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# ENVIRONMENTAL CONDITIONS OF THE GUPPY (*Poecilia reticulata*) FROM DRAINAGE CANAL SYSTEMS IN LAGOS, SOUTHWESTERN NIGERIA

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**Running title:**Environmental conditions of *Poecilia reticulata,* from Drainage Canal Systems
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**Abstract:** The physico-chemical parameters of the drainage canal systems were monitored. The air temperature ranged from 23.0 to 32.0°C (mean: 28.4 ± 2.63°C). The surface water temperature ranged from 21.0 to 31.0°C (mean: 26.8 ± 1.97°C). The hydrogen ion concentration (pH) ranged from 5.35 to 7.20. The dissolved oxygen value ranged from 2.10 to 4.80 mg/l (mean: 3.85 ± 0.54 mg/l) while electrical conductivity value ranged from 0.15 to 1.90 $\mu Scm^{-1}$ (mean: 0.68 ± 0.37 $\mu Scm^{-1}$). Total dissolved solid ranged from 0.08 to 1.00 mg/l (mean: 0.34 ± 0.19 mg/l). The air temperature positively correlated with conductivity and total dissolved solids (r = 0.29). Similarly, water temperature positively correlated with conductivity and total dissolved solids (r = 0.24, 0.25, respectively). Also, dissolved oxygen positively correlated with conductivity and total dissolved solids (r = 0.22, 0.21 respectively). The abundance of *Poecilia reticulata* positively correlated with total dissolved solids and conductivity (0.23 and 0.24, respectively) while it negatively correlated with pH and dissolved oxygen (-0.12 and -0.16, respectively). Though, these paired values were insignificantly correlated (P > 0.05), the values fell within the standard range for sustainable fish production.

**Keywords:** Drainage canal, physico-chemical parameters, *P. reticulata*

## Introduction

*Poecilia reticulata* is among the most diverse animals in terms of the number of species and the diversity of its behaviour. It inhabitsa wide range of aquatic habitats, such as estuaries, lakes, ponds, weedy ditches and canals (Rodriguez, 1997; Lawal *et al*., 2012).

It is common in coastal habitat in tropic, sub-tropic and temperature regions. The guppy *P. reticulata* is native to Brazil, Guyana, Venezuela, and the Caribbean Islands, but has also been introduced into a number of water bodies in Asia, Europe, North America and Africa (Welcomme, 1988; Fishbase, 2006). *P. reticulata* and a number of near relatives are found in fresh-water steams and ponds of the northeast coast of South America and Islands of the Caribbean (Skelton, 1993) and in the drainage canal systems of Lagos, Nigeria (Lawal *et al.*, 2012).

The distribution and existence of guppy also depends on specific environmental parameters such as salinity, pH, temperature, rainfall, conductivity, total dissolved solid and availability of dissolved oxygen (Chapman and Kramer, 1991; Hay *et al.*, 1999; Lawal *et al.*, 2012). The major collection sites have been Venezuela, Trinidad, Barbados, Guyana and the north coast of Brazil. In these areas the average summer temperature is 28°C and the winter temperature is 25°C. Guppy prefers tropical temperature range 18 – 28°C, pH range 7 – 8, Latitude 14 °N – 2 °N and Longitude 67 °W – 52 °W (Croft *et al.*, 2004).

Guppy occurs in warm springs and their effluents, weedy ditches and canal. In deeper bodies of water, such as brackish lagoons and estuaries, guppies will stay in small schools in shallow areas near a natural outcrop or a plant thicket that will afford refuges from predators. They are found in various habitats ranging from highly turbid water in ponds, canals and ditches at low elevations to pristine mountain streams at high elevations (Kenny, 1995; Lawal *et al*., 2012). *P. reticulata*through gradual adaptation were able to tolerate salinities ranging from 39.0% (100% sea water) to 58.5% but requires fairly warm temperatures (23 – 24°C) and quiet vegetated water for survival. It prefers a hard water aquarium and can withstand levels of salinity up to 15.0% sea water which has led to its being occasionally included in marine tropical community tank, as well as in freshwater tropical tanks (Shikano and Fujio, 1997; Fishbase, 2006).

