

Food preference of red devil (*Amphilophus labiatus*) in the Sermo Reservoir, Kulon Progo Regency

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Abstract. Food preference is one of the important information that can be used to know the food chain in order to manage fisheries resources. This study aims to determine the food habits and preference of red devil (*Amphilophus labiatus*) in the Sermo Reservoir, Kulon Progo Regency. Samples were collected randomly each month from September 2013 to February 2014. Each sample collected was measured its total length, body weight, and determined sex, then dissected to measure the gut length and to observe gut contents. Results showed that red devil is omnivorous (relative gut length = 3.83) with food composition consisted of fish, crustaceans, detritus, phytoplankton, zooplankton, plants, insects, insect's larvae, *Chironomus* sp., and annelids. A change occurred in the food preference of red devil, i.e. the young fish prefers to feed *Chironomus* sp. larvae (86.02 %) whereas the adult fish prefers fish/fish chunk (81.82 %). Trophic level status of red devil showed as carnivorous and niche overlapping between male and female of the adult.

1. Introduction

The Sermo Reservoir is an artificial reservoir that located in the Hargowilis Village, Kokap District, Kulon Progo Regency, Yogyakarta. It has some endemic fishes that consists of wader pari (*Rasbora latestriata*) while some introduction fishes are tilapia (*Oreochromis* sp.), tambaqui (*Cyclossoma macropomum*), common carp (*Cyprinus carpio*) and gouramy (*Osphronemus goramy*). Since 2012, red devil (*Amphilophus labiatus*) has become a dominant catch by fisherman (~75 %). The composition of total catch in 2012 consisted of *Mozambique tilapia* (7 %), tilapia (15 %), red devil (73 %), spotted barb (2 %), and silver rasbora (3 %) [1]. The dominance of red devil has depressed other species. Although the population was increased, the price of red devil reduced than tilapia or other species. As a consequence, it decreased the income of local fisherman [2].

The uncontrolled growth of red devil lowers other fish population for long-term period and affects food chain. Red devil is a part of reservoir community and controlling its population should be based on the ecological balance. A good management of resources can be carried out by monitoring and collecting data frequently through sampling of total catch that records species composition, length and weight composition, reproduction aspect, otolith, and fish gut content [3, 4]. Previous studies have investigated the relationship of length and weight as well as otolith of red devil in the Sermo Reservoir. However, the food habits and preference of red devil have not been studied until today [5, 6].

Food preference consists of the relative length of fish gut and food preference level. Food preference shows information about food composition, food habits, and preference level of red devil on certain food type. Information about food types and habits are important in the fish resources management in order to restore the balance of the reservoir resources, maintain the fish resources, and increase catch



productivity. Aim of this research was to investigate the food composition, habits, and preference of red devil (*Amphilophus labiatus*) in the Sermo Reservoir, Kulon Progo Regency.

2. Materials and Methods

Samples were collected biweekly for six months, from September 2013 to February 2014. Samples were taken in four stations: (a) outlet, (b) reservoir body, (c) reservoir basin, and (d) inlet (figure 1). Samples were collected from the fisherman total catch that used gillnet. 50 fishes were randomly collected every month. Fish morphology was observed to assure the research sample. Red devil has thick lips, steep forehead elongation and red-black devil has 5–8 vertical lines on the body [7]. All of the samples were analyzed at the Department of Fisheries of Universitas Gadjah Mada.

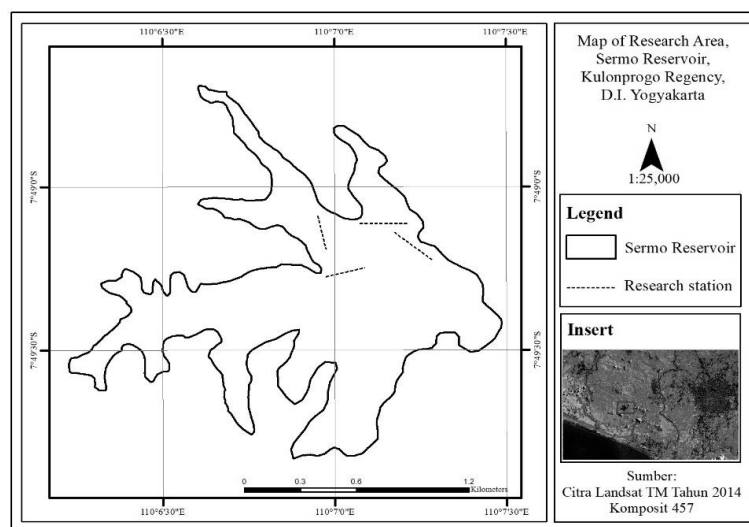


Figure 1. Map of research area in the Sermo Reservoir.

