
Original article

# Aestivation, diversity and distribution of anurans at Jabi Lake Abuja

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## ABSTRACT

The Anuran population globally has been on a steady decline with species becoming extinct. A total of 257 Anurans were investigated including *Xenopus fischbergri, Xenopus tropicalis, Sclerophryls regularis*, *Hoplobatrachus occipitalis* and *Amnirana galamensis.* Aestivation, 52% of *S. regularis* prefer to aestivate under wood logs while 35% prefer to aestivate under rocks with only 11% preferring to aestivate in burrows. *Xenopus fischbergri* and *X. tropicalis* showed no sign (0%) of aestivation under rocks but showed 79% aestivation in mud burrows and only 21% of it aestivate under wood logs and leaves. *Hoplobatrachus occipitalis* and *A. galamensis* did not aestivate under rocks with 0% occurrence but they both aestivated in mud burrows with *A. galamensis* having 69% and *H. occipitalis* 60% while 40% of *H. occipitalis* and 31% of *A. galamensis* occurring under wood logs. Simpson's index showed the least probability in August (0.2049) with an exponential increase of 0.5062 and 0.5556 in January and February. It was observed that Shannon-H of 0 in March and May (Dry season) indicate no evenness among the species during those months. However, this increased subsequently in the rainy season with the highest (1.597) observed in August.

**Keywords:** Anuran, Aestivation, Diversity and Lake

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## INTRODUCTION

Amphibians are a class of tetrapods that evolved from lobe-finned fish (Sarcopterygii or Crossopterygii) and primitive tetrapods (Labarynthondria). About 340 million years ago they were among the earliest groups to diverge from ancestral fish tetrapods from aquatic form to terrestrial during the evolution of animals [20]. They are found in many habitats and microhabitats ranging from human habitations to desert regions. They are found inside the water, muddy and rock crevices, burrowing deep in the soil, or bushes, high canopy trees, etc. Rainy season is the best time to find amphibians. As rain provides adequate moisture to keep eggs from drying, many of the amphibians breed during this period having the maximum chance of survival of

their eggs. Generally, amphibians are active at night (nocturnal) and one can easily locate and identify the amphibian species based on their calls in the night hours [13].

They can be herbivorous or omnivorous and they are consumed by both vertebrates and invertebrates, they are also used as pest controllers as they play an important role in ecosystem and have strong impact on other organisms [12].

Many reasons are attributed to the decline of amphibian species such as global warming, habitat destruction and modification, others include: exploitation, chemical usage, introduced species, Ultraviolet-Beta radiation (UV-B), pollution, disease, etc. But over-exploitation, being one of the major causes [10], is rarely mentioned while other causes have gained much research interest. [23], however, mentioned that over-exploitation is one of the reasons for the worldwide amphibian decline. Since the 1980s, declines in amphibian populations have been noted from locations all over the world. These declines are perceived as one of the most critical threats to global biodiversity_[13]. This study aims to identify the locations where anurans aestivate, explore their diversity, and examine their distribution within the lake.

## MATERIALS AND METHODS

### Study Area

The study was carried out at Jabi Lake, Abuja FCT (9° 4N 7° 29E). This is an artificial Lake with natural water located in Jabi District of Abuja (Fig. 1). The Lake experiences two weather conditions annually: a warm, humid rainy season and a dry season [6]. At the bank of the Lake are recreational park and shopping malls.

The rainy season begins from April and ends in October when daytime temperatures reach 28°C (82.4°F) to 30°C (86.0°F) and nighttime around 22°C (71.6°F) to 23°C (73.4°F). In the dry season, daytime temperatures can soar as high as 40° C (104.0°F) and nighttime temperatures as low as 12°C (53.6°F). Even the chilliest night can be followed by daytime temperatures well above 30°C (86.0°F). The high altitude and undulating terrain of the FCT act as a moderating influence on the weather of the territory [6].

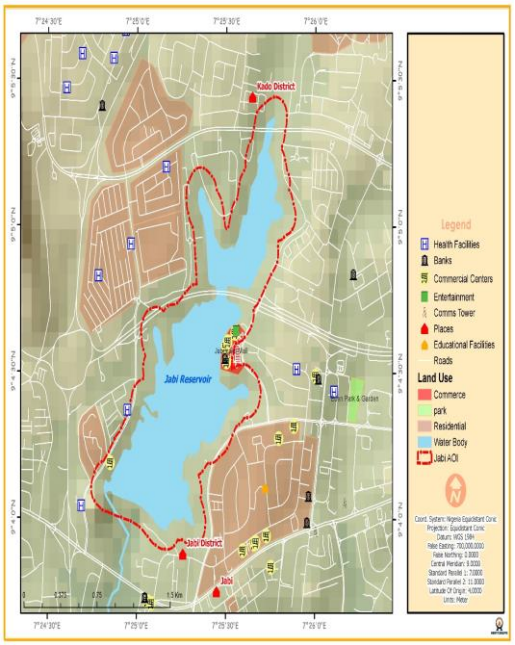


**Figure 1: Map of Jabi Lake Abuja (GIS, 2023).**

### Anuran Sampling

The amphibians (toads and frogs) were collected between 20:00 and 05:00hrs in vegetations close and away from the lake, underneath leaf litter and on the trees. Auditory survey and opportunistic samplings were used both in breeding and non-breeding periods to include most of the species in the study area [2]. Visual encounters, and calls were also used to record the anurans in the field. Each