In spite of the ecological and economical values of *P. reticulata* to local community, there is dearth of information on the environmental conditions of guppy with the exception of its food and feeding habits from drainage canal systems of Lagos Metropolis (Lawal *et al*., 2012). Accordingly, this study investigates the prevailing environmental conditions of *P. reticulata* in the drainage canal systems of Lagos Metropolis Southwestern Nigeria and it is hoped that the information provided would be useful in the management of the species for sustainability.

## 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 06025.343 N and longitude 003024.666 E (Fig. 1). 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.

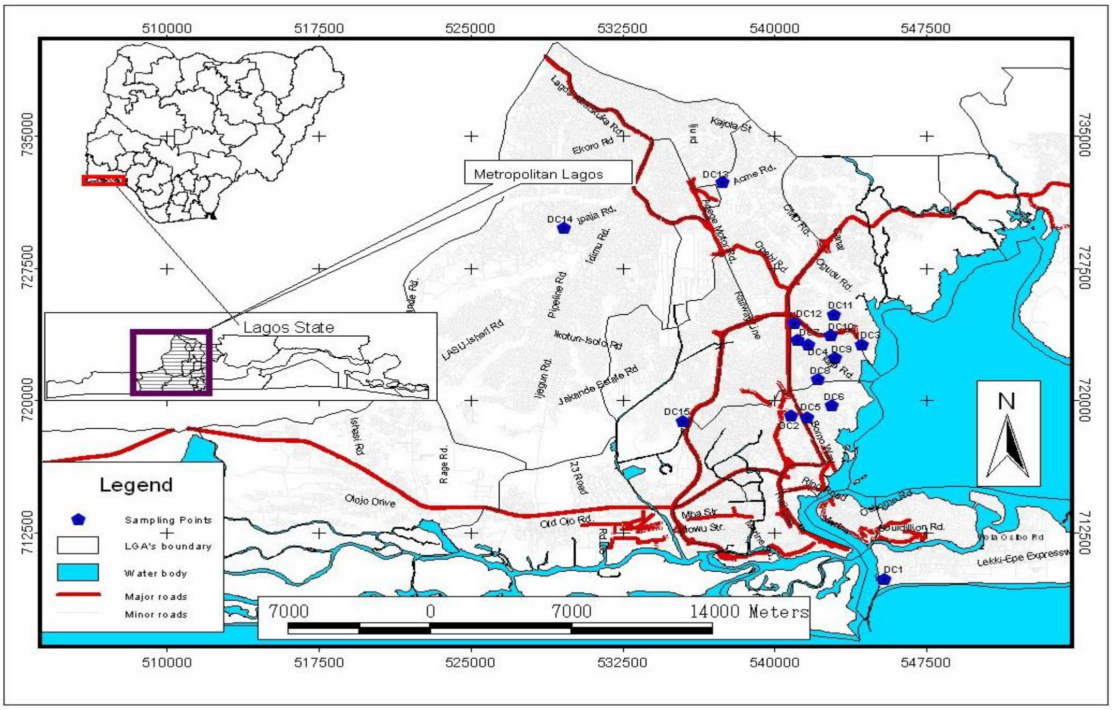


**Fig. 1:** Map of Lagos Metropolis showing sample stations

***Sampling***

The physico-chemical parameters in each drainage canal were determined monthly from 8.00 – 15.00 Hours from November, 2004 to October 2006. The parameters measured in-situ were air and surface water temperature, pH, dissolved oxygen, conductivity and total dissolved solid as described by Boyd (1979). Air and surface water temperatures were determined in the field using mercury-in-glass thermometer graduated in degree Celsius ($^oC$). The pH, dissolved oxygen and electrical conductivity values were determined using Hanna water probe (Model HI 991301).

***Collection and abundance of P. reticulata***

Fish specimens were collected monthly for a period of two years 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 using the 'search and hit' technique. 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 analysis in the laboratory.

***Statistical analysis***

The correlation coefficient matrix of the physico-chemical parameters and the abundance of *P. reticulata*were determined using SPSS 10.0 packages for windows following the procedures described by Ogbeibu (2005).

