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SHORT COMMUNICATION

# Microplastics Ingestion by Fish in the Biawak Island

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**ABSTRACT**

Plastic pollution is a growing global concern. The Biawak Island is region conservation area in Indramayu, so not much human activity. But, marine debris in the Biawak Island is rife. In the present study, we investigated microplastic accumulation on Fish in the Biawak Island. This study fish is divided into 3 groups based on feeding habits, that is carnivore, herbivore and omnivore. We assessed the abundance of microplastic debris found in the gastrointestinal tract of fishes caught by local fishermen. Carnivore fish grup found 49-205 microplastic particle per-individual, herbivore fish grup found 60-316 microplastic particle per-individual, and omnivore grup found 83-106 microplastic particle per-individual. The ingestion of microplastics by fish was negatively correlated with the diversity of feeding habits. But accumulated of microplastic density in herbivore and carnivore is significantly different to omnivore.

***Keyword*:** Ingestion, Microplastic, Fish, Biawak Island

## 1. INTRODUCTION

Marine pollution is which one of many problem from Sustainable Development Goal (SDGs) 14. The marine pollution comes from 4 main sources, shipping activities, dumping,

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seabed activites and activities on land and air (Churchill, 1988). But, marine pollution is dominated by plastic materials that is about 60-80%, with total plastic growth from 1950-2012 of 288 tons (Andrady 2011; Galgani et al 1995; Moore 2008; UNEP 2014).

The Biawak Island is conservation area in Indramayu, so not much human activity. But, Biawak Island contaminated garbage from fishing activities, such as streofoam (foam), nets, ropes, bottles and plastic bottle cap (Purba *et al*, 2017). Normally, plastics can be degraded for hundreds of years, such as fishing lines degraded for 600 years, 450 years for plastic bottles and 10-20 years for plastic bags (Hetherington 2005). Plastic degradation occurs gradually. The result of plastic degradation usually becomes microplastic, ie plastic with size less than 5 mm (Andrady 2011). In addition, microplastic is produced from shampoo, wash face or soap (Cole 2011).

Microplastic found in water of Biawak Island (Pangestu et al, 2016). Potential ingestion of microplastic by fish in the water of biawak island is appreciable (Andrady 2011). Because, research of stomach content from fish in the North Pacific is found microplastic with density 20% (Choy and Drazen, 2013) to 35% (Boerger et al., 2010). The accumulated microplastic in the digestion of fish affects behavior or even fish death. Furthermore, accumulated microplastic by fish can be dangerous for humans, because microlpastic contaminants can be accumulated in fish tissue (Rochman et al, 2015). So, there needs to be research to investigate of microplastic in the digestion of fish.

Ingestion of microplastic occur when plastic material is mistaken for food, or intentionally captured and ingested by fish (Ivar do Sul and Costa, 2007). The food web may be the cause of microplastic ingestion by fish, example transfer of microplastics in the planktonic food web (Setälä, 2014), or transfer of microplastic by *Mytilus edulis* to *Carcinus maenas* (Farrell, 2013).

In this study to investigate influence feeding habits for microplastic ingestion. Fish is divided into 3 groups based on feeding habits, that is carnivore, herbivore and omnivore. We assessed the abundance of microplastic debris found in the gastrointestinal tract of fishes caught by local fishermen.

## 2. MATERIAL AND METHOD

This research was in May-July 2017 and located in the waters of Biawak Island, Indramayu. Locate of Biawak Island is ±40 km north coast of Indramayu spanning between 05°56'002" S and 108°22'015" E, 26 miles (50 km) north of fishing base in Indramayu (figure 1). In the Biawak Island have one lighthouse and several Ministry of Transportation guesthouses. No more human activities in Biawak Island, but inthis place is one of the tourist destinations. Futhermore, Fisherman get to break fishing activiteis in biawak island.