sampling was carried out at night as most anurans are nocturnal and reportedly seen more at night than during day [1]. This nocturnal sampling required a five-man effort assisted with a handheld torchlight to increase anuran detection during sampling. Purposive sampling methods were used to establish permanent quadrats and transects, with five permanent quadrats measuring 25 m × 25 m set up in areas near the lake. Also, a 100 m nocturnal transect was used to survey anurans in the vegetation away from the lake and vegetation trails with human disturbance. The transect was unconnected due to safety precautions and restricted access. The GPS locations of all four angles of the quadrats and transects were obtained with a hand-held GPS in relation to the universal transvers Mercator (UTM) and were taken for onward transmission to the GIS laboratory where the Google Earth Pro Software was used to produce pictures of the location. Visual Encounter Survey (VES) [14] and Call Survey [7] aided the sampling search to be conducted in high-potential areas within quadrats, transect and other locations. Safety precautions were put in place particularly as it concerned snakes by wearing thick boots, usage of hand gloves and bandaging exposed areas of the hand, other measures include usage of whistles on site, usage of back packs instead of handbags, usage of ankle-length sticks to remove leaf litters coupled with well sharpened cutlasses and the usage of torch for proper illumination. Anuran movements were monitored through the rainy season (May-October) into the dry season (November-April) to identify potential areas for anuran aestivation. Areas with burrows in muddy areas were of high priority as well as rocky areas. Taxonomic keys from [21] was used to identify Anurans from the lake between for a period of one year (January to December 2023).

## RESULTS

In terms of aestivation of anurans, the results reveal that 52% of *Sclerophrys regularis* prefers to aestivate under wood logs while 35% prefers to aestivate under rocks with only 11% preferring to aestivate in burrows (Figure 2). *Xenopus fischbergri* and *X. tropicalis* showed no sign of aestivation under rocks (0%) but showed about 79% aestivation in mud burrows and only 21% of it aestivate under wood logs and leaves. *Hoplobatrachus occipitalis* and *Amnirana galamensis* also did not aestivate under rocks with 0% occurrence but they both aestivated in mud burrows with *A. galamensis* having 69% and *H. occipitalis* 60% while 40% of *H. occipitalis* and 31% of *A. galamensis* aestivated under wood logs respectively (Figure 2).

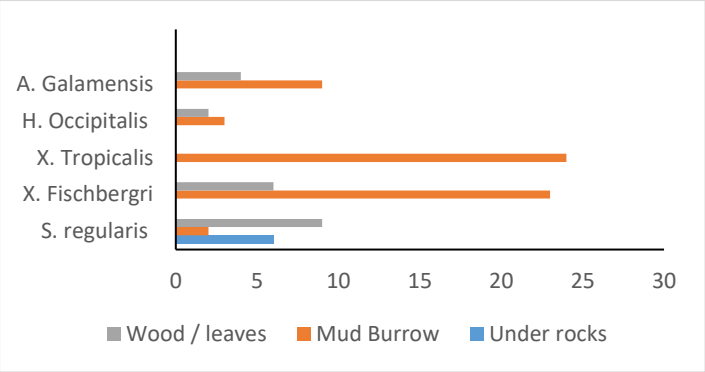


**Figure 2: Aestivation of Anurans in the lake**

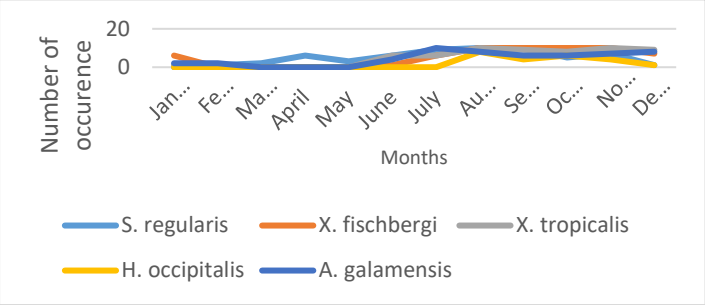


**Figure 3: Monthly Distribution of the 5(five) species of Anuran**

The pattern of distribution of Anuran species throughout the season shows an increased number of anurans occurring during the rainy season (July, August, September, October and November) with a sharp decline occurring during the dry season from December to April (Figure 3).

Species richness, which is denoted by the number of species present, revealed that there was an increase in number of species present from the dry to raining season. Specifically, all the species are present from August to December while there is reduced species abundance in January to May (Table 1).