**Results and Discussion**

The patterns of monthly variations in the physico-chemical parameters for the study period are shown in Fig. 2. Air and water temperatures did not vary widely during the study period however, the air temperature ranged from 23.0 to $32.0^oC$ (mean: $28.4 \pm 2.63^oC$). The lowest mean value ($23.0^oC$) of air temperature was recorded in July 2006 while, the highest mean value ($30.0^oC$) was recorded in November 2005.

Also, the surface water temperature ranged from 21.0 to $31.0^oC$ (mean: $26.8\pm1.97^oC$), the lowest mean value ($22.0^oC$) was recorded in July 2006 while the highest mean value ($29.0^oC$) recorded in November 2004. The hydrogen ion concentration (pH) ranged from 5.35 to 7.20. The lowest pH value (5.35) was recorded in September 2006 while its highest value (7.20) was obtained in October 2006. The dissolved oxygen (DO) value ranged from 2.10 to 4.80 mg/l (mean: 3.85 $\pm$ 0.54 mg/l). The lowest mean value (3.00 mg/l) of DO was obtained in August 2005 and the highest mean value (4.10 mg/l) was recorded in October 2006. The electrical conductivity value ranged from 0.15 to 1.90 $\mu Scm^{-1}$ (mean: $0.68 \pm 0.37$ $\mu Scm^{-1}$). The lowest mean value (0.37 $\mu Scm^{-1}$) was recorded in April 2006 while, the highest mean value (0.71 $\mu Scm^{1}$) was recorded in January 2005. Total dissolved solids ranged from 0.08 to 1.00 mg/l (mean: 0.34±0.19 mg/l) with the lowest mean value (0.19 mg/l) recorded in April 2006 while the highest mean value (0.36 mg/l) recorded in February 2005.

The correlation coefficient (r) for the determined physico-chemical parameters and the abundance of *P. reticulata* is shown in Table 1. The air temperature had weak positive correlation with conductivity and total dissolved solids ($r = 0.29$). Similarly, the water temperature had weak positive correlation with conductivity and total dissolved solids ($r = 0.24$, 0.25, respectively). Also, dissolved oxygen had weak positive correlation with conductivity and total dissolved solids ($r = 0.22$, 0.21, respectively). Abundance of *P. reticulata* showed a weak positive correlation with total dissolved solids and conductivity (0.23 and 0.24, respectively) while it negatively correlated with pH and dissolved oxygen (-0.12 and -0.16, respectively). However, these paired values were insignificantly correlated ($P > 0.05$).

