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The Comparative Analysis of Microplastic Contamination in Kembung (*Rastrelliger sp*) and Kurisi Fish (*Nemipterus nemurus*) from Coastal Waters of Mangindara, Indonesia

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Abstract

Background: Microplastics are a major component of marine debris, and their accumulation in aquatic environments can disrupt marine food chains, particularly in fish. Mangindara Village, South Galesong District, Takalar Regency, is a coastal area currently experiencing severe environmental pollution, especially from plastic waste and household effluents. This condition raises serious concern, as plastic debris can degrade into microplastics that are not visible to the naked eye, enter marine organisms such as fish, and ultimately pose risks to human health.

Methods: This study employed an observational design with a descriptive approach and laboratory analysis to examine the presence, types, and abundance of microplastics in Fish kembung (Rastrelliger sp.) and kurisi (Nemipterus nemurus) collected from the waters of Mangindara Village. The study population consisted of fish kembung and kurisi fish captured in the study area. Samples were selected using random sampling, with three individuals from each species analyzed.

Results: The results showed that all examined fish samples contained microplastics. The average microplastic concentration in fish kembung was 0.061 g, whereas kurisi fish exhibited a higher average concentration of 0.085 g. The identified microplastics were predominantly line-shaped and appeared in blue, black, and red colors.

Conclusion: These findings indicate widespread microplastic contamination in coastal fish species consumed by local communities. Therefore, reducing single-use plastic use and improving proper waste management practices are strongly recommended.

Keywords: Microplastics, Fish, Coastal Pollution, Marine Debris

BACKGROUND

Waste pollution is a pervasive global issue, with nearly every country, including Indonesia, facing significant challenges in waste management. Microplastics, defined as microscopic particles resulting from the fragmentation of plastic materials after extended environmental exposure (1, 2), have emerged as a critical concern. Annually, Indonesia is estimated to contribute between 0.48 and 1.29 million metric tons of plastic waste to the marine environment. This plastic waste primarily enters the ocean due to insufficient waste management systems, which permit plastics to flow into rivers and subsequently reach coastal and marine waters (3, 4).

Fish are among the marine organisms most susceptible to microplastic exposure, primarily through feeding and direct interaction with the aquatic environment. Indian mackerel (*Rastrelliger* sp.) and threadfin bream (*Nemipterus nemurus*) are commercially significant species, widely distributed and consumed by coastal communities in the Takalar region. These species exhibit distinct habitat preferences and feeding behaviors: Indian mackerel is predominantly pelagic and feeds on plankton, while threadfin bream is demersal and omnivorous. These ecological differences are believed to influence the degree of microplastic exposure and accumulation within fish tissues (5, 6).

Microplastics constitute a significant form of marine pollution, impacting food webs within coastal and marine ecosystems. As a component of marine debris, the accumulation of microplastics in aquatic environments can disrupt trophic interactions, particularly among fish. The primary route for microplastic entry into fish is ingestion, either directly from the water column or indirectly through contaminated prey. According to a 2016 United Nations report, more than 800 marine species have been contaminated by microplastics, with approximately 69% of cases resulting from ingestion and subsequent accumulation within organisms (7, 8).

Previous studies have documented widespread microplastic contamination in the digestive systems of fish, identifying microplastics in the gastrointestinal tracts of 39 out of 89 fish samples examined. Senduk found that pellet-shaped microplastics were predominant in Indian mackerel, whereas fiber-shaped microplastics were most common in scad fish. Recent literature reviews indicate that the abundance and types of microplastics in Kembung fish (*Rastrelliger kanagurta*) vary considerably depending on geographic location and environmental conditions (9, 10). From a human health perspective, the consumption of microplastic-contaminated fish raises increasing concerns regarding food safety. Microplastics and their associated contaminants may be transferred through the food chain, elevating the risk of human exposure via seafood consumption. Although the long-term health implications remain unclear, emerging evidence suggests potential risks such as oxidative stress, endocrine disruption, inflammatory responses, and cytotoxic effects. These concerns are particularly relevant in coastal communities that rely heavily on marine fish as a primary protein source (11, 12).

Despite growing global attention to microplastic pollution, research examining the relationship between coastal microplastic contamination, bioaccumulation in edible fish species, and potential human health impacts remains limited, particularly in developing coastal regions. Comprehensive investigations into the occurrence and toxicity of microplastics in coastal fish, as well as their implications for human health, are urgently required to inform sustainable coastal management, seafood safety, and public health protection (13-15).

