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Relationship among *Tilapia guineensis* Fingerlings Abundance and Water Quality Variations in a Brackish Water Reservoir in Lagos

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ABSTRACT

In recent times, there has been an upsurge in the culture of tilapia in Nigeria resulting in increased demand for the fingerlings which is hardly satisfied. This is due to increasing demand for table size tilapia as food fish and under-sized tilapia in the fish meal and fish canning industries in Nigeria. Collection of *Tilapia guineensis* fingerlings from the wild, to augment hatchery production has been the practice and this is subject to environmental fluctuations. Multivariate regression and correlation analyses of accumulated data were used to investigate the effects of changes in water quality parameters on abundance of fingerlings of *Tilapia guineensis* in a brackish water habitat in Lagos. Dissolved Oxygen (DO), salinity and Secchi transparency were found to be the most dominant factors affecting the abundance of *Tilapia guineensis* fingerlings in the Lagos lagoon. Peak period of abundance was closely associated with period of low salinity (0.50 to 5.60 ‰), which coincided with the period of low transparency and low DO in the rainy season. The correlation analyses of *Tilapia guineensis* fingerlings with the water quality parameters yielded the following correlation coefficients (r)-0.598; (salinity); -0.644 (transparency); -0.710 (DO); -0.566; (temperature) and 0.129 (pH). The abundance of *Tilapia guineensis* fingerlings in the Lagoon was ultimately defined by a suitable regression equation. This result is expected to optimize the collection of fingerlings of *Tilapia guineensis* from the wild and boost food fish security in Nigeria and elsewhere.

Key words: Water quality parameters, multivariate regression, seasonal variations, dissolved oxygen, fingerlings

INTRODUCTION

The demand for fish and fishery products in Nigeria is estimated at 1.5 million metric tons annually but her total annual domestic production hovers around 0.40 to 0.50 million metric tons (Anyanwu, 2006). This gives an annual deficit of about 0.90 million metric tons .As a result Nigeria imports frozen fish to the tune of ₦20b annually to bridge the deficit (Anyanwu, 2006). Fish farming is an important and integral part of domestic fish production in Nigeria. Anyanwu (2006) estimated the potential of fish farming at 0.65 to 1.0 million metric tons annually, which can bridge the deficit if it can be fully developed. However, Anyanwu (2006) estimated actual fish production from aquaculture at 60,000 metric tons only annually. The potential is hardly tapped (Tobor, 1991).

In recent times, there has been an upsurge in the culture of tilapia because of increase in demand for food fish, fishmeal and fish canning industries. One of the factors responsible for the

low level of fish production from brackish water environment is the scarcity of fingerlings of brackish water fish species such as *Tilapia guineensis*, *Mugil* sp. and *Chrysichthys nigrodigitatus* etc. As of now demand for *Tilapia guineensis* fingerlings has far outstripped supply. In order to bridge the deficit, efforts should be made to augment hatchery production with collection from the wild. However the availability of fingerlings of *Tilapia guineensis* in the wild is known to be subject to environmental fluctuation. Multivariate regression analysis has been successfully applied to fish growth (Prein *et al*., 1993) and can be used to delineate environmental effects on abundance of Tilapia guineensis seeds in the wild.

This study reported the effects of seasonal variations of water quality parameters on abundance of *Tilapia guineensis* fingerlings in the Lagos lagoon. It is aimed at identifying peak period of abundance and collection of *Tilapia guineensis* fingerling from the wild in Nigeria and elsewhere.

MATERIALS AND METHODS

Collection of data: The reservoir (0.20 ha) used for this study was located on the shorelines of the Lagos lagoon which has direct connection with the sea. The sluice gate of the reservoir was left open for two weeks. At the end of the two weeks, the sluice gate was closed and the reservoir was seined two times with seine net (mesh size: 5 mm). The fingerlings of *Tilapia guineensis* and other fish species landed were sorted, counted and recorded. This exercise was carried out twice every month for three years.

Water physicochemical parameters were taken during low and high tides on each sampling day. Measurement of salinity (‰) was done with a salinity refractometer, temperature (°C) was measured using mercury-in-glass thermometer, pH was measured with a pH meter model 191. For transparency, a weighted white secchi disc of 35 cm diameter was used. Dissolved Oxygen (DO) was measured using the Winkler's method (APHA, 1995; Boyd, 1990). Data on rainfall totals and Relative Humidity (RH) were obtained from marine meteorological station, Lagos.

Statistical analysis: Correlation and regression analyses were carried out to investigate relationship between variations in abundance of *Tilapia guineensis* fingerlings and the water quality parameters. Multivariate regression analysis was implemented using statistical analysis system (SAS, 1999).

