Food and Feeding Habits of the Guppy, *Poecilia reticulata*, from Drainage Canal Systems in Lagos, Southwestern Nigeria

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Abstract

The food and feeding habits of the Guppy, *Poecilia reticulata,* from drainage canal systems in Lagos Metropolis, Nigeria, was investigated over a period of 24 months. Fish samples were collected monthly from 15 study sites. A total of 2400 fish stomachs were analyzed using the numerical and frequency of occurrence methods. *P. reticulata* fed mainly on algae, organic detritus, diatoms, mosquito larvae parts, protozoan, zooplankton and fish parts while algae form the most abundant and important food item, constituting 79.03% of food items by numerical and 33.17% by occurrence of stomachs examined. Amongst the algae, *Ulothrix* sp. was the most preferred, constituting 33.17% by numerical and 20.82% by occurrence. The least eaten food item was fish parts constituting 4.46% by numerical and 1.19% by occurrence. There was a significant difference ($P < 0.05$) in the number of algae and mosquito larvae consumed, while there was no significant difference ($P > 0.05$) in the number of other food items consumed for both seasons. However, by occurrence method there was no significant difference ($P > 0.05$) in food items consumed for both seasons. The three size classes of *P. reticulata* exhibited similar food habits with the presence of eight categories of food items in their stomachs. The largest size class ate more of algae, organic detritus and fish parts, followed by the medium size class while the small size class ate less of these food items. The species is an opportunistic benthopelagic omnivores, whose preference for food fluctuates with season, with a peak in diversity of food types occurring in the rainy season.

Introduction

Poecilia reticulata (Peters, 1859), a small benthopelagic fish occupies a wide range of aquatic habitats, such as estuaries, lakes, ponds, weedy ditches and canals (Page & Burr, 1991). The stomach contents of fishes have been used by many investigators to determine their feeding habits (Hyslop, 1980). Studies on the food and feeding habits of fish form the basis for the development of successful capture and culture fisheries, world-wide (Adebisi, 1981; Blay & Eyeson, 1982). According to Ndome & Victor (2002), the correct usage of fish species for fish culture, ornamental purpose and larval control requires fundamental information on the feeding ecology of the fish. In the past *P. reticulata* was widely introduced for mosquito control, and it is also a popular ornamental fish because they come in diverse colours and very attractive in nature which make them a veritable export product and foreign exchange earner (McKay, 1984; Allen *et al*., 2002). Harrington & Harrington (1982) reported that *Poecilia latipinna,* from a high subtropical salt marsh, are primarily vegetarians whose diet varies with habitat. Winemiller (1993) observed that *Poecilia gills* feed on detritus, diatoms and filamentous algae. *P. reticulata* feeds on zooplankton, larvae of small insects and detritus (Arthington, 1989; Rodriguez, 1997).

Despite the value of *P. reticulata* to the local populace and its potentials in export

trade there is paucity of information on the feeding ecology of *P. reticulata* from drainage canal systems of Lagos Metropolis. This paper investigates the food and feeding habits of the Guppy, *P. reticulata,* and it is hoped that the information provided would be useful in rational exploitation and aquacultural management of the species.

Materials and methods

Study area

The study areas are non-tidal, polluted canals, which receive water from surface run-off and waste water from different residential buildings, and empty into the Lagos lagoon through the numerous creeks in the city. The drainage canals are shallow with depth ranging from 0.56–1.20 m. They lie between latitude 06°25.343 N and longitude 003°24.666 E. The substratum of the canals is made of soft organic mud, mixture of fine and coarse sand, mixed with decaying organic matter. Two climatic seasons prevail in the study area. The wet season (May–November) is characterized by high monthly rainfall, while the dry season (December–April) is characterized by low precipitation. The dominant aquatic macrophytes include *Azolla africana* and *Pistia stratiotes,* which provide shaded area favoured by the species.