Mangindara Village, located in South Galesong District, Takalar Regency, was selected as the study site due to its position as a coastal area bordering the Flores Sea. This strategic location provides extensive access to marine resources. The majority of Mangindara Village residents depend on fishing as their primary livelihood, making marine ecosystems vital for both economic activities and daily food consumption. Preliminary field observations revealed severe coastal pollution, particularly from plastic waste and household refuse. Significant quantities of waste were observed accumulating along the shoreline, with some debris entering the surrounding waters. This situation is concerning because plastic waste can degrade into microplastics that are undetectable to the naked eye, yet can enter marine organisms and ultimately the human food chain.

Currently, research on microplastic contamination in consumable fish species, especially those harvested directly from coastal waters near human settlements, remains limited. Most existing studies have focused on microplastics in seawater or sediments, or have examined fish without accounting for species differences, capture locations, or varying environmental exposures. Understanding variations in microplastic content among commonly consumed fish species is essential, particularly in coastal areas experiencing significant plastic pollution. Fish inhabiting contaminated waters may ingest microplastic particles, potentially posing a risk to public health through dietary exposure. This study aims to identify differences in microplastic content between Kembung fish (Rastrelliger sp.) and Kurisi fish (*Nemipterus nemurus*) collected from the coastal waters of Mangindara, Indonesia. Specifically, the research conducts a comparative analysis of microplastic contamination in these two species from this region**.**

METHODS

Study Design

This study utilized an observational descriptive approach. Laboratory analysis determined the presence, classification, and concentration of microplastics in fish samples. The research was conducted in Mangindara Village, South Galesong District, Takalar Regency, Indonesia. Sampling and laboratory procedures were executed systematically. were performed according to established procedures.

Setting and Participants

The study population consisted of Kembung fish(*Rastrelliger* sp.) and kurisi fish(*Nemipterus nemurus*) captured from the coastal waters of Mangindara Village. Fish samples were selected using a random sampling technique. A total of six fish were analyzed, comprising three Kembung fish and three threadfin bream.

Sample Preparation and Microplastic Extraction

Fish samples were dissected to isolate the intestines. The abdominal cavity was opened with a sterile scalpel. Intestines were removed and rinsed with distilled water to remove contaminants.Each intestinal sample was placed in a clean glass beaker, then a 10% potassium hydroxide (KOH) solution was added until the tissue was fully submerged. The beakers were covered with aluminum foil to prevent airborne contamination and incubated in an oven or incubator at 40–60°C for 24–48 hours until complete tissue digestion was achieved. The solution was gently stirred periodically to facilitate digestion.

After digestion, the solution was filtered using membrane filters with pore sizes ranging from 0.45 to 1.2 µm, assisted by a filtration funnel and vacuum pump when available. The filters were rinsed with distilled water to remove residual reagents, placed in sterile petri dishes, and dried either at room temperature for at least 24 hours or in a low-temperature oven set to approximately 40°C until completely dry.

Microplastic Identification

Filters were dried using (insert drying method, e.g., air drying at room temperature or oven drying at 40°C), before examination under a stereo microscope to identify microplastic particles based on morphological characteristics, including shape (line, fragment, film, or granule), color, and size. Prior to examination, samples were stirred at a specified frequency to ensure homogenization. Microplastic identification criteria followed the guidelines proposed by GESAMP (2019). All observed microplastic particles were recorded and classified into observation tables according to the identified categories.

Data Analysis

Descriptive statistics were used to summarize fish length, body weight, intestinal weight, and microplastic abundance. Data normality was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. Because the data were not normally distributed ($p < .05$), nonparametric statistical analyses were applied.

Ethical Considerations

This study received final ethical approval from the Ethics Committee of Universitas Muslim Indonesia (approval number: 337/A.1/KEP-UMI/V/2025).

RESULT AND DISCUSSION

RESULT

Identification of differences in microplastic content in kembung and kurisi fish in Mangindara Village, South Galesong District, Takalar Regency in 2025 can be seen in the following table.