The total length of red devil was measured by ruler and total weight was measured by scales. Samples were then dissected for the gonad and digestive tract observation. Digestive tract preserved with formalin 4 % was measured. Volume of each food type was measured by modified Sedgwick rafter. Each food type was observed by quantitative method, i.e. numerical and volumetric method. Numerical method counted food types component while gravimetrical method counted volume of food types [8]. Each food type was observed using microscope with 4x to 10x magnification and identified by following [9]. Data were analyzed using the following formulas:

Index of Preponderance [10]

$$IP = \frac{V_i O_i}{\sum_{i=1}^n V_i x O_i} \quad (1)$$

where:

IP = index of preponderance

V_i = percentage of food volume

O_i = percentage of occurrence

Trophic level [11]

$$T_t = 1 + \sum \left\{ \frac{T_{tp} x I_p}{100} \right\} \quad (2)$$

where:

T_p = trophic level

T_{tp} = trophic level at food level

I_i = index of preponderance

Niche breadth [12]

$$B_{ij} = \frac{1}{\sum_{i=1}^n \sum_{j=1}^m p_{ij}^2} \quad (3)$$

where:

B_{ij} = niche breadth of fish group to food resources

P_{ij} = proportion of fish group related to food resources

N = number of fish group (i=1,2, 3..., n)

M = number of food resources (j=1,2, 3..., m)

Niche breadth is standardized to get point 0-1 using formulas based on Hulbert [3] which is:

$$BA = \frac{B-1}{N-1} \quad (4)$$

where:

BA = niche breadth's Levins standardization (between 0-1)

B = nihce breadth's levins

N = number of utilized resources

Niche overlapping [12]

$$C_h = \frac{2 \sum P_{ij} P_{ik}}{\sum P_{ij}^2 + P_{ik}^2} \quad (5)$$

where:

Ch = Simplified Morisita Index

P_{ij}, P_{ik} = proportion of resources from total of resources

3. Results

The number of samples were 425 species and samples with food content were 211 species. Length distribution of red devils was about 7.20–15.5 cm and most of them were male (56.87 %). Weight distribution of red devil was about 6.2–74.6 g. Food habits were measured by food composition that fed by fish. Food of red devils consisted of fish (34 %), crustacea (2 %), detritus (10 %), phytoplankton (13 %), zooplankton (17 %), macrophyte (3 %), insects (4 %), larva insects (1 %), *Chironomus* sp. (12 %), and annelids (4 %). The food composition of red devils in the Sermo Reservoir is shown in figure 2.

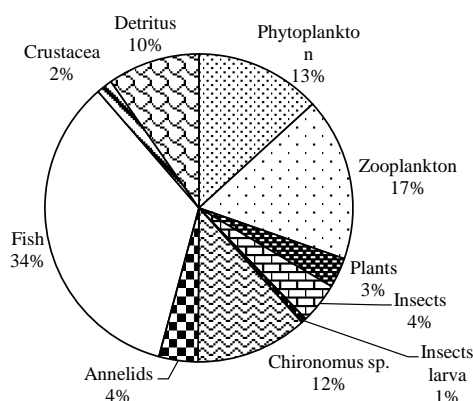


Figure 2. Food composition of red devil in the Sermo Reservoir.

Food habits can be known based on the food composition of red devil. Food composition of red devil consists of fish (34), crustacea (2 %), detritus (10 %), phytoplankton (13 %), zooplankton (17 %), plants (3 %), insects (4 %), insects' larvae (1 %), *Chironomus* sp. (12 %), and annelids (4 %). The dominant food composition of red devil is fish. Various food types of food composition of red devil show that red devil is omnivorous.

Table 1. Index of preponderance of red devil in the Sermo Reservoir.

Food type	Percentage (%)	Group
Phytoplankton	2.98	Additional food
Zooplankton	1.97	Additional food
Macrophyte	0.13	Additional food
Insects	0.51	Additional food
Insects larvae	0.01	Additional food
<i>Chironomus</i> sp.	6.92	Complementary food
Annelids	0.36	Additional food
Fish	82.79	Main food
Crustacean	0.06	Additional food
Detritus	3.91	Additional food
Unidentified	0.36	Additional food

Chironomus sp. (86.2 %) has dominated the main food of red devil which has length group of < 9 cm, whereas piece of fish is the main food for the 9–< 14 cm of length group. *Chironomus* sp., detritus, and *Trebonema*, sp. is the complementary food. Other food is an additional food.

