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FOOD AND FEEDING HABITS OF WILD GUPPY (*Poecilia reticulata*), IN NATURAL WATER BODIES OF SRI JAYEWARDENEPURA CANAL SYSTEM, SRI LANKA

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ABSTRACT

Guppy (Poecilia reticulata) is a small freshwater fish belonging to the family Poeciliidae, first introduced to Sri Lanka in 1928 and used to control malaria mosquito vectors during1940-1950. The present study investigates the food and feeding habits of wild guppy. The six locations identified for sampling between January 2016 and December 2017 were: Attidiya, Bellanwila, Rattanapitiya, Nawala, near Parliament Grounds, and Jayewardenepura Hospital. Once a month, water and fish samples were collected from each sampling site and sent to the lab for analysis (n=216; n=2160). The researcher measured the Total Length (TL), Total Width (TW), and the weight of fish with an accuracy limit of 1mm and 0.1mg, respectively. Under the microscope, the food items in the dissected stomach were identified using the standard keys and counted using a Sedgewick-Rafter cell to calculate the percentages.

Female fishes were larger than males, and the average mean of body length value was 24.56 ± 5.46 mm (range: 15-35 mm) in females and 20.19 ± 2.75 mm (range: 15.0-24.5 mm) in males. Mean body weight of females and males were recorded as 0.174 ± 0.105 g (range: 0.026- 0.382 g) and 0.075 ± 0.021g (0.024- 0.11 g) respectively. Guppy has consumed most of the food items available in water (freshwater debris). Their feeds mainly consisted of freshwater debris (41%), phytoplankton (24 %), zooplankton (21 %), unidentified insect parts (12%), and adult mosquito parts (2%). The guppy is an omnivore, and in the wild, they feed on a combination of animal and plant-based meals.

KEYWORDS: *Poecilia reticulata, Omnivorous, Gut contents, Food habits, Natural water bodies.*

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1. INTRODUCTION

Poecilia reticulata is a small freshwater fish belonging to the family Poeciliidae, first introduced to Sri Lanka in 1928 and used to control malaria mosquito vector during 1940-1950 (Silva and Kurukulasuriya 2010). Males appear smaller than their females. Males reach up to 4 cm in length while females grow up to 6 cm (Pethiyagoda, 1991). They are distributed all over Sri Lanka and well established across North-Western, Western and Southern provinces (Weerasinghe, 2008; Bambaradeniya, 2008; Gunawardena, 2008). They inhabit various aquatic habitats such as streams, marshes, paddy fields, and polluted waterways (Pethiyagoda 1991; Edirisinghe and De Alwis 2012). *P. reticulate* is considered an invasive species in Sri Lanka (Silva and Kurukulasuriya 2010).

According to the preliminary studies, *P. reticulata* (Guppy) and *Gambusia affinis* (Mosquitofish) are abundant in the Sri Jayewardenepura canal system, one of the oldest canal systems in Sri Lanka located in a highly urbanized, highly polluted area (Edirisinghe and De Alwis 2012). The present study investigated the food and feeding habits of the Guppy, *P. reticulata*, to provide valuable information in rational exploitation and aquaculture management of the species.

Many investigators used the stomach contents of fish to determine their feeding habits (Hyslop, 1980). The development of successful capture-and-culture fisheries worldwide depends on fish nutrition and feeding habits (Adebisi, 1981; Blay and Eyeson, 1982).

According to Ndome and Victor (2002), the correct usage of fish species for fish culture, ornamental purpose, and larval control requires basic information on the feeding ecology of the fish. *P. reticulata* was widely used in the past to control mosquitoes. It is a popular ornamental fish due to its diverse colour patterns. They are very attractive fish, making them a veritable export product and foreign exchange earner (McKay, 1984; Allen *et al*., 2002).

2. METHODS

Study Area

The present study covers six selected locations (covering three sampling points in each location) in Colombo, the Sri Jayewardenepura canal system, and part of the Diyawanna Oya canal network. It is a man-made canal system located on the left bank of the lower valley of Kelani Ganga and situated in the western province, Colombo district of Sri Lanka, latitudes 6^0 52’ 55” - $6^0$55’ 45” N and longitudes 79^0 52’ 35” – 79^0 55’ 15” E (Figure. 1).