Based on Tables 1 and 2, the measurements for Kembung fish (Rastrelliger spp.) were body lengths of 20.0-25.0 cm, body weights of 100.0-195.0 g, and intestinal weights of 7.0–9.0 g. Kurisi fish (Nemipterus spp.) exhibited body lengths of 20.0–21.5 cm, body weights of 100.0–150.0 g, and intestinal weights of 3.0–5.0 g. A total of 61 microplastic particles were identified across all fish samples. All microplastics observed were line-shaped. Color variation included blue, black, and red, with blue dominant. Kembung fish samples contained 10 particles in sample 1, 10 particles in sample 2, and 11 particles in sample 3. Kurisi fish samples showed similar contamination patterns across all individuals. The size of microplastic particles identified in Kembung fish ranged from 0.433 to 3.325 mm. In threadfin bream (Nemipterus spp.), particle sizes ranged from 0.495 to 5.727 mm, indicating a wider size distribution compared to Kembung fish. Differences in microplastic abundance between Kembung fish and Kurisi fish were analyzed using the Mann–Whitney U test. Multiple linear regression was conducted to examine the relationships among microplastic abundance, fish length, body weight, and intestinal weight. All statistical analyses were performed at a significance level of $\alpha = 0.05$.

Table 1. Results of Identification and Analysis of Microplastics in Kurisi Fish

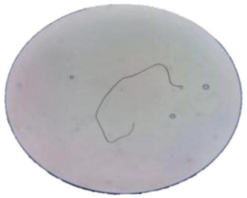
Sample	Lenght fish	Weight fish	Weight bowel	Form	Colour	size	Total per sampel	Picture
Kurisi fish 1	24	100	3	Line	Blue	0.794	9	
				Line	Blue	2.711		
				Line	Blue	1.011		
				Line	Blue	1.573		
				Line	Blue	1.087		
				Line	Red	5.474		
				Line	Blue	1.255		
				Line	Blue	1.312		
				Line	Black	2.621		
Kurisi fish 2	21,5	114	4	Line	Black	4.130	11	
				Line	Blue	2.115		
				Line	Blue	0.961		
				Line	Blue	0.527		
				Line	Blue	1.318		
				Line	Blue	1.337		
				Line	Blue	1.865		
				Line	Blue	2.004		
				Line	Blue	1.610		
				Line	Red	0.585		
				Line	Blue	0.895		
Kurisi fish 3	21,5	114	5	Line	Blue	1.028	10	
				Line	Blue	0.805		
				Line	Blue	1.793		
				Line	Blue	0.886		
				Line	Black	0.971		
				Line	Blue	2.176		
				Line	blue	0.495		
				Line	Blue	1.194		
				Line	Blue	2.936		
				Line	Blue	5.727		
			Total				30	

Table 2. Results of Identification and Analysis of Microplastics in Kembung Fish

Sample	Lenght fish	Weight fish	Weight bowel	Form	Colour	size	Total per sampel	Picture
Kembung fish 1	24	144	7	Line	Blue	2.999	10	
				Line	Blue	1.298		
				Line	Blue	0.527		
				Line	Blue	0.915		
				Line	Blue	2.548		
				Line	Red	2.564		
				Line	Blue	1.828		
				Line	Blue	1.895		
				Line	Black	0.479		
				Line	Red	1.146		
Kembung fish 2	24	171	9	Line	Black	2.871	10	
				Line	Blue	3.099		
				Line	Blue	1.618		
				Line	Blue	3.071		
				Line	Blue	0.571		
				Line	Blue	1.488		
				Line	Blue	3.238		
				Line	Blue	2.481		
				Line	Blue	3.325		
				Line	Blue	1.151		
Kembung fish 3	25	195	8	Line	Black	0.826	11	
				Line	Blue	0.839		
				Line	Blue	0,747		
				Line	Blue	1.618		
				Line	Black	0.991		
				Line	Black	1.800		
				Line	Black	0.433		
				Line	Blue	2.656		
				Line	Blue	0.751		
				Line	Blue	0.731		
				Line	Red	1.072		
			Total				31	

Table 3. Abundance of Microplastic Concentration of kembung Fish in Mangindara Village

Sample fish	Microplastic Abundance (fish weight)	Abundance of Microplastics (Fish Guts)
Kembung fish 1	0,069	1,429
Kembung fish 2	0,058	1,111
Kembung fish 3	0,056	1,375
Average	0,061	1,305

According to Table 3, Microplastic abundance per fish body weight in Kembung ranged from 0.056 to 0.069 particles/g, with an average of 0.061 particles/g. When calculated per unit intestinal weight, microplastic abundance ranged from 1.111 to 1.429 particles/g intestine, with a mean of 1.305 particles/g intestine.