Fish were collected by fisherman. Fisherman catch fish on the east, west and south of the Biawak Island. We must indentification of fish, because to devide fish to according by feeding habits. We weigh individual fish, and then remove the gut of fish. Alcohol (70%) poured in botle of the gut. Before the gut of fish soaked alcohol, the gut must be weigh and then minced small size.

The procedure fo microplastic separation with other objects, as follows: (1) The intestinal sample is inserted into 1 L clean glass bottle for each fish intestine; (2) Extraction of plastics is done in accordance with how to dissolve organic substances. Dissolve the sample

with $H_2O_2$ as much as 200-400mL or 30% of the sample weight; (3) about 800 mL of NaCl solution is added to the jar from the dissolved solution by means of flotation; (4) grab a microplastic that floats on the surface using a pipette; (5) Observe the microplastic and count the microplastic density on the microscope (40x).

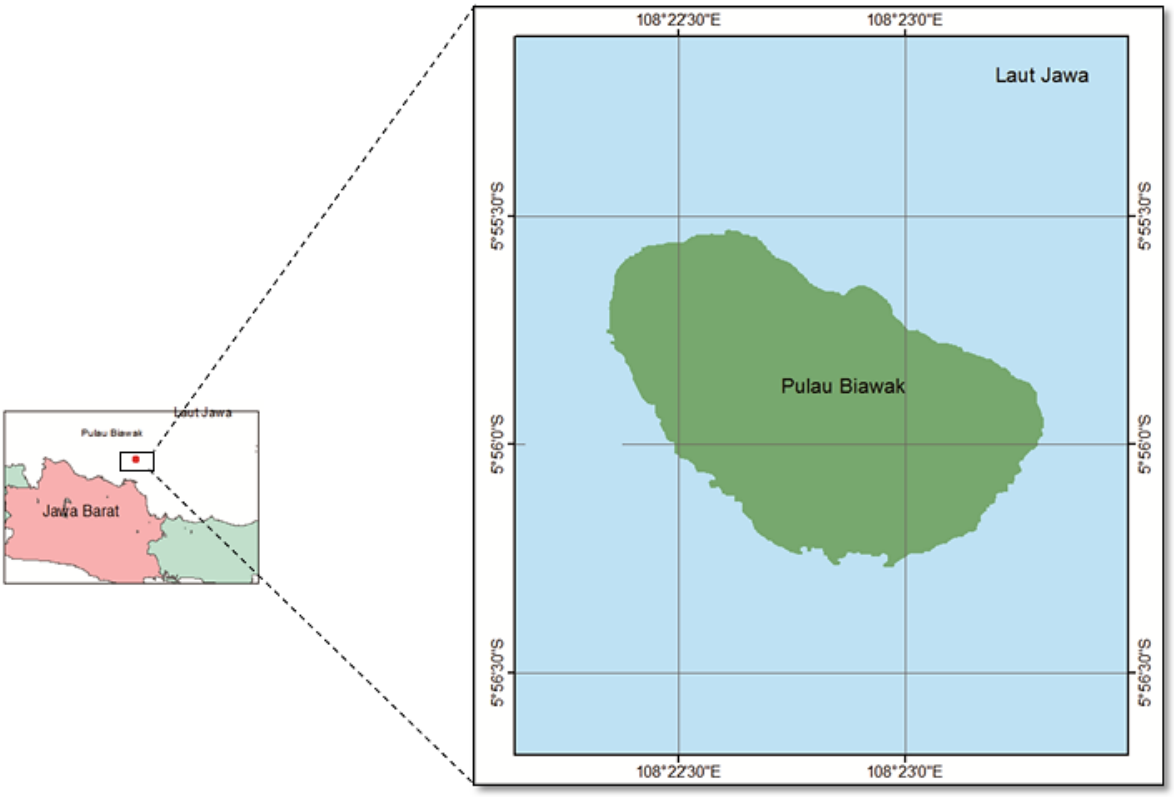


**Figure 1.** Research Location

Formula for microplastic density ingested by fish is the amount of microplastic divided by the gut weight. Microplastic density data were tested by statistic test, distribution, and t-test to compare microplastic accumulation in fish eating habit.

