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# CONTRIBUTIONS OF ENVIRONMENTAL FACTORS TO THE ESTIMATIONS OF *EUSTRONGYLIDES AFRICANUS* LARVAE DENSITIES IN *CLARIAS GARIEPINUS* AND *CLARIAS ANGUILLARIS* FROM BIDA FLOOD PLAIN OF NIGERIA

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**Abstract**
The contribution of environmental factors to the estimations of *Eustrangylides africanus* larvae densities in *Clarias gariepinus* and *C. anguillaris* from Bida flood plain of Nigeria was investigated. Six environmental factors (sand, silt-clay, soil pH, water turbidity, dissolved oxygen and total phosphate content) having positive or negative correlation coefficient (***r***) between 0.50 and 0.85 contributed to the estimations of *E. africanus* larvae densities in the wild population of *Clarias* species.

## Introduction

Disease aetiology is a triad complex (Snieszko, 1974), which includes the host (fish), the parasite (agent), and the micro – and macro – habitats (environment). Climate is the average of atmosphere conditions (that is desirable minimum of 35 years) involving the systematic observation, recording and processing of the various elements: temperature, humidity, sunshine, evaporation, rainfall and others (Areola *et al.* 1992). Physiographically, the study area consists of level of gentle rolling plains. The monotyony of the landscape is only broken by some conical or flat-topped residual hills. The elevation of the plain is between 120 and 240m above sea level (Adeleye, 1976). Meteorologically, the area has a marked wet (April to October) and dry (November to May) season and lies within the 1270mm isohyets (Kowal and Knabe, 1972). The soild is reddish and highly leached with low base status, consisting of loamy sand over sand-clay to clay subsurface horizons (Esu, 1976) of the Nupe sandstone with ustic moisture response and in isohyperthermic temperature regime.

Several investigations indicated that the distribution of ecto-and endo-parasites in the fish host populations are related to their environment and their geographical locations (Toweill and Tabor 1982; Bates and Kennedy, 1991). The occurrences of helminth parasites in Nigerian fishes have been extrensively studied (Alfred-Okya, 1989; Emere, 2000) were not related to contribution of environmental factors. Thus changes brought about by the environmental, fish and invertebrate host populations, and helminth parasites incidences might not be understood. *Clarias* are highly prized and are found all year round in markets of Bida and its environs. The aim of this study therefore is to investigate the contribution of some environmental factors to the estimation of *Eustrongylides africanus* larvae in *Clarias* species from Bida floodplain of Nigeria. This study will provide base line information on the contributions of environmental factors to the estimation of *Eustrongylides africanus* larvae densities in *Clarias* species from Bida floodplain of Nigeria.

## Materials and Methods

The study covered an area between longitude 5o 45' to 60 15'E and latitude 80 30' top 90 10'N within the southern Guinea savannah zone of Nigeria (Areola *et al.* 1991). Regular field data were collected from the fishing localities (Doko, Dokogi, Fokpo and Dutsu) in Bida floodplain on the soil, water and fish components.

The rapid partial analysis of soil involved splitting of the samples into a sand fraction(particles greater than 62µ) and a silt-clay fraction (particles less than 62µ) according to Wentworth scale as modified by Krumben (Buchannan and Kain, 1971). Soil hydrogen concentration pH in water (1:1 soil to water) was measured by inserting the pH meter (Model 264A, Jenway, England) electrodes into partly settled suspension stirred during measurement.

Water samples were collected, with a 2-litre van- Dorn water sampler, into clean plastic container and preserved for respective laboratory analysis carried out. The water temperature was measured on the spot by using graduated mercury in glass thermometer calibrated at 0.2°C interval with a range of 0 to 40°C, recorded immediately for each water sample into sampled bottles. The conductivity, turbidity and total dissolved solids were measured in their respective units by standard methods described by HACH (1980). The pH of the water samples was determined by the colorimeter method described HACH (1980) using the Lovibord pH comparator with bromothymol blue as indicator. The acid modification of Winkler's iodometric method descried by ALPHA (1989) involving the use of four major reagents (manganous sulphate Mn+2S04 ): sodium of potassium hydroxide and iodide (Winkler's reagents); concentrated sulphuric acid ($H_2SO_4$) and sodium thiosulphate ($Na_2SO_2O_3$) estimate the dissolved oxygen content of the water sample in mg/l. The nitrate and total phosphate content was measured in mg/l in each water sample using the cadmium reduction and ascorbic acid method respectively as described by HAC (1980).

The records of the climatic factors (minimum and maximum temperature, relative humidity, rainfall, evaporation and sunshine) kept between January 1959 and December 1999 at the Metrological Unit of the National

Cereal Research Institute (NCRI) Badeggi – Bida were assembled and analyzed as secondary data.