Table 4. Abundance of Microplastic Concentration of Kurisi Fish in Mangindara Village, Takalar

Sample fish	Microplastic Abundance (fish weight)	Abundance of Microplastics (Fish Guts)
Kurisi fish 1	0,06	3
Kurisi fish 2	0,096	1,.75
Kurisi fish 3	0,001	2
Average	0,085	2,583

Based on Table 4, Kurisi fish exhibited higher microplastic abundance than Indian mackerel. Based on body weight, microplastic abundance ranged from 0.060 to 0.100 particles/g, with an average of 0.085 particles/g. Based on intestinal weight, abundance ranged from 2,000 to 3,000 particles/g intestine, with a mean of 2,583 particles/g intestine.

Table 5. Normality Test of kembung fish and Kurisi Fish Based on Fish Weight

Kode sampel	Kolmograv smirnov			Shapiro wilk		
	Stastic	Df	Sig	Stastic	df	Sig
Abundance of Fish	0,267	61	0,000	0,838	61	0,000
Sample	0,146	61	0,003	0,906	61	0,000

The results of the normality test presented in Table 5 indicate that the microplastic data for kurisi fish 1, kurisi fish 2, kurisi fish 3, kembung fish 1, kembung fish 2, and kembung fish 3, based on fish body weight, are not normally distributed, as evidenced by a significance value (Sig.) of 0.000. Consequently, the analysis proceeded with the non-parametric Mann-Whitney test.

Table 6. Mann Whitney Test Results for kembung fish and Kurisi Fish Based on Fish Weight

	Fish weight
Mann-Whitney U	0.000
Wilcoxon W	45.000
Z	-4.359
Asymp Sig (2-tailed)	0,000

Based on Table 6, the Mann-Whitney test results in Table 5 show an Asymp Sig. (2-tailed) of 0.000 (<0.05), which indicates that there is a statistically significant difference in the abundance of microplastic content based on fish weight.

Table 7. Normality Test of Mackerel and Kurisi Fish Based on Fish Intestine Weight

	Code	Kolmogorov Smirnov		Shapiro Wilk		
Sample	Statistic	Df	Sig	Statistic	df	Sig
Abundance of the Intestines	0,252	61	0,000	0,767	61	0,000
Sample	0,146	61	0,003	0,906	61	0,000

Based on the results tabel 7 of the normality test shown in table 6, it is known that the microplastic data in kurisi fish 1, kurisi fish 2, kurisi fish 3, mackerel fish 1, mackerel fish 2 and mackerel fish 3 based on the weight of the fish intestines are not normally distributed, which is indicated by a significance value (Sig.) of 0.000. Therefore, it is continued using the non-parametric Mann-Whitney test.

Table 8. Mann Whitney Test Results for lembung fish and Kurisi Fish Based on Fish Intestine Weight

	Abundance of Fish
Mann-Whitney U	0.000
Wilcoxon W	45.000
Z	-4.359
Asymp Sig (2-tailed)	0,000

The results of the Mann-Whitney test in table 8 show an Asymp Sig. (2-tailed) of 0.000 (<0.05) which indicates that there is a statistically significant difference in the abundance of microplastic content based on the intestinal weight.

Table 9. Multiple Regression Test Results for kembung fish and Kurisi Fish

Model	Unstandardized Coefficients		standar Coefficients	t	Sig
	B	Std. Error	Beta		
(Constant)	-16,283	11,087		1,469	0,280
Fish lenght	-.406	0,695	-1,030	-.585	0,618
Fish weight	0,19	0,043	0,882	0,438	0,704
Intestinal weight	0,085	0,275	0,268	0,310	0,786

Based on table 8 showing the results of the multiple regression analysis displayed in the table, it is known that there is no significant relationship between the abundance of microplastics and fish body length, fish weight, or intestine weight.

DISCUSSION

This study demonstrates that both Kembung (*Rastrelliger* sp.) and Kurisi (*Nemipterus nemurus*) from the coastal waters of Mangindara Village are contaminated with microplastics, as microplastics were detected in all analyzed samples (100%). This finding indicates pervasive plastic pollution in this coastal ecosystem and aligns with previous research documenting high levels of microplastics in marine fish, especially in coastal and nearshore environments with intense anthropogenic activity.