Table 2. Index of preponderance based on the length size.

Food Type	Index of Preponderance (%)			
	< 9 cm	9–11	12–14	> 14
Phytoplankton				
- <i>Tribonema</i> sp.	6.99	1.41	4.68	1.23
- <i>Ephitemia</i> sp.	0.00	0.00	0.01	0.00
- <i>Nitzschia</i> sp.	0.00	1.41	0.03	0.00
- <i>Spyrogira</i> sp.	0.00	0.02	0.00	0.00
Zooplankton				
- <i>Aapidiaca</i> sp.	0.00	0.01	0.02	0.00
- <i>Daphnia</i> sp.	0.00	0.01	0.00	0.00
- <i>Cyclops</i> sp.	0.00	0.10	0.00	0.00
- <i>Diaphtomus</i> sp.	0.41	1.43	0.32	0.11
- <i>Euglypha</i> sp.	1.82	0.68	1.97	0.47
Makrofita	2.33	0.05	0.10	0.20
Insects	0.00	0.69	0.32	0.78
Insects larvae	0.00	0.02	0.00	0.00
<i>Chironomus</i> sp.	86.02	5.30	6.68	5.78
Annelids	0.00	0.80	0.00	0.03
Fish	2.43	84.44	80.45	76.41
Crustacean	0.00	0.12	0.00	0.00
Detritus	0.00	2.91	4.99	14.99
Unidentified	0.00	0.54	0.24	0.00

The Index of Preponderance shows that food changing is based on the length group of red devil. The younger red devil preferred to feed *Chironomus* sp. than other food whereas the adult red devil fed fish as the main food. In addition, the complementary food of adult red devil is detritus.

Table 3. Trophic level of red devil in the Sermo Reservoir.

Length Class (cm)	N (species)	Trophic Level	Status
< 9	4	3.36	Carnivore
9–11	132	3.82	Carnivore
12–14	16	3.74	Carnivore
> 14	59	3.63	Carnivore

Trophic level shows the fish level of food chain in the ecosystem. Red devil is a carnivore in the Sermo Reservoir (3.36–3.82). Both younger and adult red devil are carnivore. All of the red devil consumed the carnivore food type in the Sermo Reservoir.

Table 4. Niche breadth of red devil.

Length Class (cm)	N (species)	Male		Female	
		Niche Breadth	Standardization	Niche Breadth	Standardization
< 9	4	1.868	0.072	1.061	0.005
9–11	132	1.241	0.020	1.736	0.061
12–14	16	2.714	0.143	1.404	0.034
> 14	59	1.916	0.076	1.705	0.059

Niche breadth shows the various type of foods which are consumed by red devil and it is an indicator of food habit. Male red devil has wider niche breadth than female. Niche breadth of male red devil ranges from 1.241 to 2.714 with Levins standardization ranges from 0.020 to 0.143. Male red devil consumed higher various food type on the 12–14 cm of length group than others. Niche breadth of female red devil ranges from 1.061 to 1.736 with Levins standardization ranges from 0.005 to 0.061. Female red devil consumed higher various food type on the > 9 cm of length group than others.

Table 5. Niche overlapping of male red devil.

Length Class (cm)	< 9	9–11	12–14	>14
< 9	1	0.133	0.101	0.108
9–11		1	0.868	0.942
12–14			1	0.960
> 14				1

Niche overlap shows the similarity of food type which is consumed between the male and female fishes or some of the length group. The niche overlap of male red devil is about 0.089–1. Male red devil on the > 9 cm of length group consumed the same food type of > 12 cm that cause competition. The younger red devil has no competition on the < 9 cm of length group.

Table 6. Niche overlapping of female red devil.

Length Class (cm)	< 9	9–11	12–14	>14
< 9	1*	0.112	0.069	0.006
9–11		1*	0.992	0.973
12–14			1*	0.963
> 14				1*

The niche overlap of female red devil is about 0.006–1. Adult female red devil consumed the same food type between > 9 cm and > 12 cm of length group. The younger female red devil has no competition, however there is a competition between > 9 cm and > 12 cm of length group. Both adult male and female red devil consumed the similar food type causing higher competition.