Fish specimens were collected monthly from November 2004 to October 2006 using a long-handled scoop net, made of fiber mesh (mesh size: 3 mm; length of handle: 1.00 m) from drainage canals in the Lagos Metropolis (Fig. 1). The method used here is designated as 'search and hit' technique. Whenever the fish was located, a hit was made with the swift downward stroke of the net slicing through the water underneath the fish and coming out of the water in a smooth flowing motion. Each monthly sampling effort lasted for 2 days, and each day's effort was executed for a period of 30 min/location. Fish caught were counted and preserved in 10% formalin, pending further stomach analysis in the laboratory. The analysis of the stomach content was carried out by both numerical and frequency of occurrence methods as described by Hyslop (1980). Out of the 2400 fish stomachs examined, 314 (13.08%) were empty. The stomach contents were examined and scored with regards to whether they were empty (0/4), 1/4, 1/2, 3/4 or 4/4 full. The stomachs were removed by slitting the fish from the anus to throat and then cutting off the intestine. The stomach contents were emptied into a Petri dish and examined under a binocular microscope. Identification of the food items were carried out with the aid of relevant keys (Needham & Needham, 1962; Wimpenny, 1966; Whitford & Schmacher, 1973; Schneider, 1990).The t-test analysis was performed using PASW Statistics 18 for windows.

Results

Stomach contents of P. reticulata

The summary of stomach contents of *P. reticulata* is presented in Table 1. Green algae were the most abundant and important food item by numerical (46.98%) and occurrence (89.1%) methods. Blue green algae were next in importance, occurring 32.05% by numerical and 58.44% by occurrence methods. Amongst the algae group *Ulothrix* sp. constituted the highest values, 20.82% and 33.17% by numerical and occurrence methods, respectively, while *Scenedesmus* sp. was the least with 3.10% (numerical) and 6.42% (occurrence). Diatoms accounted for 11.20% by numerical and 23.06% by occurrence methods. The most eaten diatom

