African Journal of Biology and Medical Research
Volume 1, Issue 1, 2018 (pp. 63-71)

www.abjournals.org

# HEALTH STATUS OF AMPHIBIANS FROM AN URBANIZING COMMUNITY AND A FOREST ZONE, RIVERS STATE, NIGERIA

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**ABSTRACT**: *Urbanization has been reported to adversely affect the health status of amphibians. We examined the health status of four amphibian species (Ptychadena spp., Hoplobatrachus occipitalis, Sclerophys spp. and Hylarana galamensis) from an urban settlement (Rumuesara) and a forested location (Agbada), using the condition factor, CF. Higher condition factor values of Ptychadena spp. were obtained in specimens from Agbada while the CF of H. occipitalis was higher in specimens from Rumuesara, although the differences were not statistically significant. Generally, CF was higher in male specimens from both locations. No significant differences were found between sexes except in Ptychadena species from Agbada where it was significantly higher in the females. Condition factor of all species investigated was greater than one. Pearson correlation between snout-vent length and body mass was statistically significant ($P<0.01$), indicating good health status of the amphibians from both locations. Urbanization did not significantly affect the CF of amphibians from Rumuesara when compared with that of specimens from the forested location, Agbada.*

**KEYWORDS**: Health Indices, Wellbeing, Anurans, Urbanization, Forest, Nigeria.

## INTRODUCTION

Body condition factor is useful in determining the health status of fishes and amphibians (Bancila *et al*., 2010; Ighwela *et al*., 2011). It can be correlated with habitat quality to determine the effect of environmental characteristics on the wellbeing of living organisms.

Hegde and Krishnamurthy (2014a) found that the body condition factor, Hepato somatic index (HSI) and the activity of Acetyl cholinesterase (AChE) could be used as indicators of the health status of amphibians. They reported that healthier amphibians had a higher body condition factor and AChE activity in the brain and lower HSI levels on their liver when compared to unhealthy ones from contaminated environments. Hegde and Krishnamurthy (2014b) also assessed the use of Gonado-somatic Index (GSI) as an indicator of health status, but found it to be statistically insignificant between frogs collected from polluted and reference points.

## LITERATURE

Several reports have been published on various aspects of amphibian parasitology and eco-toxicology in Nigeria (Akani *et al*, 2004; Aisien *et al*., 2009, 2015, 2017a, 2017b; Amuzie *et*

*al*., 2016; Amuzie, 2017a, b; Amuzie and Aisien, 2017). However, to the best of the authors' knowledge, information is deficient in the use of condition factor as an index of the health status of the amphibian fauna of the country. This paper, therefore, presents a report on the condition factor of amphibians collected from an urbanizing community (Rumuesara) and a secondary forest location (Agbada), in order to fill the information gap. The hypothesis that the condition factor of amphibians living in the forested location will be higher than that of those in the urbanizing community was tested.

## METHODOLOGY

**Study Sites**: Two locations in Rivers State, Nigeria, were investigated- Rumuesara, an urbanizing community (4º 54' 26.37''E, 7º 1' 58.128''N), and Agbada, a forested location (4º 55' 57.006''E, 7º 1' 13.692''N). Rumuesara was characterized by altered vegetation mostly composed of grasses and shrubs. It was a residential area experiencing a high rate of housing development. Agbada, on the other hand, was a quiet location surrounded by secondary forest vegetation with the dominant trees being *Elaeis guineensis* and *Musanga cecropiodes.*

**Amphibian Sampling**: Visual encounter and acoustic survey method was used to collect amphibian specimens from both locations, each of which was visited monthly between June and December, 2015. Surveys were conducted in the night between the hours of 7.00pm to 10.00pm. Amphibians were identified according to the protocols of Roedel (2000). Body mass (BM) of amphibians were determined using an electronic weighing balance (OHAUS, model Scout Pro SPU402) and snout-vent length (SVL) was taken using a metre rule.

**Computation of Condition Factor**: Fulton's index (K) was calculated according to the formula $K = W / SVL^3 \times 10^2$, following Zhelev *et al*. (2015).