The average depth of the canal system is about 1.5m (CEA 1995). It may vary seasonally due to heavy sedimentation of silt and bank erosion in the rainy season. It gets frequently clogged with floating weeds & dumps (polythene, plastics & domestic wastes (CEA 1995). The present study covers approximately 15km of the canal network. Six locations and the sampling points at each location (Table 1) were selected considering environmental factors (such as the abundance of aquatic vegetation, water flow rate, water depth, etc.) and the occurrence of *P. reticulata* populations.

Table 1: Study locations and GPS coordinates.

Location	GPS coordinates
Location 1. Attidiya	6^0 83’ 72” N, 79^0 89’ 03” E
Location 2. Bellanwilla	6^0 84’ 59” N, 79^0 89’ 41” E
Location 3. Rattanapitiya	6^0 85’ 30” N, 79^0 89’ 89” E
Location 4. Nawala	6^0 88’ 23” N, 79^0 88’ 43”E
Location 5. Near Parliament ground	6^0 89’ 36”, N 79^0 91’ 81” E
Location 6. Near Jayewardenepura hospital road	6^0 86’ 65” N, 79^0 93’ 05” E

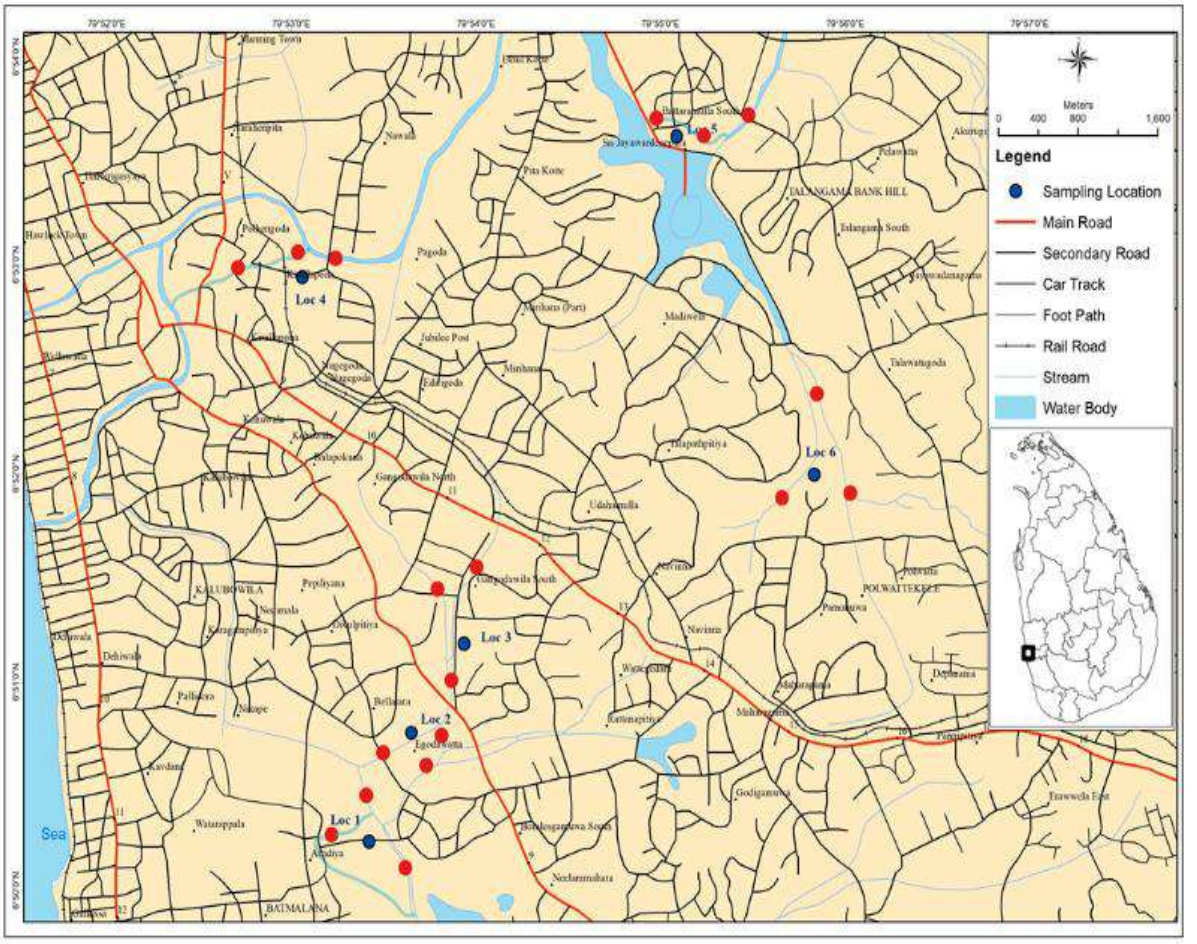

Figure 1: Study locations (in blue) and sampling points (in red) in the Colombo-Sri Jayewardenepura canal system