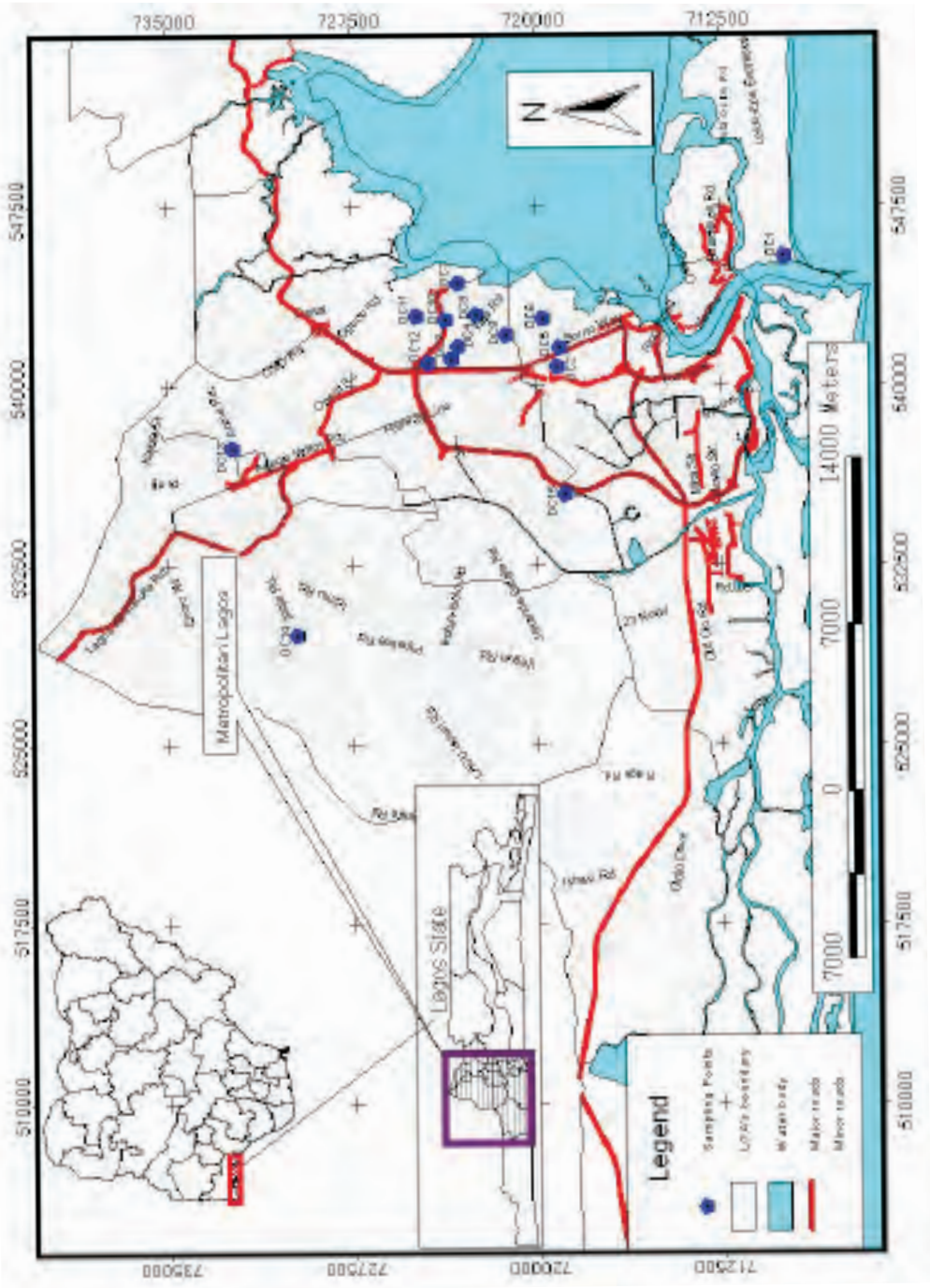

Fig. 1. Map of Lagos Metropolis showing sample stations

TABLE 1

Summary of the stomach contents of P. reticulata from drainage canal systems of Lagos Metropolis

Stomach contents	*Numerical Method*		*Occurrence Method*	
	Number	*%*	*Number*	*%*
Blue green algae				
Polycystis sp.	7971	12.23	410	19.66
Anabaena sp.	1460	9.93	392	18.79
Phormidium sp.	677	4.61	204	9.78
Coelosphaerium sp.	776	5.28	213	10.21
Green algae				
Ulothrix sp.	3059	20.82	692	33.17
Protococcus sp.	1383	9.41	403	19.32
Scenedesmus sp.	455	3.10	134	6.42
Microspora sp.	1435	9.76	477	22.87
Ophiocytium sp.	571	3.89	157	7.53
Diatoms				
Meridion sp.	754	5.13	193	9.25
Diatoma sp.	891	6.07	288	13.81
Protozoan :				
Chlamydomonas sp.	452	3.08	121	5.80
Dipteran				
Mosquito larvae parts	602	4.10	245	11.74
Fish parts	175	1.19	93	4.46
Crustacean				
Cladocera (*Polyphemus* sp.)	138	0.94	77	3.69
Ostracoda (*Cypridopsis* sp.)	69	0.47	47	2.25
Organic detritus			85	4.07
Sand grains			117	5.61

was *Diatoma* sp., accounting for 6.07% by numerical and 13.81% by occurrence, followed by *Meridion* sp. accounting for 5.13% by numerical and 9.25% occurrence. Mosquito larvae parts occurred 4.10% by numerical and 11.74% by occurrence methods. *Chlamydomonas* sp. accounted 3.08% by numerical and 5.50% by occurrence methods. Fish parts accounted 1.19% by numerical and 4.46% by occurrence methods. Cladocera accounted 0.94% by numerical and 3.69% by occurrence methods while Ostracoda accounted 0.47% by number and 2.25% by occurrence methods. Sand grain and organic detritus occurred 5.61% and 4.07%, respectively.

Seasonal variation in stomach contents of P. reticulata

The seasonal variation in food items of *P. reticulata* during the dry and wet seasons

from drainage canal systems of Lagos Metropolis is shown in Table 2. Guppy fed mainly on green algae in both dry and wet seasons. Green algae consumed were 46.98% by number and 80.57% by occurrence in dry season and 53.33% by number and 75.61% by occurrence in wet season. Blue green algae occurred 32.05% and 66.96% by number in dry season, and 28.24% by number and 45.59% by occurrence in wet season. Diatoms accounted 11.20% and 19.61% by numerical and occurrence in dry season while it constituted 8.28% and 15.57% by numerical and occurrence in wet season, respectively. Mosquito larvae parts occurred 4.10% by numerical and 13.78% by occurrence in dry season and 4.63% by numerical and 10.51% by occurrence in wet season. Protozoan accounted 3.08% and 6.36% by numerical and occurrence in dry season while it constituted 3.32% and 5.44% by numerical and occurrence in wet season, respectively.