**Statistical Analysis**: The condition factor of individual species from both locations was log $\chi$ transformed and student-t test used to test for significant differences between location, and sex. Pearson Correlation coefficients between SVL and BM were computed using Microsoft Excel. XY plots of relationship between SVL and body mass BM, and box plots showing condition factor values of male and female specimens of the amphibian species investigated were done using PAST exe statistical software. Regression equation of relationship between BM and SVL of species as well as the regression ANOVA were computed according to Fowler and Cohen (1992).

## RESULTS

Fourteen specimens of *Hoplobatrachus occipitalis* and thirty of *Ptychadena* species were collected from each of both locations for the purpose of computing their condition factor. *Sclerophys* species (n=5) and *Hylarana galamensis* (n=14) were also collected from Rumuesara urbanizing settlement and their body condition factors were also computed.

A summary of the morphometric measurements and condition factor values of *H. occipitalis* and *Ptychadena* species from both locations are presented in Table 1.

The mean condition factor of *H. occipitalis* from Rumuesara was 7.72 while that of same species from Agbada was 7.04, but these were not statistically different ($t_{26}$=1.352, P= 0.09).

The mean CF of male (n=5) and female (n=9) *H. occipitalis* specimens from Rumuesara were 7.94 and 7.59, respectively. Statistical testing showed no significant differences between both sexes ($t_{12}$=0.29; P=0.39).

Eight male and six female specimens of *H. occipitalis* were collected from Agbada with a mean CF of 7.29 and 6.71, respectively. There was however, no statistically significant difference between the CF of both sexes ($t_{12}$=0.54; P=0.30). A box plot illustrating variations in condition factor values of male and female *H. occipitalis* specimens from both locations is presented in Figure 1.

The condition factor of *Ptychadena* spp. from Rumuesara ranged from 4.51 to 9.76, while that of specimens from Agbada ranged from 3.41 to 14.90. Student t-test showed no significant differences between the condition factors of *Ptychadena* species from both locations ($t_{58}$=0.257, P=0.40). However, the mean CF was slightly higher at Agbada (7.16) than at Rumuesara (7.08).

*Ptychadena* species from Rumuesara were composed of six male and twenty-four female specimens. Mean CF for both sexes from this location were 6.36 and 7.26 for male and female specimens, respectively. These were, however, not statistically significantly different ($t_{28}$=1.66; P=0.05).

Twelve male and eighteen female specimens of *Ptychadena* species were collected from Agbada during the period. The mean CF of the male specimens was 5.92 while that of their female counterparts was 7.99, giving a higher CF for female than male specimens. Student t-test revealed a highly significant difference between the condition factors of male and female *Ptychadena* from this location ($t_{28}$=2.71, P=0.006). A box plot illustrating variations in condition factor values of male and female *Ptychadena* specimens from both locations is presented in Figure 2.

Pearson correlation coefficients between SVL and BM was higher than 0.5 for both amphibian species from both locations investigated. The coefficient between SVL and BM of *Ptychadena* spp. from Rumuesara, and those from Agbada were 0.90 and 0.864 ($r_{0.01(2)28}$=0.463), respectively. Pearson correlation coefficients between SVL and BM of *H. occipitalis* were 0.91 and 0.85 for Rumuesara, and Agbada ($r_{0.01(2)12}$=0.661), respectively. Therefore, all correlations were significant at 0.01 probability levels.

XY plots illustrating the relationship between SVL and BM as well as the regression equation for each species from both locations are shown in Figures 3a-d. The regression of BM on SVL of *Ptychadena* species and *H. occipitalis* from both locations was highly significant: *Ptychadena* spp. from Rumuesara, F= 122.41, P=9.87E-12; *Ptychadena* spp. from Agbada, F=58.25, P=2.59E-08; *H. occipitalis* from Rumuesara and Agbada, F=144.46, P=4.75E-08 and F= 37.41, P=5.2E-05, respectively.

The condition factor of *Sclerophys* spp. and *Hylarana galamensis* specimens from Rumuesara were computed and the statistical summary is presented in Table 2. In both species, higher condition factor was obtained in male specimens.