The sampling method of fish

P. reticulata (guppy) was present in all sites investigated during field visits subsequently identified as wild populations. Fish were separated according to their sex and counted. Representative samples were immediately preserved in properly labeled plastic bottles using 5% formaldehyde and brought to the laboratory. During the study period, the researcher analyzed randomly selected fish (n= 2160).

Total lengths (TL) and total weights (TW) of fish measured nearest to 0.1 cm and TW to the nearest 0.1mg). At significance levels (p 0.05), a nonparametric Mann-Whitney U test assisted in comparing body weight and length between males and females. During the dissection, the stomach and the uncoiled intestine were cut-opened, and their contents emptied into a Petri dish. The stomach and gut contents dissolved in 5 ml of water and 1 ml of solvent were transferred into Sedgewick-Rafter cell and examined under the binocular microscope. The appropriate keys helped to identify the food items (Needham and Needham, 1962; Wimpenny, 1966; Whitford and Schmacher, 1973; Schneider, 1990). The following equation aided in calculating the percentages of food items in 1 ml of dissolved gut content after counting the food items (Thomas, 1997; Harris, 2012 Phan et al., 2015).

$$\text{Percentage (\%) of food item per 1 ml} = \frac{\text{Number of particular food item counted} \times 100}{\text{Total number of food items counted}}$$

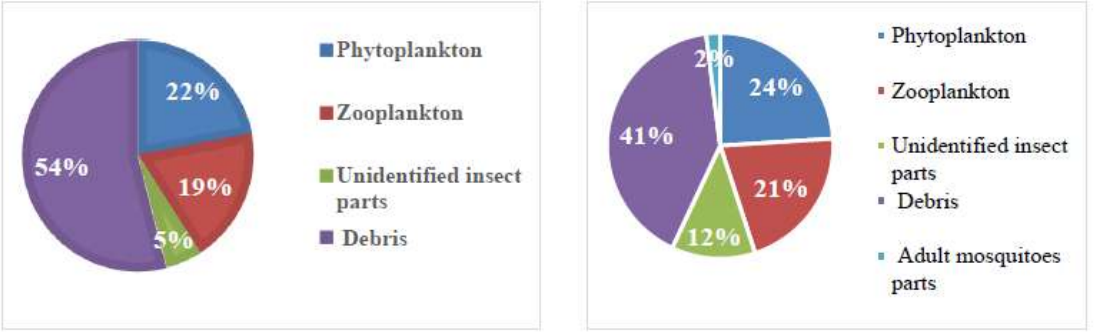

Figure 2: (a) Percentage (%) of food items in the water in study locations, (b) Percentage (%) of food items in the gut contents of *P. reticulata*

Sampling of plankton

During the investigation period, the Zooplankton and phytoplankton samples (n-216) collected from each sampling site (n-18) in each location on each sampling day aided in analyzing the plankton composition in the waters.

In each site, 20 liters of water filtered through a 55-micron plankton net were used to collect plankton. Collected plankton samples were preserved in labeled plastic bottles by adding Lugol's solution (1% concentration) and kept for 24 hours to settle. Enumeration and microscopic identification were performed at the laboratory under a binocular light microscope at x4 and x10 magnifications with calibrated eyepiece using a Sedgwick rafter counting chamber (Chittapunet *et al*., 2009). Magnus Live USB 2.0 camera aided to capture Images for further identification. Standard plankton identification guides assisted in identifying Plankton species (Thomas, 1997, Harris, 2012; Phan et al., 2015;).

3. RESULTS

Lengths, weight, and relative abundance of wild guppy

The relative abundance of females was always higher than that of males. Relative densities of females were roughly twice that of the males and approximately 2:1 female: male ratio, which is evident in all locations.