The greater abundance of microplastics in Kurisi fish (Threadfin bream, Nemipterus nemurus, 0.085 particles/g) compared to Kembung fish (Indian mackerel, Rastrelliger sp., 0.061 particles/g) is likely related to differences in ecological behavior and feeding strategies. Kurisi fish, as a demersal species, inhabit bottom waters and sediments, which are frequently sinks for microplastics. In contrast, Kembung fish are pelagic and primarily feed in the water column, where microplastic concentrations are generally lower. Previous studies have similarly reported that demersal fish accumulate more microplastics than pelagic species due to increased interaction with contaminated sediments.

Previous research has demonstrated that microplastic ingestion in marine fish is strongly influenced by habitat and feeding behavior. Studies have also indicated that bottom-dwelling organisms are more susceptible to microplastic exposure due to sediment accumulation. These findings support the current results, particularly regarding the higher contamination levels observed in Kurisi fish. Regarding particle characteristics, the predominance of line-shaped (fiber) microplastics in blue, black, and red colors is consistent with global trends in marine environments. Fibers typically originate from synthetic textiles, fishing gear, and the degradation of ropes. Prior studies have identified fibers as the most prevalent microplastic form in fish gastrointestinal tracts, suggesting that these particles are readily ingested because they resemble natural food items such as plankton. The observed color distribution further supports the hypothesis that fish may selectively ingest microplastics that visually resemble their prey (16-18).

The detection of microplastics in all examined samples indicates a significant level of environmental contamination, which may pose risks to both marine ecosystems and human health. Since fish serve as a primary protein source for coastal communities, including Mangindara, the consumption of contaminated seafood may facilitate the transfer of microplastics and associated toxic substances to humans. This observation is consistent with previous research highlighting the potential for trophic transfer of microplastics along the food chain (19-20). Overall, the present study reinforces evidence that microplastic pollution is widespread in marine environments and varies according to ecological and biological factors. The higher contamination observed in demersal fish compared to pelagic species underscores the role of habitat in determining exposure risk, emphasizing the urgent need for enhanced waste management practices and stronger regulatory frameworks to address plastic pollution (21-22).

When normalized by body weight, Kurisi fish (Threadfin bream, Nemipterus nemurus) exhibited higher microplastic abundance (0.085 particles/g) than Kembung fish (Indian mackerel, Rastrelliger sp., 0.061 particles/g), suggesting that Kurisi fish may experience greater exposure to microplastics per unit of body mass. Factors such as capture location, water column stratification, feeding behavior, and ecological niche likely contribute to this variation. Calculations based on intestinal weight showed that Kurisi fish had substantially higher microplastic concentrations (2.583 particles/g intestine) than Kembung fish (1.305 particles/g intestine). These results support the hypothesis that the gastrointestinal tract is the primary site for microplastic accumulation and that Kurisi fish may be exposed to higher contamination levels in their habitat (23-24). Differences in microplastic abundance between the two species reflect their ecological characteristics. Threadfin bream, which inhabit areas closer to the seabed, may encounter higher concentrations of microplastics that accumulate in sediments or near-bottom waters. As a result, demersal fish species are potentially at greater risk of microplastic ingestion through both direct exposure and trophic transfer.

Previous studies have reported similar patterns of microplastic contamination in marine fish. For example, microplastics were detected in all examined Kembung fish samples collected from Kwatisore waters, Papua Barat, and these samples showed higher microplastic abundance than in studies conducted in less polluted areas. Additionally, microplastics have been identified in the digestive tracts of trevally fish, with the highest accumulation observed in the gastrointestinal organs (25).

Normality test results indicated that microplastic abundance data were not normally distributed ($p < .001$). Consequently, the Mann–Whitney U test was used to assess differences in microplastic content between Kembung (Indian mackerel, Rastrelliger sp.) and threadfin bream (Kurisi, Nemipterus nemurus). The analysis revealed a significant difference in microplastic abundance between the two species ($p < .001$), with Kurisi fish containing significantly higher microplastic loads than Indian mackerel. These findings demonstrate that species-specific ecological and habitat-related factors are important determinants of microplastic accumulation in marine fish. Variations in feeding behavior, habitat preference, and exposure to contaminated environments may all contribute to the observed differences in microplastic content. No significant association was indicated between microplastic abundance and fish length, body weight, or intestinal weight ($p > .05$). This finding suggests that morphometric characteristics are not reliable predictors of microplastic contamination levels in fish. Instead, environmental factors such as habitat quality, proximity to pollution sources, and feeding ecology may exert a greater influence on microplastic accumulation. Fish inhabiting coastal areas near human settlements or industrial activities are more likely to encounter higher concentrations of microplastics, regardless of their length or body weight.