## DISCUSSION

Condition factor is commonly used to compare the health status of organisms collected from different habitats (Ighwela *et al*., 2011). The condition factor of both *Ptychadena* species and *H. occipitalis* specimens collected from both locations did not vary significantly. All condition factor values were greater than one (1) indicating that all the frogs were in good condition. Hegde and Krishnamurthy (2014a) observed that some frogs (*Fejervarya limnocharis*) collected from rice fields contaminated with pesticides and fertilizers had negative condition factors. However, the authors reported no significant differences in the SVL and BM of frogs from both contaminated and control sites. Thammachoti *et al*. (2012), on the other hand, reported significant differences in the condition factor of same species collected from agricultural fields with herbicide use and reference sites, with lower condition factor being recorded in specimens from the contaminated site. The altered vegetation at Rumuesara may have led to an increase in the availability of food organisms such as worms, insects and beetles. This notwithstanding, animals living in urban locations are known to be exposed to more stressful conditions with consequent impacts on their parasite infection rate and general wellbeing (Barber, *et al*., 2010; Lazić *et al*., 2017).

Mean condition factor of *Ptychadena* species from Agbada significantly differed between sex, with the female specimens having the higher values. However, there were no significant differences between the CF in the sexes of *Ptychadena* species from Rumuesara, and the CF of *H. occipitalis* specimens also didn't show significant differences between sexes at both locations. While this may indicate that CF did not vary with sex, Green (2001) stated that CF could indicate parasite load as well as the expenditure of energy in developing secondary characteristics. It has been shown that male amphibians often harbour a higher load of parasites because of the action of testosterone at reducing their immune response against infections (Hamann *et al*., 2010). Considering that fact, then it is presumed that a higher parasite burden in the male *Ptychadena* species from Agbada could be responsible for the observation of their significantly lower condition factor. It is also worthy of mention that gravid female amphibians feed voraciously in order to provide the nutritional requirements of reproduction. This could result in higher weight gains in the female than in the male specimens. However, in *H. occipitalis* from both locations, and *Ptychadena* spp., *Sclerophys* spp. and *H. galamensis* from Rumuesara, higher condition factors were obtained in the male specimens. This could also be an adaptation- increased feeding- in response to the energy needs of male calling amphibians during the breeding season.

The length-weight relationship showed that the frog specimens increased in weight with increase in length, exhibiting an isometric growth pattern. Pearson correlation coefficients between SVL and BM were highly significant ($P<0.01$) in all amphibians collected from both locations. This further indicates the good health status of the amphibians.

## CONCLUSION

The condition factor of *Ptychadena* species, *H. occipitalis*, *Sclerophys* species and *H. galamensis* have been presented in this report. Since this is the first report on the subject from Nigeria, the results present a reference material for future studies. The altered landscape at Rumuesara did not significantly reduce the condition factor of amphibians collected from that

location when compared with the results obtained from specimens from the Agbada forest zone.

**Future Research**

Though urbanization did not significantly affect the health status of the amphibians examined in this research, more studies should be conducted to ascertain the impact of urbanization on amphibians and other wildlife. It is also recommended that the impacts of other anthropogenic factors be investigated. In this research, only the condition factor was used; future research should consider other factors, such as the gonado-somatic index (GSI), Hepato somatic index (HSI) and the activity of Acetyl cholinesterase (AChE).