Routine examination were carried out on four hundred and eighty specimens of *Clarias gariepinus* and *C. anguillaris* of different sexes, lengths and weights. The specimens were randomly sampled from four fishing localities of Bid floodplain species to determine occurrence of *Eustrongylides africanus* larvae in relation to sex and season of the year as described by Margolis *et al.* (1982). Simple linear regression/correlation analysis were carried out to examine any associations among prevalence, mean intensity and abundance of *Eustrongylides africanus* larve in *Clarias* species of Bida floodplain and the sixteen environmental factors [maximum temperature (x1), minimum temperature (x2) and relative humidity (x3); rainful (x4); sunshine (x5), evaporation (x6), sand (x7), silt-clay (x8), soil pH (x9), water temperature (x10), conductivity (x11), turbidity (x12), total dissolved solids (x13), water pH (x14), dissolved oxygen (x15) and total phosphate content (x16),]

**Results and Discussion**

The correlated coefficient ® for sixteen environmental factors with the occurrences of *Eustrongylides africanus* larve in *Clarias* species frp, Bida floodplain is shown on Table 1. Six, five and six out of the 52 combinations of the sixteen environmental factors with known correlation coefficient ((r $\geq \pm$ 0.50) contributed respectively to the estimation of prevalence, mean intensity and abundance of *E. africanus* larve densities in *Clarias* species (Tables 2, 3 and 4) were sand, sand, silt – clay, soil pH, turbidity, dissolved oxygen and phosphate as follows:

*Equations for prevalence*

$Y = -145x + 140.7$ ($r = -0.83$) with sand
$Y = -1.24x + 18.1$ ($r = -0.54$) with silt clay
$Y = -5.9x + 65$ ($r = -0.50$) with soil pH
$Y = -0.55x + 24.5$ ($r = -0.51$) with turbidity
$Y = -0.52x + 48.2$ ($r = -0.69$) with dissolved oxygen
$Y = -0.03x + 35.1$ ($r = -0.70$) with total phosphate content

*Equations for mean intensity*

$Y = -0.8x + 8.4$ ($r = -0.75$) with sand
$Y = -0.12x + 1.2$ ($r = -0.85$) with silt clay
$Y = -0.45x + 5.0$ ($r = -0.63$) with soil pH
$Y = -0.07x + 2.7$ ($r = -0.80$) with total phosphate content

*Equations for mean abundance*

$Y = -0.05x + 4.8$ ($r = -0.85$) with sand
$Y = -0.06x + 0.2$ ($r = -0.76$) with silt clay
$Y = -0.28x + 2.4$ ($r = -0.65$) with soil pH
$Y = -0.02x + 1.3$ ($r = -0.59$) with dissolved oxygen
$Y = -0.04x + 1.0$ ($r = -0.79$) with total phosphate content

The silt-clay of the soil and water turbidity were positively correlated to the prevalence of *E. africanus* larve in *Clarias* species. Thus silt-clay of the soil and water turbidity increase as the prevalence of *E. africanus* larve species increases and vice versa. The sand, soil pH dissolved oxygen and total phosphate content were negatively correlated to the prevalence of *E. africanus* larve in *Clarias* species. Thus the sand, soil pH dissolved oxygen and total phosphate content would increase as the prevalence of *E. africanus* larve species in *Clarias* species increase, and vice versa.

The silt-clay of the soil was positively correlated to the mean intensities of *E. africanus* larve in *Clarias* species. Thus silt-clay of the soil increases as the main intensity of *E. africanus* larve species increases and vice versa. The sand, soil pH and total phosphate content were negatively correlated to the mean intensities *E. africanus* larve in *Clarias* species. Thus the sand, soil pH and total phosphate content increases as the mean content increases as the mean intensities of *E. africanus* larve species in *Clarias* species decrease, and vice versa.

The silt-clay of the soil was positively correlated to the mean abundance of *E. africanus* larve in *Clarias* species. Thus, silt-clay of the soil increases as the main abundance of *E. africanus* larve species increases, and vice versa. The sand, soil pH, dissolved oxygen and total phosphate content were negatively correlated to the mean abundance of *E. africanus* larve in *Clarias* species. Thus, the sand, soil pH, dissolved oxygen and total phosphate content increases as the mean content increases as the mean abundance of *E. africanus* larve species in *Clarias* species decrease, and vice versa.