Fish parts consumed were 1.19% by numerical and 4.59% by occurrence in dry season and 1.12% by numerical and 3.56% by occurrence in wet season. Cladocera occurred 0.94% by numerical and 3.53% by occurrence in dry season and 0.67% by numerical and 3.38% by occurrence in wet season. Ostracoda accounted 0.47% and 2.65% by numerical and occurrence in dry season while it constituted 0.43% and 1.88% by numerical and occurrence in wet season, respectively. Sand grain and organic detritus occurrence in dry season were 5.63% and 3.75% while their occurrences in wet season were 5.61% and 4.07%, respectively. The t-test showed a significant difference ($P < 0.05$) in the number of algae and mosquito larvae consumed, while there was no significant difference ($P > 0.05$) in the number of other food items consumed for both seasons. However, by occurrence method the t-test did not show any significant difference ($P > 0.05$) in food items consumed for both seasons.

TABLE 2

Seasonal variation of the stomach contents of P. reticulata *from drainage canal systems of Lagos Metropolis (Dec. 2004–Nov. 2005)*

Stomach contents	*Dry Season (December 2004 – May 2005)*				*Wet Season (June 2005 – November 2005)*			
	Numerical Method		*Occurrence Method*		*Numerical Method*		*Occurrence Method*	
	No	*%*	*No*	*%*	*No*	*%*	*No*	*%*
Blue green algae	1673	32.05	379	66.96	860	28.24	243	45.59
Green algae	2307	46.98	456	80.57	1624	53.33	403	75.61
Diatoms	419	11.20	111	19.61	252	8.28	83	15.57
Protozoan	216	3.08	36	6.36	101	3.32	29	5.44
Mosquito larvae parts	279	4.10	78	13.78	141	4.63	56	10.51
Fish parts	49	1.19	26	4.59	34	1.12	19	3.56
Cladocera	44	0.94	20	3.53	20	0.67	18	3.38
Ostracoda	20	0.47	15	2.65	13	0.43	10	1.88
Organic detritus			25	4.42			20	3.75
Sand grains			38	6.71			30	5.63

Stomach contents of P. reticulata *in relation to size*

The guppy, *P. reticulate,* was grouped into three size classes based on its stomach contents. The small size class ranged from 1.50 to 2.40 cm, the medium size class ranged from 2.50 to 3.40 cm while the large class ranged from 3.50 to 4.40 cm. The relative abundance by percentage of each food items in terms of numerical and occurrence methods are shown in Fig. 2, 3 and 4. The three size classes of *P. reticulata* exhibited similar food habits with the presence of eight categories of food items, in their stomachs. *P. reticulata* fed mainly on algae irrespective of the size class, with values ranging from 80 to 82% by numerical and 51 to 59% by occurrence. Organic detritus was the next important food item with values ranging from 21 to 30% by occurrence.

Fish parts were the least eaten food item with values ranging from 1 to 2% by numerical and 1 to 4% by occurrence. However, the largest size class (Fig. 1) ate more of algae, organic detritus and fish parts, followed by the medium size class (Fig. 2) while the small size class (Fig. 3) ate less of these food items. Amongst the class group 1.50–2.40 cm, there was no significant difference ($P > 0.05$) in both the numerical and occurrence values of all the food items. The class group 2.50–3.40 cm, showed a significant difference ($P < 0.05$) in the numerical values of algae and crustaceans, while there was significant difference ($P < 0.05$) in the occurrence values of algae and fish parts. Similarly, among the class group 3.50–4.40 cm, there was significant difference ($P < 0.05$) in both the numerical and occurrence values of algae.