## FIGURES

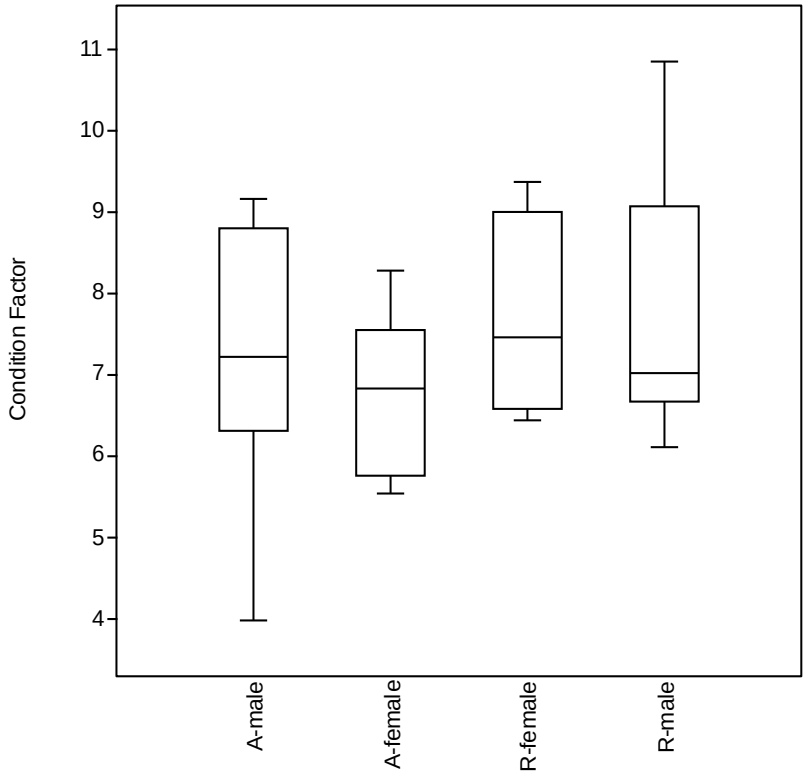


**Fig. 1: Box Plot (with Standard Error Bars) Showing Condition Factor Values of Male and Female *H. Occipitalis* Specimens from both Locations**

*Key: A-male, A-female = Male and female specimens, respectively, from Agbada forest location; R-male, R-female=Male and female specimens, respectively, from Rumuesara urbanizing settlement.*

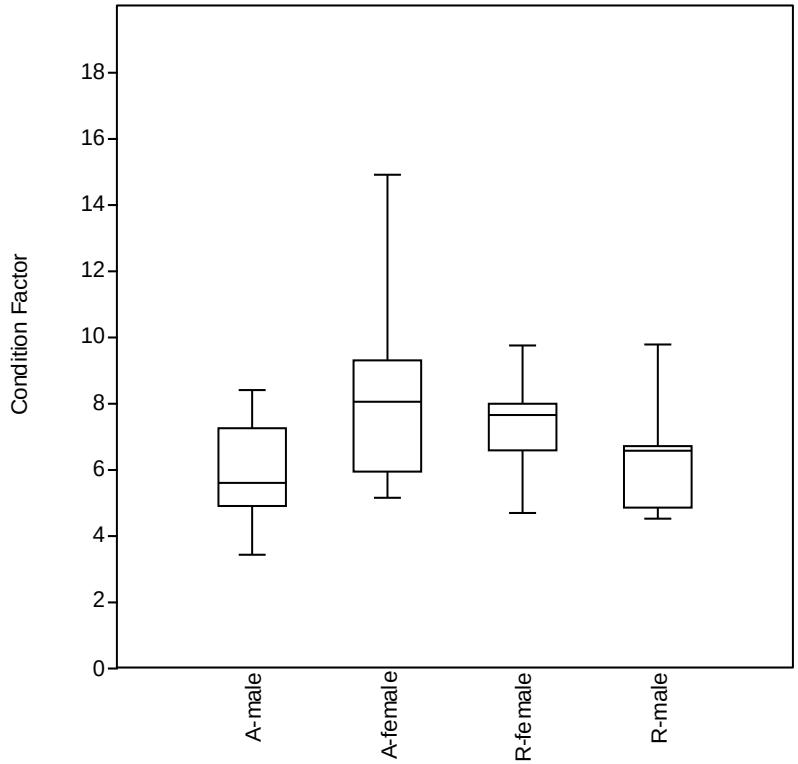


**Fig. 2: Box Plot (with Standard Error Bars) Showing Condition Factor Values of Male and Female *Ptychadena* Species from both Locations**

*Key: A-male, A-female = Male and female specimens, respectively, from Agbada forest location; R-male, R-female=Male and female specimens, respectively, from Rumuesara urbanizing settlement.*