Beside that, accumulation microplastik in the water colomn must be a measured. The measured abudance of microplastic in water colomn using plankton nett. The water sample taken at a depth of 3 and 4 meters. Observe the microplastic and count the microplastic density on the microscope (40x)

## 3. RESULT AND DISCUSSION

Total catch from fisherman is 14 fishs, there are 7 different species of fish. The species of fish identified as follows *Scarus quoyi*, *Chaetodon guttatissimus*, *Priachantus tayanus*, *Valamugil seheli*, *lutjanus lutjanus*, *Lethrinus atkinsoni*, and *pletorhinchus chrysotaenia*. The species of fish that are identified some of them have eating habits such as: coral polyp eaters,

plankton eaters and small fish eaters. We classify into 3 groups of feeding habits, such as : Carnivores, Herbivores and omnivores.

Food habits of the fish sample is plankton, mollusca, crustacea, shirmp, algae, bentic, pholiyp and fish. The fishes sample identified is 5 fishes to herbivore, 3 fishes to omnivore and 6 fishes to carnivore. We observed microplastic inside the gastrointestinal tract (guts) of 14 individual fishs. the amount of microplastic found is presented in the table 1. The most abundant fish found in microplastic is Scarus niger, with a total of 550 particles. At least found in *Parupeneus multifasciatus*, with a total of 21 microplastic particles. Microplastic particles are dominated by fragments, whereas fiber forms are found in only a few fish, not all fish are found in microplastic particles with a fiber shape.

**Table 1.** The amount of microplastic found by the fish gastrointestinal tract

| No | Spesies | Total | Gut Wight (gr) | weight (gr) | Microplastic density (particle/gram) | Feeding Habits | Food Habits |
|---|---|---|---|---|---|---|---|
| 1 | *lutjanus lutjanus* | 49 | 2,5 | 80,5 | 19,60 | Carnivore | Fish, Crustacea |
| 2 | *lutjanus lutjanus* | 155 | 4,41 | 250,5 | 35,15 | Carnivore | Fish, Crustacea |
| 3 | *Lethrinus atkinsoni* | 97 | 3,57 | 300,5 | 27,17 | Carnivore | Fish, Crustacea, Mollusca |
| 4 | *Lethrinus atkinsoni* | 91 | 2,24 | 290,5 | 40,63 | Carnivore | Fish, Crustacea, Mollusca |
| 5 | *Lethrinus atkinsoni* | 100 | 1,55 | 210,5 | 64,52 | Carnivore | Fish, Crustacea, Mollusca |
| 6 | *Lethrinus atkisoni* | 205 | 2,3 | 240,5 | 89,13 | Carnivore | Fish, Crustacea, Mollusca |
| 7 | *pletorhinchus chrysotaenia* | 83 | 0,695 | 96,5 | 119,42 | Omnivore | Crustacea, Shirmp, Planton |
| 8 | *pletorhinchus chrysotaenia* | 184 | 1,08 | 170,5 | 170,37 | Omnivore | Crustacea, Shirmp, Planton |
| 9 | *pletorhinchus chrysotaenia* | 106 | 1,44 | 220,5 | 73,61 | Omnivore | Crustacea, Shirmp, Planton |
| 10 | *Scarus quoyi* | 316 | 5,05 | 606,5 | 42,38 | Herbivore | Bentic, Algae |
| 11 | *Scarus quoyi* | 214 | 11,27 | 405,5 | 26,35 | Herbivore | Bentic, Algae |
| 12 | *Chaetodon guttatissimus* | 297 | 12,4 | 23,5 | 9,35 | Herbivore | Pholyp dan Algae |
| 13 | *Priachantus tayanus* | 116 | 1,09 | 350,5 | 55,05 | Herbivore | Bentic |
| 14 | *Valamugil seheli* | 60 | 2,5 | 100,5 | 19,60 | Herbivore | Microalgae |

The percentage of the gut mass compared with total fish weight ranged from 0.31 - 52.77%. The omnivorous group has a smaller percentage of the gut mass compared with

carnivores and herbivores, which is 0.63 – 0.72 % from the total weight of the fish. The highest percentage of the gut mass belongs to the herbivorous group.

