.
17. Haji, A. T. S., Rahadi, B., & Firdausi, N. T. (2021). Analisis kelimpahan mikroplastik pada air permukaan di Sungai Metro, Malang. Jurnal Sumberdaya Alam dan Lingkungan, 8(2), 74-84.
18. Haryono, M. G., Firdaus, M., Sumarlin, Gaffar, S., & Mazlan. (2020). Species Diversity And Conservation Status Of Ray Fish (Elamobranchii) In Tarakan Water. Jurnal Harpodon Borneo, 13(1).
19. Hastuti, A. R., Yulianda, F., & Wardiatno, Y. (2014). Distribusi spasial sampah laut di ekosistem mangrove Pantai Indah Kapuk, Jakarta. Bonorowo Wetlands, 4(2), 94–107. 10.13057/bonorowo/w040203
20. Hiwari, H., Purba, N. P., Ihsan, Y. N., & Yuliadi, L. P. S. (2019). Condition of microplastic garbage in sea surface water at around Kupang and Rote, East Nusa Tenggara Province. Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia, 5(2), 165–171. https://doi.org/10.13057/psnmbi/m050204
21. Hastuti, A. R., Lumbanbatu, D. T. F., & Wardianto, Y. (2019). The presence of microplastics in the digestive tract of commercial fishes off Pantai Indah Kapuk coast, Jakarta, Indonesia. Biodiversitas, 20(5), 1233-1242.
22. Hermawan, R., Akbar, M., Salanggon, A. M., Aristawati, A. T., Renol., Finarti., Pramita, E. A., Adel, Y.S., Dewanto, D. K., & Syahril. (2023). Kajian Mikroplastik Pada Ikan Ekonomis di Pasar Tradisional Kota Palu. Jurnal Kelautan, 16(1), 1-9.
23. Hidayati, D., Fauziyah., Aunurohim., Ashuri, N. M., Setiawan, E., Mulyadi, Y., Syahroni, N., Joesidawati, M. I., & Suwarsih. (2023). Microplastic characteristic found in gastrointestinal tract of pelagic and demersal fishes in Tuban, East Java. Journal of Marine-Earth Science Technology, 4(1), 9-15.
24. Iriani, R. T., Rahim, N., Difinubun, M. I., & Risfany. (2023). Identifikasi Keberadaan Mikroplastik di Saluran Pencernaan Ikan Baronang (Siganus canaliculatus) Hasil Tangkapan Warga Di Perairan Kali Remu Kota Sorong Papua Barat. Jurnal Aquafish Saintek, 3(1), 1-10.
25. Ismail, M. R., Lewaru, M. W., & Prihadi, D. J. (2019). Microplastics ingestion by fish in the Pangandaran Bay, Indonesia. World News of Natural Sciences, 23(1), 173-181.