**Table 1**: Correlation coefficient (***r***) for sixteen environmental factors with occurrence of *Eustrongylides africanus* larvae infection in *Clarias* species from Bida Floodplain

| | Preva. | Inten | Abun. | Max Tem ($x_1$) | Min Tem ($x_2$) | RH ($x_3$) | Rain ($x_4$) | Evapo ($x_5$) | Sun ($x_6$) | Sand ($x_7$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Prevalence | 1 | | | | | | | | | |
| Intensity | 0.82 | 1 | | | | | | | | |
| Abundance | 0.92 | 0.97 | 1 | | | | | | | |
| Temp max ($x_1$) | 0.14 | 0.07 | 0.13 | 1 | | | | | | |
| Temp min ($x_2$) | -0.19 | -0.09 | 0.18 | -0.23 | 1 | | | | | |
| RH ($x_3$) | -0.38 | -0.27 | -0.38 | -0.85 | 0.65 | 1 | | | | |
| Rain ($x_4$) | -0.03 | 0.01 | -0.06 | -0.85 | 0.67 | 0.91 | 1 | | | |
| Evapo ($x_5$) | 0.09 | 0.03 | 0.03 | 0.40 | 0.76 | 0.01 | 0.14 | 1 | | |
| Sun ($x_6$) | -0.04 | -0.20 | -0.14 | 0.64 | -0.50 | -0.61 | -0.82 | -0.15 | 1 | |
| Sand ($x_7$) | -0.83 | 0.75 | 0.85 | 0.45 | -035 | -0.69 | 0.36 | -0.12 | -0.05 | 1 |
| Silt-clay ($x_8$) | 0.83 | 0.75 | 0.85 | 0.45 | -035 | -0.69 | 0.36 | -0.12 | -0.05 | -1.00 |
| pH ($x_9$) | -0.49 | -0.63 | -0.65 | -0.66 | 0.33 | 0.79 | 0.58 | -0.17 | -0.14 | 0.87 |
| Temp ($x_{10}$) | 0.16 | 0.20 | 0.15 | -0.05 | 0.66 | 0.28 | 0.41 | 0.64 | -0.28 | 0.21 |
| Cond. ($x_{11}$) | 0.29 | 0.09 | 0.11 | -0.25 | -0.03 | 0.22 | 0.13 | -0.22 | 0.39 | 0.16 |
| Turb ($x_{12}$) | 0.51 | 0.31 | 0.33 | -0.40 | 0.47 | 0.44 | 0.61 | 0.29 | -0.22 | -0.10 |
| TDS ($x_{13}$) | 0.41 | -0.09 | 0.06 | -0.33 | 0.04 | 0.22 | 0.35 | -0.02 | 0.02 | 0.02 |
| pH ($x_{14}$) | 0.36 | 0.01 | 0.16 | 0.81 | -0.41 | -0.81 | -0.76 | 0.20 | 0.78 | -0.47 |
| DO ($x_{15}$) | -0.069 | -0.45 | -0.59 | -.071 | 0.54 | 0.88 | 0.70 | -0.04 | -0.54 | 0.74 |
| $PO_3$ ($x_{16}$) | -0.70 | -0.80 | -0.79 | -0.46 | 0.25 | 0.54 | 0.43 | -0.04 | -0.38 | 0.62 |

X1 – Maximum temperature, X2 – Minimum temperature, X3 – Relative humidity, X4 – Rainfall, X5 - Evaporation, X6 – Sunshine, X7 - Sand, X8 – Silt-Clay, X9 – Soil pH, X10 ¬- Water Temperature, X11 - Conductivity, X12 – Turbidity, X13 – Total dissolved solids, X14¬ – Water pH; X15 – Dissolved oxygen, X16 – Total phosphate content.

**Table 1** (continued): Correlation coefficient ® for sixteen environmental factors with occurrence of *Eustrongylides africanus* larvae infection in *Clarias* species from Bida Floodplain

| | Silt/ Clay ($x_8$) | pH ($x_9$) | Tem ($x_{10}$) | Con. ($x_{12}$) | Tur ($x_{12}$) | TDS ($x_{13}$) | pH ($x_{14}$) | DO ($x_{15}$) | $PO_3$ ($x_{16}$) |
|---|---|---|---|---|---|---|---|---|---|
| Silt-clay ($x_8$) | 1 | | | | | | | | |
| pH ($x_9$) | -0.87 | 1 | | | | | | | |
| Temp ($x_{10}$) | -0.21 | -0.12 | 1 | | | | | | |
| Cond. ($x_{11}$) | -0.16 | 0.47 | 0.01 | 1 | | | | | |
| Turb ($x_{12}$) | 0.10 | 0.30 | 0.61 | 0.67 | 1 | | | | |
| TDS ($x_{13}$) | -0.02 | 0.50 | 0.05 | 0.67 | 0.72 | 1 | | | |
| pH ($x_{14}$) | 0.47 | --0.41 | -0.09 | 0.18 | -0.05 | 0.23 | 1 | | |
| DO ($x_{15}$) | -0.74 | 0.64 | 0.26 | -0.11 | 0.08 | -0.15 | -0.84 | 1 | |
| $PO_3$ ($x_{16}$) | -0.62 | 0.60 | 0.03 | -0.33 | -0.15 | 0.09 | -0.42 | 0.71 | 1 |

X1 – Maximum temperature, X2 – Minimum temperature, X3 – Relative humidity, X4 – Rainfall, X5 - Evaporation, X6 – Sunshine, X7 - Sand, X8 – Silt-Clay, X9 – Soil pH, X10 ¬- Water Temperature, X11 - Conductivity, X12 – Turbidity, X13 – Total dissolved solids, X14¬ – Water pH; X15 – Dissolved oxygen, X16 – Total phosphate content.