RESULTS AND DISCUSSION

Mean values of number of *Tilapia guineensis* fingerlings, the selected water quality parameters, rainfall totals and relative humidity for the period of study are shown in Table 1. Number of *Tilapia guineensis* fingerlings collected ranged from 2000 to 3600 with a mean of 2725±484 units, while mean water salinity values varied from 0.50 to 28.50 ‰, with a mean of 9.76±8.14 ‰. Mean DO values ranged from 2.50 to 6.10 ppm with a mean of 3.96±1.04 ppm, while pH values varied from 6.50 to 8.00 units with a mean of 7.25±0.46 units. Secchi transparency values ranged from 35.10 to 63.50 cm with a mean of 44.89±7.50 cm, while surface water temperature varied from 24.00 to 30.50°C with a mean of 27.58±1.56°C. Rainfall totals ranged from 0.00 to 746.601 mm with a mean of 178.97±211.03 mm, while the relative humidity ranged from 74.00 to 87.00 ‰ with a mean of 79.94±4.24 ‰. Simple, stepwise regression analyses of *Tilapia guineensis* fingerlings with the water quality parameters using reciprocal model yielded the following correlation coefficients (r): -0.5982 (salinity); -0.6465 (transparency); -0.7104

Table 1: Mean values of number of *Tilapia guineensis* fingerlings and selected water quality parameters

Statistics	Tgf×1000 (unit)	Salinity (‰)	DO (ppm)	pH	Temperature (°C)	Transparency (cm)	Rainfall (mm)	Relative humidity (%)	No of observations
Maximum	3.60	28..50	6.10	8.00	30.50	6350	746.60	87.00	36
Minimum	2.00	0.50	2.50	6.50	24.00	35.10	0.00	72.00	36
Mean (pooled)	2.73±0.48	9.76±8.14	3.97±1.04	7.25±0.47	27.58±1.57	49.80±7.51	178.97±211.03	79.94±4.24	36
r value	1.00±0.00	-0..598±0.0	-0.710±0.0	0.129±0.0	-0.566±0.0	-0.644±0.0	0.476±0.00	0.621±0.00	
Mean (wet season)	3.10±0.22	4.10±4.12	3.29±0.44	7.23±0.47	24.85±6.27	39.44±2.51	329.05±237.00	83.00±3.77	15
Mean (dry season)	2.33±0.37	15.00±7.17	4.67±0.95	7.21±0.45	28.36±0.99	48.82±7.61	38.08±40.45	77.00±2. 68	15
t-test result	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	p<0.05	

Tgf: Number of *Tilapia guineensis* fingerlings

(DO); -0.5665 (temperature); 0.1298 (pH); 0.4756 (rainfall); and 0.6213 (RH). The result of multivariate regression analysis showed that the abundance of *Tilapia guineensis* fingerlings (Tgf) in the lagoon can be defined by the following equation: Tgf = 0.014 (salinity)-0.186(DO)+0.079 (pH)-0.086 (temperature)-0.020 (transparency)+0.0003 (rainfall)+0.016 (RH)+4.739.

Abundance of fingerlings of *Tilapia guineensis* in the Lagos Lagoon generally indicated marked seasonal variation with the selected water quality parameters. For instance low salinity range (0.50 to 5.60‰) was found closely associated with period of peak abundance of *Tilapia guineensis* fingerlings. On the other hand, period of low abundance coincided with period of high salinity in the Lagoon. Also period of peak abundance of *Tilapia guineensis* fingerlings was associated with period of relatively low values of DO, Temperature and secchi transparency. Incidentally the period of low salinity, DO, temperature and secchi transparency values coincided with the period of peak rainfall (224.40 to 746.60 mm) and high relative humidity (85.00 to 87.00 ‰).

The results of the regression analyses would indicate partly that low salinity levels favoured high abundance of fingerlings of *Tilapia guineensis* in the Lagoon. This is consistent with the findings of Ezenwa (1982) who observed that the period of low salinity in the Lagos Lagoon coincided with highest concentration of fingerlings of *Chrysichthys nigrodigitatus* and *Mugil* sp. in the Lagoon. The results further indicate that although peak period of abundance of fingerlings of *Tilapia guineensis* occurred during the period of low salinity in rainy season, *Tilapia guineensis* fingerlings were available in the Lagos lagoon all year round. From the values of the correlation coefficients, it is evident that DO secchi transparency and salinity were the most dominant factors influencing the abundance of *Tilapia guineensis* seeds in the Lagos lagoon. The period of high salinity levels, which is limiting is attributed to the tidal influence, while periods of low salinity is attributed to the dilution effects of the rain and floods of the rainy season (Rigler, 1979). The positive correlation coefficient (r = 0.129) obtained in respect of pH is expected since pH values were higher during cloudy weather in rainy season (Buttner *et al*., 1993). pH values which remained relatively stable through out the study period is indicative of high buffering capacity of the Lagos lagoon water. The result of regression analyses which indicated that decreasing dissolved oxygen values coincided with periods of abundance of *Tilapia guineensis* fingerlings is not consistent with the findings of Boyd and Litchtkoppler (1979). The low dissolved oxygen values may be attributed to low photosynthetic activities of phytoplankton due to predominantly cloudy weather in peak rainy season.

CONCLUSION

It is therefore, concluded that fingerlings of *Tilapia guineensis* are available all months of the year in the Lagos lagoon. Its abundance exhibits seasonal variation with period of peak abundance being during low secchi transparencies and low salinities in peak rainy season.

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