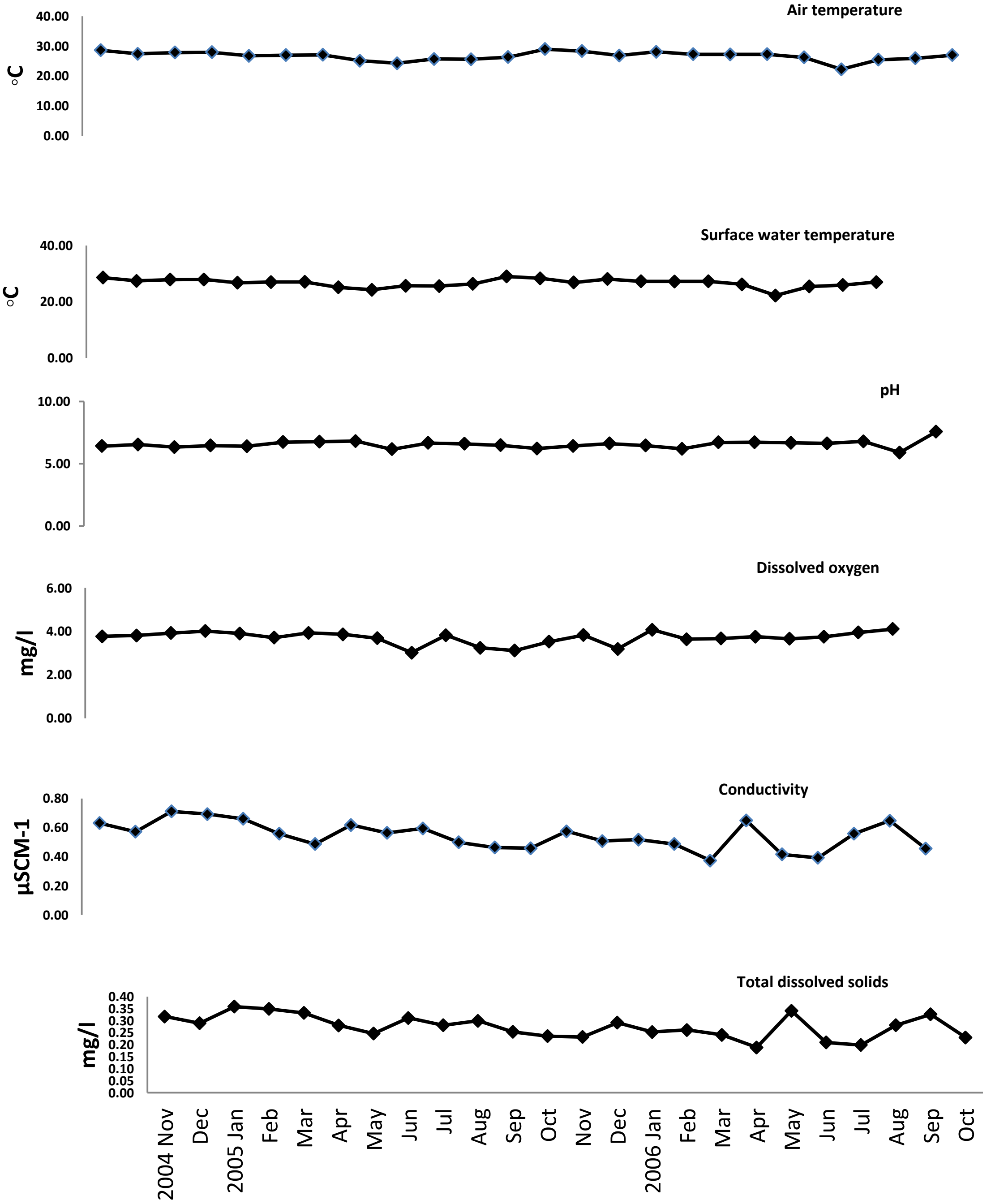


**Fig. 2: Monthly variations in physico-chemical parameters in drainage canal systems of Lagos Metropolis, Nigeria (November, 2004 – October, 2006)**

**Table 1: Correlation coefficient matrix of physico-chemical parameters and abundance of *P. reticulata* from drainage canal systems in Lagos, Southwestern Nigeria**

| | Air Temp. (°C) | Water Temp. (°C) | pH | DO (mg/L) | Conductivity (µSCM-1) | TDS (mg/L) | Abundance of *P. reticulata* |
|---|---|---|---|---|---|---|---|
| Air Temp (°C) | 1.00 | | | | | | |
| Water Temp (°C) | 0.96 | 1.00 | | | | | |
| pH | -0.14 | -0.11 | 1.00 | | | | |
| DO (mg/L) | 0.07 | -0.06 | 0.15 | 1.00 | | | |
| Conductivity (µSCM-1) | 0.29* | 0.24* | -0.32 | 0.22 | 1.00 | | |
| TDS (mg/L) | 0.29* | 0.25* | -0.30 | 0.21 | 1.00 | 1.00 | |
| Abundance of *P. reticulata* | 0.05 | 0.09 | -0.12* | -0.16* | 0.24* | 0.23* | 1.00 |

Correlation is significant at the 0.05% level (2-tailed)

Air temperature ranged from 23.0 to 32.0°C, while the surface water temperature ranged between 21.0°C and 31.0°C indicating tropical warm climate (Rodriguez, 1997; Gupta and Gupta, 2006). The fluctuation in water temperatures closely followed the ambient air temperature (Welcomme, 1979; Edokpayi *et al.,* 2004). The range of air and water temperatures observed in this study was similar to those reported for most water bodies in Southern Nigeria (Nwankwo, 1998; Ogbeibu, 2001; Onyema and Nwankwo, 2006). The slight differences between air and water temperatures at the study sites were probably due to vegetation cover and water level (Egborge, 1979; Edokpayi *et al.,* 2004). The high temperature recorded in the dry season between December and May, might be due to low precipitation and high evaporation during the dry season.