The microplastics density of the fish it was noted that the herbivorous fish group: 9.35 – 55.05 particles / gr with an average of 46.03 particles / gr, carnivores: 27.17 – 89.13 particles / gr with an average of 121 , 13 particles / gr, and omnivores: 73.61 – 170.31 particles / gr with an average of 30.54 particles / gr (Figure 2).

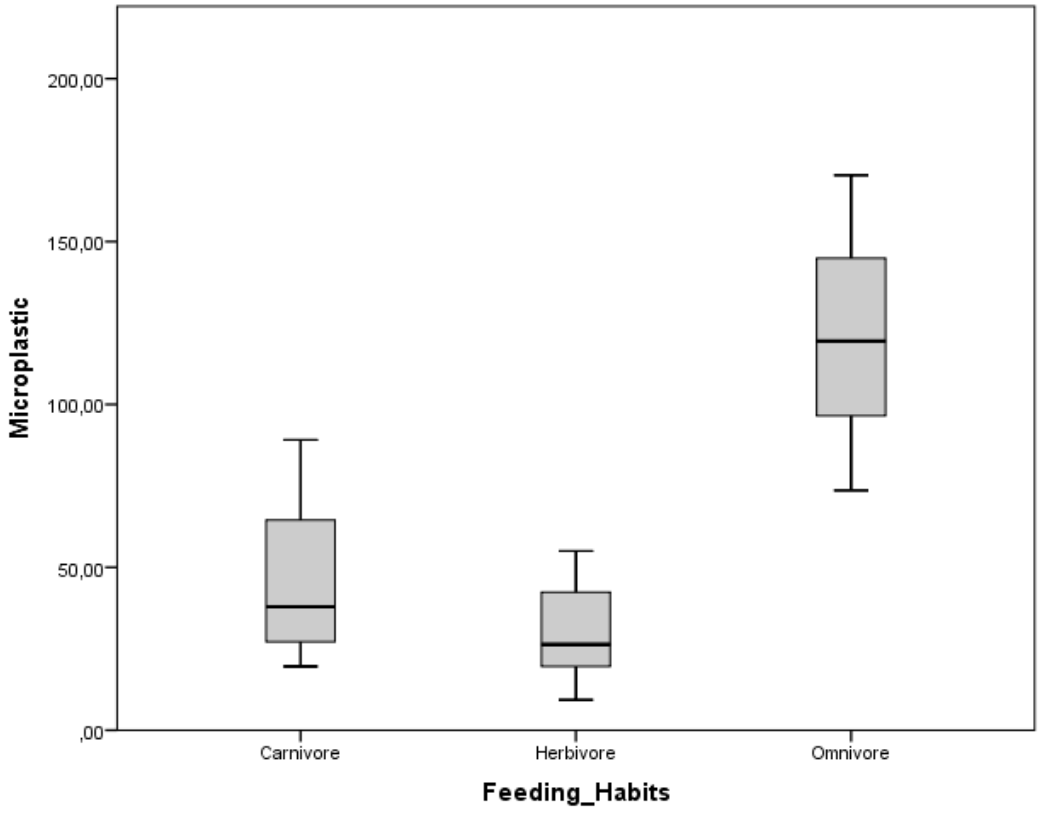


**Figure 2.** Microplastic Density Boxplot on the gut of fish

Statistical analysis of nonparametric t-test between feeding habits and microplastic density in fish, it was no significant association between feeding habits and the amount of microplastic accumulation in the gut. Two-way significance test results are as follows 0.008 for herbivore, 0.049 for omnivore and 0.020 for carnivore. But, result of non parametric advanced test to shows the omnivorous feeding habits to have greater potential for microplastic ingestion. This is evidenced by microplastic density in fish with omnivorous groups greater than the microplastic density in both other fish eating herbivores and carnivoress.