CONCLUSION

Kembung and kurisi fish collected from the coastal waters of Mangindara Village, South Galesong District, Takalar Regency, were found to be contaminated with microplastics. Based on body weight, Kurisi fish exhibited higher microplastic abundance (0.085 particles/g) compared to Kembung fish(0.061 particles/g). All six fish samples analyzed were positive for microplastic contamination, with line-shaped particles predominantly observed in blue, black, and red colors. These findings highlight the widespread presence of microplastics in fish consumed by coastal communities. Therefore, it is strongly recommended that the public reduce single-use plastic use and adopt proper waste disposal practices. Additionally, government authorities should strengthen policies and regulations to control plastic waste and prevent further marine pollution.

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AUTHOR’S CONTRIBUTION STATEMENT

AB:Conceptualization, Writing-Original Draft, Review & Editing. Y, S :Conceptualization, Methodology, Manuscript review. Y, A: Formal analysis, Writing -Original draft, Manuscript review. AB, Y, S : Manuscript review

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

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REFERENCES

1. Wright SL, Rowe D, Thompson RC, Galloway TS. Microplastic ingestion decreases energy reserves in marine worms. Curr Biol. 2013 Dec 2;23(23):R1031-3. doi: 10.1016/j.cub.2013.10.068. PMID: 24309274.

2. Ferreira I, Venâncio C, Lopes I, Oliveira M. Nanoplastics and marine organisms: What has been studied? Environ Toxicol Pharmacol. 2019 Apr;67:1-7. doi: 10.1016/j.etap.2019.01.006. Epub 2019 Jan 21. PMID: 30685594.
3. Jangid H, Dutta J, Karnwal A, Kumar G. Microplastic contamination in fish: A systematic global review of trends, health risks, and implications for consumer safety. Mar Pollut Bull. 2025 Oct;219:118279. doi: 10.1016/j.marpolbul.2025.118279. Epub 2025 Jun 10. PMID: 40499269.
4. Ikhtiar M. Microplastics Identification As Bioremediation In The Tello River Makassar. An Idea on Safety and Environment. 2025; 1(01): 01–05. doi:10.53690/ise.v1i01.487.
5. Suharsono, Ikhtiar M, & Baharuddin A . Analisis Spasial Risk Assesment dan Identifikasi Mikroplastik dan Keberadaan Pseudomonas Sebagai Bioremidiasi Di Perairan Kota Makassar. Journal of Aafiyah Health Research (JAHR).2021; 2(1): 69-83. doi:10.52103/jahr.v2i1.530
6. Baharuddin A., Asran A., Ikhtiar M. and Suhermi. Spatial Analysis of Microplastics Using the FT-IR (Fourier Transform Infrared) Method in Green Mussel Farmers' Feces. Window of Health : Jurnal Kesehatan.2023; 331-343. doi: 10.33096/woh.vi.1108.
7. Lestari FA, Masitah, Jailani, Nasution R. Identifikasi mikroplastik pada beberapa jenis ikan di Sungai Manggar Balikpapan sebagai daerah penyangga IKN. *Jurnal Biosense*. 2024;7(02):237–250. doi:10.36526/biosense.v7i02.4216.
8. Nurkhasanah B, Nasution R, Jailani, Masitah. Identifikasi mikroplastik yang terdapat pada beberapa jenis ikan di perairan Sungai Sangasanga Kelurahan Sarijaya. *Jurnal Biosense*. 2024;7(02):251–264. doi:10.36526/biosense.v7i02.4300.
9. Rasuna WY, Masitah, Kurniawati ZL, Nasution R. Analisis kandungan mikroplastik pada saluran pencernaan ikan di PPI Selili Samarinda, Kalimantan Timur. *Jurnal Biosense*. 2024;7(01):175–188. doi.10.36526/biosense.v7i01.3856.
10. Muliari M, Mahdaliana M, Irfannur I, Sitanggang HA, Akmal Y, Radhi M, Batubara AS. Microplastic content of three types of economically important fish in the industrial area waters of North Aceh and Lhokseumawe Regency. Arwana: Jurnal Ilmiah Program Studi Perairan. 2025;7(1):74–81. doi:10.51179/jipsbp.v7i1.3298.
11. Revalita DR, Waldani D, & Fujianti P. Determinants of Workplace Accidents among Heavy Equipment Operators: A Cross-Sectional Study in Indonesia. An Idea on Safety and Environment.2025; 1(02):39–49. doi:10.53690/ise.v1i02.577.
12. Fakhira NY, Simbolon VA, Diansafitri M. Identifikasi keberadaan mikroplastik pada ikan tamban (*Sardinella fimbriata*) di Pelabuhan Bongkar Muat Tanjung Moco. Jurnal Kesehatan Lingkungan Indonesia. 2026;25(1):20–27. doi:10.14710/jkli.78366**.**
13. Yuliati Y, Baharuddin A. Identification of Characteristics, Abundance, Color, and Size of Microplastics in Shellfish in the Coastal Waters of Galesong Beach. lontarariset. 2025;6(1):35-44.
14. Defriatno M, Herdianto A. Potensi dampak kesehatan dari cemaran mikroplastik pada tubuh ikan Sungai Bedadung. BIOSAPPHIRE: Jurnal Biologi dan Diversitas. 2025;4(1):1–12. doi:10.31537/biosapphire.v4i1.2307.
15. Koongolla JB, Lin L, Pan YF, Yang CP, Sun DR, Liu S, Xu XR, Maharana D, Huang JS, Li HX. Occurrence of microplastics in gastrointestinal tracts and gills of fish from Beibu Gulf, South China Sea. Environ Pollut. 2020 Mar;258:113734. doi: 10.1016/j.envpol.2019.113734.PMID: 31884260.
16. Pratiwi HM, Takagi T, Rusni S, Inoue K. Euryhaline fish larvae ingest more microplastic particles in seawater than in freshwater. Sci Rep. 2023 Mar 10;13(1):3560. doi: 10.1038/s41598-023-30339-y. PMID: 36899025.
17. Widyastuti S, Abidin AS, Hikmaturrohmi H, Ilhami BTK, Kurniawan NSH, Jupri A, Candri DA, Frediansyah A, Prasedya ES. Microplastic Contamination in Different Marine Species of Bintaro Fish Market, Indonesia. Sustainability. 2023; 15(12):9836. doi:10.3390/su15129836.