*Hoplobatrachus occipitalis*

*Amnirana galamensis*

*Sclerophrys regularis*

*Xenopus tropicalis*

*Xenopus fischbergri*

The Simpson's index measures the probability that two random selections will be of the same species. It was noted that the lowest probability occurred in August (0.2049), which coincides with the peak of rainy season. However, there was an exponential increase in the probability in January and February, with values 0.5062 and 0.5556 respectively, From March to May, Simpson's index reached 1, indicating that only one species (*S. regularis*) was present during this time, as most anurans aestivate during this period (Table 1).

The Shannon- H index measures the richness and evenness of a species, it was observed that in March and May (Dry season) there was no (0) evenness of species for those months. However, this increased subsequently in the rainy season with the highest value (1.597) observed in August (Table 1).

**Table 1: Biodiversity index of Anuran species from January to December 2023.**

| Month/ Index | Chao-1 | Equitability_(J) | Shannon_H | Simpson's index_D | Individuals | Taxa_S |
|---|---|---|---|---|---|---|
| **January** | 3 | 0.7725 | 0.8487 | 0.5062 | 9 | 3 |
| **February** | 2 | 0.9183 | 0.6365 | 0.5556 | 3 | 2 |
| **March** | 1 | 0 | 0 | 1 | 2 | 1 |
| **April** | 1 | 0 | 0 | 1 | 6 | 1 |
| **May** | 1 | 0 | 0 | 1 | 3 | 1 |
| **June** | 4 | 0.8961 | 1.242 | 0.308 | 17 | 4 |
| **July** | 4 | 0.9808 | 1.36 | 0.2633 | 31 | 4 |
| **August** | 5 | 0.9925 | 1.597 | 0.2049 | 48 | 5 |
| **September** | 5 | 0.968 | 1.558 | 0.2189 | 39 | 5 |
| **October** | 5 | 0.9804 | 1.578 | 0.2131 | 35 | 5 |
| **November** | 5 | 0.9711 | 1.563 | 0.2175 | 38 | 5 |
| **December** | 6 | 0.8287 | 1.334 | 0.2899 | 26 | 5 |

The evenness index which estimates how close the number of occurrences is among different species of Anuran. The study found the Evenness Index (J) was high for most of the year, indicating that anuran species are distributed evenly within the community. However, the index dropped to 0 in March, April, and May because only one Anuran species (*S. regularis*) was present during those months.

Finally, the Chao-1 index from the study revealed a higher abundance in December (6) with relatively high abundance (4-5) from June to November. However, there is low abundance (1) in March to May

## DISCUSSION

There is ample evidence to suggest that the rainy season increases the diversity of Anuran species. Because of the ideal breeding conditions during the rainy seasons, [9] discovered that Anuran diversity in tropical forests peaks, which we observed in our study too. [4] also note that the presence and activity of anuran species are boosted when temporary pools are available and when rainfall results in higher humidity and perfect conditions for larval development and breeding. From our study we observed an increase during the rainy season, this might be because there is an abundance of water bodies and food for the anurans.

Similarly, because there are more breeding grounds and resources available during the wet season, species richness and diversity are higher [5] according to a study on anuran metacommunities in Western Brazil and a study in Southeastern Nigeria [18]. This study shows an increase in species richness from the dry to the rainy season, which is consistent with studies carried out in other tropical locations including in Nigeria. In a study conducted in Benin in Nigeria, [9] found that Anuran richness was higher during the wetter months. They attributed this to the seasonal availability of mating grounds. Similarly, [8] found that seasonal variations have a substantial impact on anuran populations, with a discernible rise in species diversity during wet seasons. Ecological studies typically use biodiversity indices, such Shannon's and Simpson's, to measure species evenness and diversity. The significance of these indices in comprehending the dynamics and structure of communities was highlighted by [17]. Seasonal implications on biodiversity are highlighted by our observation of increased indices during the wet season, which is consistent with trends observed in another research [15]. These indices aid in comprehending a community's species distribution and abundance [16]. Research on the behavioural ecology of amphibians lends credence to the environmental preference for aestivation observed in this study. According to studies, during dry seasons, several species choose specific microhabitats to reduce their danger of desiccation and predation. For instance, research conducted in Southeast Asia by [3] showed that frogs have specific preferences for microhabitats that offer the best moisture retention. This is the reason all frog species found in this study *X. tropicalis, X. fischbergri H. occipitalis and A. galamensis* (100%, 79%, 60% and 69%) prefer to aestivate in mud burrows which have a higher moisture retention when compared to other aestivation site like woods and rock cervix. This was also consistent with research conducted in Brazil by [22], who discovered that some species favoured microhabitats for aestivation, which aided in their survival during the dry season. This was also observed in Ivory coast with the

first sight of savanna frog [19]. [24] emphasized the importance of protecting vital habitats for the conservation of amphibians, particularly considering changing environmental conditions and habitat degradation.

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