**Table 2**: Estimations of prevalence of *Eustrongylides africanus* larvae infection in *Clarias* species from Bida Floodplain using environmental factors with known correlation coefficients ($r \geq \pm 0.50$)

| **Environmental Factors (EFs)** | **Equation for Prevalence (Y)** | **Equivalence of EFs (When Y = 0)** | **Equivalence of (EFs) (For 1 % Change in Y)** |
|---|---|---|---|
| Sand (%) | $Y = -145 x_1 + 140.7$ ($r = -0.83$) | x = -96.7 | x = -0.7 |
| Silt Clay (%) | $Y = -1.24 x_2 + 18.1$ ($r = -0.54$) | x = -14.6 | x = 0.8 |
| Soil pH (unit) | $Y = -5.9 x_3 + 65$ ($r = -0.50$) | x = 110.1 | x = -1.7 |
| Turbidity (mg/l) | $Y = -0.55 x_4 + 24.5$ ($r = -0.51$) | x = -444.7 | x = 8.2 |
| Dissolved Oxygen (mg/l) | $Y = -0.52 x + 48.2$ ($r = -0.69$) | x = 92.6 | x = 0.9 |
| Phosphate (mg/l) | $Y = -0.03 x_5 + 35.1$ ($r = -0.70$) | x = 1252.5 | x = 5.7 |

**Table 3**: Estimations of mean intensity of *Eustrongylides africanus* larvae infection in *Clarias* species from Bida Floodplain using environmental factors with known correlation coefficients (r ≥ ± 0.50)

| Environmental Factors (EFs) | Equation for Intensity (Y = No of larvae per infected fish sampled) | Equivalence of EFs (When Y = 0) | Equivalence of (EFs) (For 1 % Change in Y) |
|---|---|---|---|
| Sand (%) | $Y = -0.079\ x_1 + 8.39$ (r = -0.75) | x = 106.2 | x = -12.8 |
| Silt Clay (%) | $Y = -1.2\ x_2 + 1.23$ (r = -0.85) | x = -10.3 | x = 8.4 |
| Soil pH (unit) | $Y = -0.45.x_3 + 5.04$ (r = -0.63) | x = 11.2 | x = -2.2 |
| Phosphate (mg/l) | $Y = -0.55x + 24.5$ (r = -0.51) | x = 38.0 | x = -6.0 |

**Table 4**: Estimation of mean abundance of *Eustrongylides africanus* larvae infection in *Clarias* species from Bida Floodplain using environmental factors with known correlation coefficients (r ≥ ± 0.50)

| Environmental Factors (EFs) | Equation for Prevalence (Y) | Equivalence of EFs (When Y = 0) | Equivalence of (EFs) (For 1 % Change in Y) |
|---|---|---|---|
| Sand (%) | $Y = -0.053\ x_1 + 4.80$ (r = -0.85) | x = 90.6 | x = -18.9 |
| Silt Clay (%) | $Y = 0.062\ x_2 + 0.17$ (r = 0.76) | x = -2.7 | x = 10.7 |
| Soil pH (unit) | $Y = -0.28\ x_3 + 2.42$ (r = -0.65) | x = 8.6 | x = -3.7 |
| Dissolved Oxygen (mg/l) | $Y = -0.016\ x_4 + 1.33$ (r = -0.59) | x = -83.1 | x = -62.5 |
| Phosphate (mg/l) | $Y = -0.016\ x_4 + 1.33$ (r = -0.59) | x = 23.1 | x = -23.8 |

## Conclusion

Many fish farmers, as well as hatchery operators, often need to know the health statues so as to make management decisions like how weight gain feed intake and utilization, and also to administer the right damage of medication. Reasonable skill in estimating parasitic infection density is necessary for fishery workers as it will frequently be necessary to estimate parasite density when facilities to measure environmental factors are not readily available or their use are not practicable. This study has shown that environmental factors, as media for proper fish productivity, could be used to estimate the density of parasitic infections in freshwater fishes. Thus, a simple device for quick and accurate estimation of the density of parasites in fishes could be derived for research and development purposes.

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