4. Discussion

The Index of Preponderance shows the variation of food habits and preference [10]. Fish and/or other part of fishes are the main food of red devil in the Sermo Reservoir (IP > 40 %; 82.79 %). Whereas *Chironomus* sp. is the complementary food (4% ≤ IP ≤ 40%; 6.92%). The additional food included phytoplankton, detritus, zooplankton, macrophyte, insects, insect's larvae, annelids, crustacea, and unidentified (IP < 4 %; 0.01–3.91 %).

As comparison, some closed related species have different food habit. *Amphilohus ocellatus* prefers to feed rotifer, cladocera, copepod, and fish, whereas *Amphilophus citrinellus* tends to feed cyanophyceae, bacillariophyceae, rotifer, cladocera, and fish [13]. Every species has relatively food preference that can be affected by several factors [10]. The abundance of natural food in waters is not necessarily used by fish. Factors that affected food consumption of fish are the spreading of food, food viability, fish preference, and physical factors by time and place. The number of food and food type are affected by age, time, and place.

The food preference of red devil shows a change, with the main food of younger red devil (< 9 cm) is *Chironomus* sp. and of adult red devil is fish. The changing food preference has been demonstrated by *Amphilophus citrinellus* in the Djuanda Reservoir. It exhibited a change in food preference along with length [4]. This change is affected by food viability and abundance in waters. The pattern of food habit can be affected by some factors like age, stage, time, and environmental factor that affect food natural viability [14]. Viability of food in waters is also affected by biotic and abiotic factors like temperature, light, space, and surface area [10].

Male red devil has wider niche breadth than female so that male red devil eats various food types than female. Niche breadth standardization of male and female red devil is relative narrow. Most of red devils consumed piece of fish than other food types so that influence the narrow niche breadth although the food types are diverse. An organism consumes various foods and when the consumed food is relatively same, it would affect the high niche breadth [15].

Red devil has different niche breadth based on the species and length size. Organism consumes a lot of food resources will increase the niche breadth although the viability of food resources is low [16]. Food niche breadth will change in every fish group, with small fish used narrow niche breadth [10].

Trophic level is the sequence of food utilization level or material and energy like food web [19]. Trophic level of red devil in the Sermo Reservoir is about 3.36–3.82. It shows that red devil is a carnivore. Both younger and adult red devil are carnivore in the trophic level status. Younger red devil mainly consumed *Chironomus* sp. and adult red devil consumed fish. Red devil can prey herbivore fish in the food web.

Niche breadth of red devil varies at each length size class. Fish abundance and capability of food utilized in waters isn't determined based on the fish length growth. Niche breadth of red devil in the Sermo Reservoir is generally about 1.061–2.714. Niche breadth of *Amphilophus citrinellus* in the Djuanda Reservoir is about 7.5472 [3]. Niche breadth difference can be affected by food viability, food

abundance, and fish habitat. The number and food types consumed by a species usually based on age, habitat, and time [10].

Niche overlap is several food resources that utilized by some organisms [17]. Male red devil is overlap on the > 9 group cm and > 12 group cm. Male red devil in the length group that utilized similar food can cause prey or competition. Niche overlap between length group shows that similar food utilized by different group. Utilization of the same food will cause food predation. The greater niche overlap between length group causes greater predation between group and a uniform food type [18]. Niche overlap in the Sermo Reservoir generally shows a great chance on the food predation between class group. Small red devil (< 9 cm) has the lowest prey than adult (> 9 cm).

Niche overlap of red devil is about 0.0006–0.973. *Amphilophus citrinellus* in the Djuanda Reservoir has niche overlap of about 0.8825. *Amphilophus amphilopus* and *Amphilophus citrinellus* use the same food type. Same food type utilization will cause food prey between species or group. High value of niche overlap will cause a prey and low value of niche overlap will decrease prey between group [13].

Red devil in the Sermo Reservoir prefers to feed fish body than other foods. This condition makes certain fish population decreased. Fish composition in the Sermo Reservoir is dominated by red devil [1]. Sustainable handling needs to be done for balancing the fish population in the Sermo Reservoir. One of the stages is fish introduction that can suppress the population of red devil and achieve the balance of food chain in the Sermo Reservoir.

5. Conclusion

Food type of red devil in the Sermo Reservoir consists of fish, crustacea, detritus, phytoplankton, macrophyte, insects, insect's larva, *Chironomus* sp., and annelids. Small fish is the highest preference of adult red devil (> 9 cm) whereas *Chironomus* sp. is the highest preference of small red devil (< 9 cm). Red devil in the Sermo Reservoir is an euryphage that consumes several food types and is a carnivore. Red devil has changed the food type by increasing length group. High predation in a grabbing food occurs in the adult red devil.

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