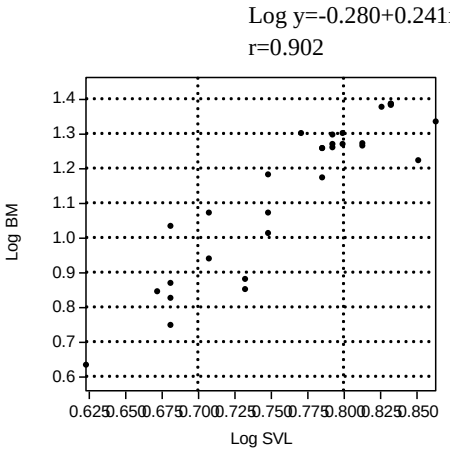


**Fig. 3a: *Ptychadena* Species, Rumuesara**

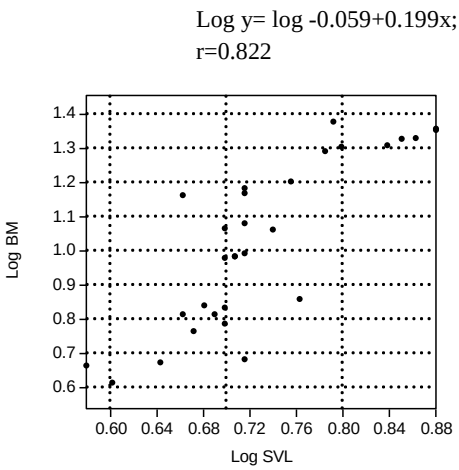


**Fig. 3b: *Ptychadena* Species from Agbada**

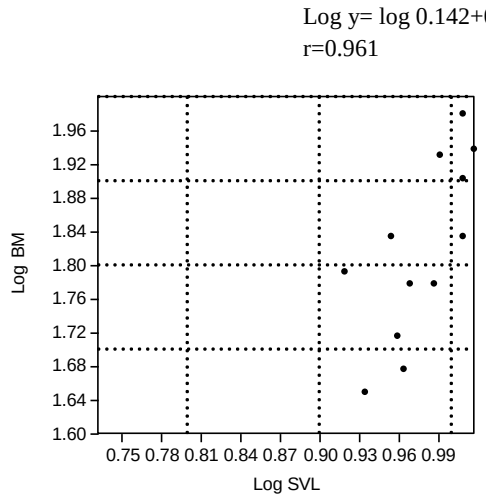


**Fig. 3c: *H. Occipitalis* from Rumuesara**

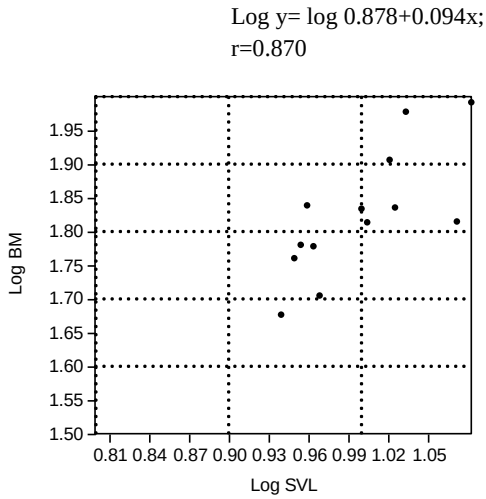


**Fig. 3d: *H. Occipitalis* from Agbada**

**Figure 3: XY Plots of Log SVL and Log BM of the Anuran Species Showing the Regression Equations**

## TABLES

**Table 1: Condition Factor (CF) of *H. Occipitalis* and *Ptychadena* spp. from Rumuesara Urbanizing Settlement and Agbada forest Location**

| Amphibian species | Location | Range | | | Mean CF value |
|---|---|---|---|---|---|
| | | SVL | BM | CF | |
| *H. occipitalis* | Agbada forest location | 6.3-12.1 | 22.0-98.1 | 3.97-9.16 | 7.04 |
| | Rumuesara urbanizing settlement | 5.4-10.4 | 11.6-95.5 | 6.57-10.84 | 7.72 |
| *Ptychadena* spp. | Agbada forest location | 4.0-7.6 | 4.1-23.8 | 3.41-14.9 | 7.16 |
| | Rumuesara urbanizing settlement | 4.2-7.3 | 4.3-24.3 | 4.51-9.76 | 7.08 |

*Key: SVL= Snout-vent length; BM= Body mass; CF= Condition factor*

**Table 2: Summary of the SVL, BM and CF of *Sclerophys* spp. and *H. Galamensis* from Rumuesara**

| Species | Sex | SVL | BM | CF | Mean CF |
|---|---|---|---|---|---|
| *Sclerophys* spp. | F | 6.5-10.6 | 21.8-55.1 | 4.63-8.41 | 7.00 |
| | M | 6.5-7.2 | 21.8-32.00 | 7.94-8.57 | 8.26 |
| *H. galamensis* | F | 3.5-9.2 | 5.1-40.0 | 5.13-11.90 | 7.65 |
| | M | 3.5-8.4 | 5.0-46.2 | 5.49-11.90 | 7.67 |

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