Discussions

The stomach contents of guppy, *P. reticulata,* were categorized into eight groups. These were 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. This agreed with Dussault & Kramer (1981), who reported that the digestive tract of wild guppies contained high proportion of green algae and larvae. Other food items were the blue green algae, diatoms, protozoan and mosquito larvae parts. Similar result was obtained by Winemiller (1993), who reported that *Poecilia gills* feed on detritus, diatoms and filamentous algae. *P. reticulata* also feeds on fish parts, zooplankton and detritus. This observation equally agreed with Arthington (1989) and Rodriguez (1997), who reported similar results for other guppy species elsewhere. The present study showed that, *P. reticulata* is planktophagous (Arthington, 1989; Winemiller, 1993) based on its food preference.

The significant difference that was recorded in the seasonal variations of algae and mosquito larvae was due to high load of organic matter occasioned by anthropogenic activities from the metropolis in the dry season. There was continuous flushing of decaying organic matter out of the drainage canal systems, resulting in improved environmental conditions in the rainy season. Generally, *P. reticulata,* in terms of feeding habits, switches between opportunistic benthopelagic omnivores (Rodriquez, 1997), detritivores and predators, with food habits determined by local abundance and availability of prey. The presence of

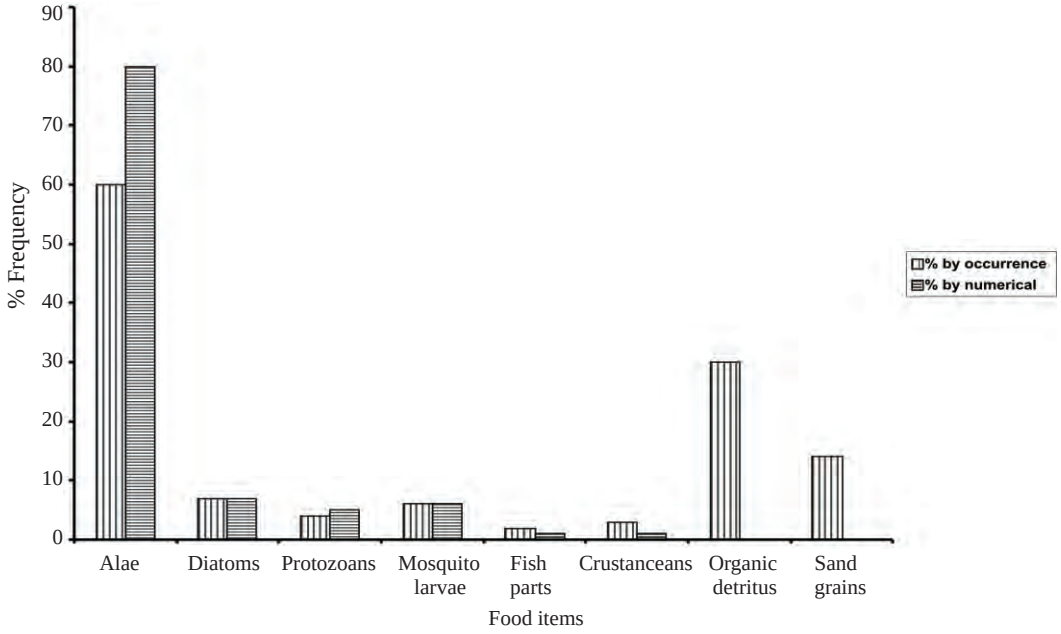

Fig. 2. Stomach contents in small sized (1.50-2.40cm) *P. reticulata* from drainage canal systems of Lagos Metropolis