18. Ibrahim YS, Abd Razak NI, Roslan NS, Anuar ST, Amin RM, Kadir A, et al. Morphochemical characteristics of microplastic fibers in edible tissues of commercial marine fish. Environ Sci Adv. 2025;4:964–979.
19. Rashid E, Hussain SM, Ali S, Ahmad N, Rehman ZU, Al-Ghanim KA, et al. Polystyrene microplastics exposure induces physiological and histopathological alterations in freshwater fish Labeo rohita. Sci Rep. 2025;15:12888.
20. Pedà C, Caccamo L, Fossi MC, Gai F, Andaloro F, Genovese L, Perdichizzi A, Romeo T, Maricchiolo G. Intestinal alterations in European sea bass Dicentrarchus labrax (Linnaeus, 1758) exposed to microplastics: Preliminary results. Environ Pollut. 2016 May;212:251-256. doi: 10.1016/j.envpol.2016.01.083. Epub 2016 Feb 4. PMID: 26851981.
21. Yang D, Shi H, Li L, Li J, Jabeen K, Kolandhasamy P. Microplastics in aquatic organisms: Occurrence, uptake, and trophic transfer. Sci Total Environ. 2022;806:150495.
22. Jabeen K, Su L, Li J, Yang D, Tong C, Mu J, Shi H. Microplastics and mesoplastics in fish from coastal and fresh waters of China. Environ Pollut. 2017 Feb;221:141-149. doi: 10.1016/j.envpol.2016.11.055. Epub 2016 Dec 7. PMID: 27939629.
23. Nelms SE, Barnett J, Brownlow A, Davison NJ, Deaville R, Galloway TS, Lindeque PK, Santillo D, Godley BJ. Microplastics in marine mammals stranded around the British coast: ubiquitous but transitory? Sci Rep. 2019 Jan 31;9(1):1075. doi: 10.1038/s41598-018-37428-3. PMID: 30705316.
24. Mesas A, Vázquez-Duhalt R, Torres E. Microplastics contamination in commercial fish species and implications for human health. Environ Res. 2020;182:109091.
25. Wootton N, Silva V, Giuretis D, Reis-Santos P, Gillanders BM. Microplastic presence in dried and fresh fish from seafood markets. Mar Freshw Res. 2025;76:MF24270.