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Journal Homepage: https://jurnal.agdosi.com/index.php/IJHS/index
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26. Labibah, W., & Triaje, H. (2020). Keberadaan Mikroplastik pada Ikan Swanggi (Priacanthus tayenus), Sedimen Dan Air Laut di Perairan Pesisir Brondong, Kabupaten Lamongan. Jurnal Juvenil, 1(3), 351-358.
27. Lasabuda, R. (2013). Pembangunan wilayah pesisir dan lautan dalam perspektif negara kepulauan Republik Indonesia. Jurnal Ilmiah Platax, 1 (2), 92-101.
28. Lestari, P. dan Trihadiningrum, Y. 2019. The impact of improper solid waste management to plastic pollution in Indonesian coast and marine environment. Marine Pollution Bulletin, 149, 110505.
29. Lithner, D., Larsson, A., & Dave, G. 2019. Environmental and health hazard ranking and assessment of plastic polymers based on chemical composition. Science of the Total Environment, 409(18), 3309–3324.
30. Lusher, A., Hollman, P., & Mandoza-Hill, J. 2017. Microplastics in fisheries and aquaculture. In FAO Fisheries and Aquaculture Technical Paper, 615.
31. Margaretha, L. S., Budijono., & Fauzi, M. (2022). Identifikasi Mikroplastik pada Ikan Kapiek (Puntius schawanafeldii) di Waduk PLTA Koto Panjang Kabupaten Kampar Provinsi Riau. Jurnal Perikanan dan Kelautan, 27(2), 235-240.
32. Mirad, A., Dessy, Y., & Thamrin. (2020). Identification Microplastic Waste in Seawater and The Digestive Organs of Senangin Fish (E. tetradactylum) at Dumai City Sea Waters. Asian Journal of Aquatic Sciences, 3(3),248-259.
33. Muhdhar, M. H. I. A., Sumberartha, I. W., Hassan, Z., Rahmansyah, M. S., & Tamalene, M. N. (2021). Examination of microplastic particles in reef fish food in Ternate Island Waters, Indonesia. Jordan Journal of Biological Sciences, 14(4), 853-858.
34. Munandar, A. D., Bintal, A., & Syafruddin Nasution., (2021), Microplastic in the Digestive Tract of Kurau (Polydactylus octonemus) in the Coastal Waters of Karimun Besar Island, Riau Islands Province. Journal of Coastal and Ocean Sciences, 2(2), 80-86.
35. Ningrum, E.W., Patria, M.P., & Sedayu, A., (2019), Ingestion of microplastics by anchovies from Talisayan harbor, East Kalimantan, Indonesia. Journal of Physics: Conference Series. 1-6.
36. Panjaitan, g. G. M., Perwira, I. Y., & Wijayanti, N. P. P. (2021). Profil Kandungan dan Kelimpahan Mikroplastik pada Ikan Kakap Merah (Lutjanus sp.) yang Didaratkan di PPI Kedonganan, Bali. Current Trends in Aquatic Science, 4(3): 116-121.
37. Purnama, D., Johon, Y., Wiloo, M. D., Renta, P. P., Sinaga, J. M., Yosefa, J. M., Marlina, H., Suryanita, A., Pasaribu, H. M., & Median, K. (2021). Analisis Mikroplastik Pada Saluran Pencernaan Ikan Tongkol (Euthynnus affinis) Hasil Tangkapan Nelayan Di Pelabuhan Perikanan Pulau Baai Kota Bengkulu. Jurnal Enggano, 6(1), 110-124.

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International Journal of Health Sciences (IJHS)
Journal Homepage: https://jurnal.agdosi.com/index.php/IJHS/index
Volume 2 | Number 2 | June 2024 |

38. Puspita, D., Nugroho, P., & Sena, E. N. (2023). Analisa Kandungan Mikroplastik pada Organ Ikan Konsumsi dari Rawa Pening. Journal Science of Biodiversity, 4(1), 16-22.
39. Sumarlin, Gaffar, S., & Mazlan. (2020). Species Diversity And Conservation Status Of Ray Fish (Elamobranchii) In Tarakan Water. Jurnal Harpodon Borneo, 13(1).
40. Suryono, D. D. (2019). Sampah plastik di perairan pesisir dan laut: implikasi kepada ekosistem pesisir DKI Jakarta. Jurnal Riset Jakarta, 12 (1), 17-23.
41. Widyastuti, S., Abidin, A. S., Hikmaturrohmi, H., Ilhami, B. T. K., Kurniawan, N. S. H., Jupri, A., Candri, D. A., Frediansyah, A., & Prasedya, E. S. (2023). Microplastic contamination in different marine species of Bintaro Fish market, Indonesia. Sustainability, 15(1), 1-14.
42. Wijaya, B. A., & Trihadiningrum, Y. 2019. Pencemaran Meso- dan Mikroplastik di Kali Surabaya pada Segmen Driyorejo hingga Karang Pilang. Jurnal Teknik ITS, 8(2), G211–G216.
43. Yona, D., Maharani, M. D., Cordova, M. R., Elvania, Y., & Dharmawan, I. W. E. (2020). Analisis mikroplastik di insang dan saluran pencernaan ikan karang di tiga pulau kecil dan terluar Papua, Indonesia : kajian awal. Jurnal Ilmu dan Teknnologi Kelautan Tropis, 12 (2), 495-505.
44. Zata, Y., Dewi, Y., dan Muhammad, I.S., (2020), Identifikasi Cemaran Mikroplastik pada Ikan Tongkol (Euthynnus affinis C.) dan Dencis (Sardinella lemuru) di TPI Lampulo, Banda Aceh, Jurnal Ilmiah Mahasiswa Pertanian, 5(1), 316-320.