Hydrogen ion concentration (pH) ranged from 5.35 to 7.20. Fluctuation in pH at the study areas was generally lower in the wet season and rises during the dry season. The results were similar to those obtained by Awachie (1981) for running water in Africa. Furthermore, the pH recorded at the drainage canal system was observed to be weakly acidic for most of the study period but, generally falls within the range reported for rivers and canals flowing through areas with vegetation (Uwadiae *et al*., 2009;Dunsin*et al*., 2012).

The dissolved oxygen (DO) content ranging from 2.10 $mgL^{-1}$ to 4.80 $mgL^{-1}$ is a reflection of the perturbed state of the site. Low dissolved oxygen recorded during the period could be attributed to increased bacterial activity due to high load of organic deposits which impose a biological oxygen demand (Akpata and Ekundayo, 1978). According to Boyd (1979) there would be cessation in feeding ability of fishes when dissolved oxygen remains lower than 3 to 4 $mgL^{-1}$ for prolonged period. Guppies were able to survive at 2.10 $mgL^{-1}$ dissolved oxygen level due to its small size and less metabolic activities. This result was similar to the range (3.8 – 4.2 mg/l) reported by Onyema and Nwankwo (2006) for some creeks in Lagos. The low oxygen level could have been as a result of the slow flowing nature of the water in the canal and its small volume which could limit oxygen diffusion (Edokpayi, 2005). Also, low level of oxygen observed particularly in the dry season could also be as a result of increase in temperature as observed during the study period.

Conductivity of a water body is an index of the total ionic content which therefore indicates the freshness or otherwise of the water body. Generally, waters with conductivity values below 100 μScm-1 are fresh while conductivity above 40,000 μScm-1 indicates marine water and those between these two limits are brackish. The low conductivity values recorded during this study closely followed that of some natural West African lake which suggests that the water body is fresh with a conductivity range of 0.15 to 1.90 μScm-1. The level of conductivity recorded during the study was as a result of anthropogenic source of cations and anions into the ecosystem during wet season and this also serves as an indicator of soluble reactive phosphorus (SRP) and nitrate nitrogen ($NO_3$-N) for periphytic algal growth (Jacoby *et al*., 1991). Nevertheless, the low values of conductivity recorded in this study was in agreement with results from some water bodies; stream, swamp and creek in southwestern Nigeria (Edokpayi and Osimen, 2002; Edokpayi and Ayorinde, 2005; Onyema and Nwankwo, 2006).

Total dissolved solid (TDS) values ranged between 0.08 mgL-1 and 1.00 mgL-1. The TDS measures essentially the same constituents as conductivity (i.e., dissolved ions) but also includes dissolved uncharged materials (organic substances). Hence, TDS is nonspecific measure of dissolved solids including natural constituents as well as pollutants. The low values recorded for TDS, during this study, was probably due to the low level of dissolved oxygen and algal bloom on the surface of water, which reduces light penetration (Nwankwo *et al*., 2004). Therefore, the values of TDS, recorded during this study showed the state of perturbation of the environment**.** This result is corroborated by earlier studies on some water bodies including kuramo water (Edokpayi *et al*., 2004), swampy water (Edokpayi and Ayorinde, 2005) and drainage channel (Dunsin *et al*., 2012) in southwestern.

The abundance of *P. reticulata* was insignificantly correlated with the physical and chemical parameters measured which was an indication that the survival of guppy in the drainage canal system is independent of these parameters nevertheless; the values recorded for these parameters were within the standard range for sustainable fish production. Similar result was reported by Idowu *et al*. (2013) when they studied the physico-chemical parameters and the abundance of African pike, *Hepsetus odoe* from a tropical reservoir. In addition, the knowledge derived could be used as baseline information for the sustainable fishery of *P. reticulata.*

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