All the water sample found microplastic particle, such as fragmen and fiber. Average of density microplastic is 30 particle/Liter to a depth of 3 meters, and 79,2 particle/Liter to a depth of 5 meters (Table 2). But, statistical analysis shown no significant for different of depth water colomn. Homogeneity of microplastic density in every depth of marine waters is suspected due to the occurrence of seawater agitation at all times with the current and waves.

**Table 2.** The amount of microplastic found by coloum water.

| Depth | Microplastic (particle/L) | | |
|---|---|---|---|
| | Fragment | Fiber | Total |
| 3 meters | 27,4 | 2,6 | 30 |
| 5 meters | 6,6 | 72,6 | 79,2 |

The aim of our study was to determine the ingestion of microplastic by fish based feeding habits. Microplastic accumulation is thought to be influenced by feeding habits, such as transfer of microplastics in the planktonic food web (Setälä, 2014). But, as described in the research results that the ingestion of microplastics by fish was negatively correlated with the diversity of feeding habits.

We observed thats all sample of fish contaminated by microplastic. But, Scarus qouyi is the highst accumulate of microplastic in the gut. Sardina pilchardus and Engraulis encrasicolus become indicators of microplastic savings in the western Mediterranean sea, almost all fish samples contain microplastic in their digestive tract (Compa *et al.*, 2018). Parrotfish eat coral reefs attached by algae or polyps. This led to the fact that the parrot fish belonging to the herbivore had a higher microplastic accumulation value than the carnivorous fish. Coral reefs that are at the bottom of the waters, will become the sinking place of microplastic. Microplastic is also attached to the coral reef, allegedly participated in by these herbivorous fish. So that accumulation will be more than with herbivore fish. In addition, herbivore groups have a longer intestine than others. So that more micropalstik buildup than carnivorous fish.

The microplastic accumulation in carnivorous fish is the lowest among other feeding habits group. Because in the predation of carnivorous fish, more directly on the target. The carnivore fish have the method of eating by annexing, staking, and camouflage, so carnivorous fish only consume food that the fish target fish (McConnaughery, 1983). The omnivore fish to swim in the water column if they do not get food intake from around the coral reefs. This behaviour of omnivore fish to making it the second order in the amount of microplastic accumulation in the gut.

In other study, demersal species showed significantly higher abundance of plastics than pelagic fishes (Jabeen, 2017). Accumulation microplastic items can be ingested by fish through prey (Wright et al. 2013, Brandao et al.,2011). Beside that, habitat play important role in the ingestion microplastic by fish (Jabeen, 2017). Ingestion of microplastic probably occurred accidently during normal fish feeding activity. But, accumulation microplastic of the water colomn is not significant for depth different.

So in this study showed that each fish has the potential to ingest microplastic particles, whether herbivorous, carnivorous or omnivorous fish. Each fish have the potential to ingest microplastic, especially if the waters are contaminated with microplastic waste. Water of Biawak Island have the microplastic debris particle weight ranging from 0.1 to 8.8 mg and size a value of 1- 5 mm (Pangestu, 2016).

## 4. CONCLUSION

All fish of sample contain microplastic in the gastrointestinal tract. Carnivore fish grup found 49-205 microplastic particle per-individual, herbivore fish grup found 60-316 microplastic particle per-individual, and omnivore grup found 83-106 microplastic particle per-individual. The ingestion of microplastics by fish was negatively correlated with the diversity of feeding habits. But accumulated of microplastic density in herbivore is significantly different to omnivore.

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