According to Mann-Whitney U test comparisons results, there was a significant sexual dimorphism in body weight and length ($p = 0.000$ in both cases), indicating females being larger than males. The average Mean body length was 24.56 ± 5.46 mm (range: 15-35 mm) in females and 20.19 ± 2.75 mm (range: 15.0-24.5 mm) in males. The Mean body weight in females was 0.174 ± 0.105 g (range: 0.026-0.382 g) in comparison with 0.075 ± 0.021g (0.024-0.11 g) in males.

Food and feeding habits of wild guppy

Figure.2 (a) represents the percentages of different food items consumed by *P. reticulata*. The summary of stomach contents of *P. reticulata* is presented in Figure 2 (b), which indicates the percentage (%) of food items in the surrounding water. The types of food in the water included phytoplankton (22%), zooplankton (19%), unidentified insect parts (5%), and debris (54%). The highest percentage was debris (Figure 2 a). However, there were no larval stages of mosquitoes in the water samples. According to the food items consumed by *P. reticulata*, the highest percentage was debris (41%), followed by phytoplankton (24%), zooplankton (21%), unidentified insect parts (12%), and adult mosquito parts (2%) as illustrated in Figure.2 (b).

Table 2: Species composition of phytoplankton and zooplankton in water at the study locations, in gut contents of *P. reticulata*

Group	Phylum	Genus/ Description	Availability in water	Availability in gut contents of *P.reticulata*
Phytoplankton	Chlorophyta	*Elakatothrix* sp	√	√
		Closterium sp.	√	√
		Cosmarium sp.	√	√
		Volvox sp	√	x
	Bacillariophyta	*Melosira* sp.	√	√
		Stephanodiscus sp	√	x
	Dinoflagellata	*Peridinium* sp.	√	√
	Euglenozoa	*Phacus* sp.	√	√
		Euglena sp.	√	√
	Cyanobacteria	*Lyngbya* sp.	√	√
		Oscillatoria sp	√	x
		Chroococcus sp	√	x
Zooplankton	Arthropods	Copepod nauplii	√	√
		Lecane sp	√	√
		Trichotria sp	√	√
		Asplanchna sp,	√	x
		Brachionus sp	√	x
		Colurella sp	√	x
		Proalinopsis sp	√	x
		Daphnia sp	√	√

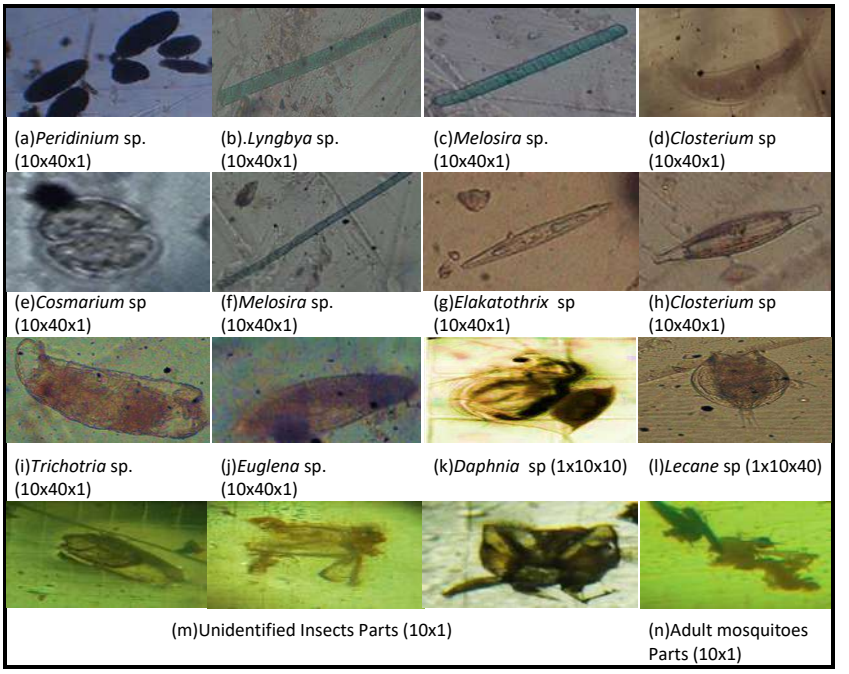

Plate 1: Common species of phytoplankton, zooplankton, and other food items were recorded of *P. reticulata* gut contains.