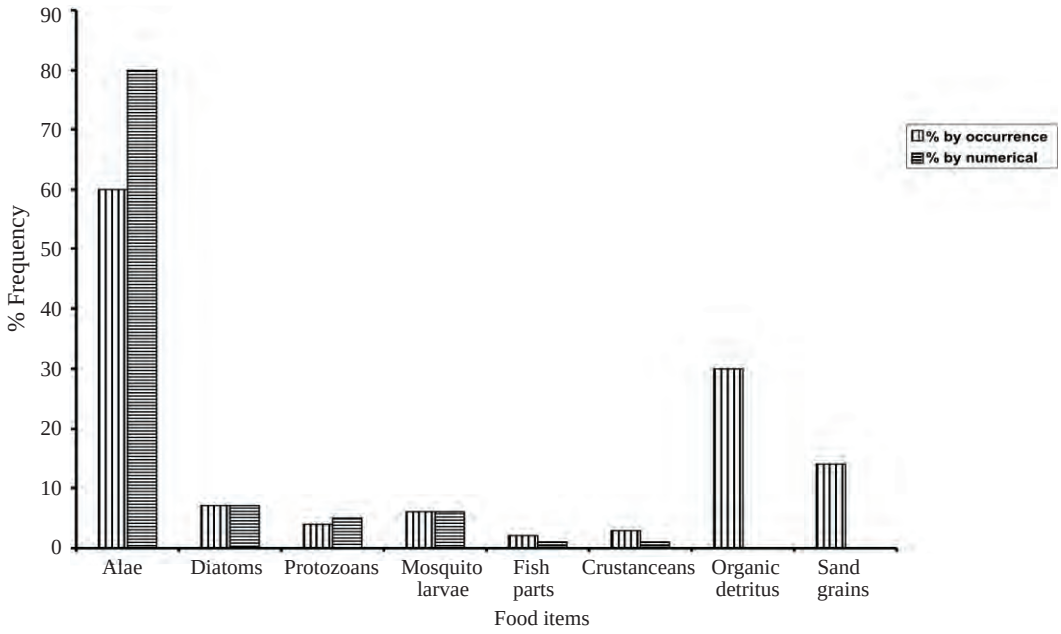

Fig. 3 Stomach contents in medium sized (2.50-3.40cm) *P. reticulata* from drainage canal systems of Lagos Metropolis

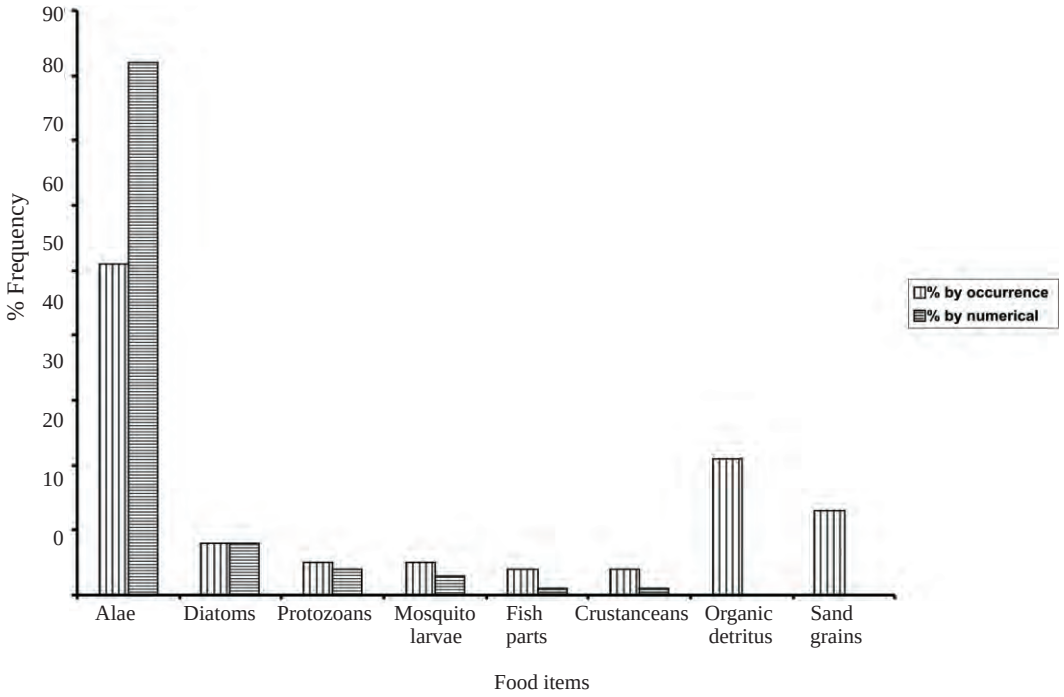

Fig. 4 Stomach contents in large sized (3.50–4.40 cm) *P. reticulata* from drainage canal systems of Lagos Metropolis

mosquito larvae in the three classes recorded in the study is an indication that guppy is predatory which could be harnessed in the use of the fish for biological control of *Anopheles gambiae* in sub-Saharan Africa.

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