There were no mosquito larvae observed in the gut contents. The presence of adult mosquito parts contained within the identified insect parts indicates their role in consuming mosquitoes. The guppy is an omnivore: feeding on animal and plant-based meals.

Table 2 further analyses the composition of phytoplankton and zooplankton in the waters of the study locations. The gut contents of *P. reticulata* (Plate 1) show common phytoplankton, zooplankton, and other food items recorded in their gut contents.

The phytoplankton in water contained genera such as *Elakatothrix* sp., *Closterium* sp., *Cosmarium* sp., *Volvox* sp., *Melosira* sp., *Stephanodiscus* sp., *Peridinium* sp., *Phacus* sp., *Euglena* sp., *Lyngbya* sp., *Oscillatoria* sp., and *Chroococcus* sp. The zooplankton in water consisted of genera such as Copepod nauplii, *Lecane* sp. *Trichotria* sp., *Asplanchna* sp., *Brachionus* sp., *Colurella* sp., *Proalinopsis* sp., *Daphnia* sp. (Table 2). *P. reticulata* have consumed most of the species available in water (Plate 1).

4. DISCUSSION

The present study recorded a female-biased sexual dimorphism for *P. reticulata* wild population. Females' mean length and weight were consistently higher than those of males for wild populations in the Sri Jayewardenepura canal system. Relative densities of females were roughly twice that of the males, and an approximately 2:1 female: male ratio is evident in all locations. However, (Sterba 1983; Hernandez *et al*., 2004) have reported different results for the same species. Nikolsky (1963) confirmed that the sex ratio might vary between populations of the same species and in the same population during different periods. While the degree of dimorphism was similar in both studies, (Sterba 1983) has recorded a maximum body length of 60 mm for females and approximately 30 mm for males, while (Hernández *et al*., 2004) recorded a maximum body length of 51.1 mm for females, and 30 mm for males. The maximum length values recorded in the present study for females and males were well below those reported by (Sterba. 1983 and Hernández *et al*., 2004).

The size range of collected specimens of *P. reticulata* investigated in the present study was 15 - 35 mm. Their feed consisted mainly of phytoplankton, zooplankton adult mosquitoes, unidentified insect parts, and freshwater debris. Lawan *et al.,* 2012, reported the stomach contents of guppy, *P. reticulata*, were categorized into eight groups. Algae, diatoms, protozoan, mosquito larvae, fish parts, crustaceans, organic detritus, and sand grains. The major food item of *P. reticulata* examined during this study was green algae, with *Ulothrix* sp. being the most preferred alga. Introducing mosquito fish also can reduce algal blooms in waters. As the fish eat mosquitoes, that will help to reduce the mosquito problem to a certain extent. They feed on zooplankton grazers (Hurlbert *et al.,* 1972). The fish eat the invertebrate predators (Hoy *et al.,* 1972, Bence, 1988). *P. reticulata* is omnivorous, feeding on algae (approximately 50% of the wild diet), invertebrate larvae, and benthic detritus (Dussault and Kramer, 1981). Within their natural range, they may also prey on larvae of their species and of other fish. Houde, 1997 reported that *Poecilia gills* feed on detritus, diatoms, and filamentous algae, and *P. reticulata* also feeds on fish parts, zooplankton, and detritus (Winemiller 1993). This observation equally agreed with Arthington (1989) and Rodriguez (1997), who reported similar results for other guppy species elsewhere. The present study results indicated that they do not play any role as mosquito larvivorous fish. Still, their feed is mainly freshwater debris, phytoplankton, and zooplankton in the Sri Jayewardenepura canal system. However, the data indicates that they may contribute to mosquito control as they have consumed a small percentage of adult mosquitoes. More sampling locations and sites are in progress to confirm these findings.

5. CONCLUSIONS

The results revealed that while the *P. reticulata* population is well-established in the canal system,

they maintain a dominant female population. Their feed consisted of the highest percentage of debris (41%), followed by phytoplankton (24%), zooplankton (21%), unidentified insect parts (12%), and adult mosquitoes' parts (2%). Guppy has consumed most of the food items available in the water. The guppy is omnivorous and, in the wild, takes in a combination of animal and a plant-based diet.

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