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Original article

Parasitic and climatic factors affecting the abundance of Anurans at Jabi Lake Abuja

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ABSTRACT

The effects of climate change and parasitic infections have contributed to the decline in the Anuran population globally. A total of 257 Anurans were investigated including *Xenopus fischbergri, Xenopus tropicalis, Sclerophryls regularis*, *Hoplobatrachus occipitalis* and *Amnirana galamensis.* Parasites identified were *Cephalochlamy campactus*, *Cosmocera ornate*, *Amplicaecum africanum*, *Ascaridia* larvae, *Chabaudus leberrie*, *Raillientina spp.* and *Entamoeba ranarum.* The overall prevalence of parasites was 51.1%. Five helminth species from 2 taxonomic classes were identified during the dry and rainy season namely Cestoda and Nematoda with the following species *Cosmocera ornate*, *Amplicaecum africanum*, *Ascaridia* larvae, *Chabaudus leberrie* and *Cephalochlamym compactus*. Two (2) other classes of parasites were identified in these anuran species which are *Arthropods* and *Protozoans* found in *Raillietiella spp* and *Entamoeba ranarum.* Parasite prevalence was higher during the rainy (30.9%) than the dry season (20.4%) and the difference was not significant (p=0.042). The effect of weather variables on the abundance of anurans was done using canonical correspondence analysis graph which revealed *S.regularis* had a positive correlation with temperature, relative humidity and precipitation while *H. occipitalis* had a positive correlation with relative humidity only and lastly *A. galamensis* and *Xenopus fischbergri* had negative correlation with all climatic parameters. Parasitic diseases and climatic changes are minor causes of the current anuran declines, but it is likely to be the biggest challenge to the survival of many species in the future.

Keywords: Parasites, Climate, Abundance and Anurans

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INTRODUCTION

Anurans are among the most neglected species globally, with limited knowledge and few research studies or publications focused on their survival. One of the key indicators of a healthy ecosystem in the wetlands is the presence of anuran species but with a decline in their species and abundance in the world is still poorly understood which is becoming a topic for most ongoing research [11]. The rising human population in Nigeria will likely tend to increase demand on wildlife edible frog populations causing frogs species used for food, medicine and commercial trade in different countries to decline [10]. Most species do not have their requisite habitat for breeding due to climatic factors such as global warming and environmental pollution that have contributed to biodiversity loss [3,7]. There is information in the southern and freshwater creeks on the parasites of Anurans in Nigeria with dearth of information in north central and northern parts of Nigeria. This research was designed to obtain the checklist of anurans available in the lake and to determine the parasites that affect them during the seasons as well as to relate climatic variables to the abundance.

MATERIALS AND METHODS

Study Area

The study was carried out at Jabi Lake, Abuja FCT (9^{o} 4N 7^{o} 29E). This is an artificial Lake with natural water located in Jabi District of Abuja (Figure 1). The Lake experiences two weather conditions annually, a warm, humid rainy season and a dry season [4]. At the bank of the Lake are recreational park and a shopping mall, fishing activities usually takes place inside the Lake throughout the year.

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

Anuran Sampling

The Anurans (toads and frogs) were collected between 20:00 and 05:00hrs in vegetation close and away from the lake, underneath leaf litter and on the trees. Auditory surveys and opportunistic samplings were used both in breeding and non-breeding periods to include most of the species in the study area [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 estimate permanent quadrats and transects with five permanent quadrats measuring 25 m × 25 m set up in areas near the lake. Besides, 100 m nocturnal transects were used to survey anurans in the vegetation away from the lake and vegetation trails with human disturbance. 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) were taken for onward transmission to the GIS laboratory where Google Earth Pro

Software was used to produce pictures of the location. Each ecological data, such as time and date of capture, microhabitat, and microclimate, were documented in a survey form. The specimens were then transported in sealed but ventilated containers to the Tissue Culture Laboratory, National Biotechnology Research and Development Agency, Abuja. Each container held specimens of same size to prevent injury or death resulting from aggression. 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, and the usage of ankle length sticks to remove leaf litters coupled with well sharpened cutlasses and the usage of torch for proper illumination. The photographs of each anuran including dorsal, ventral, and side views were taken using iPhone xr for identification. In the laboratory, specimens were examined for parasites 12 to 18 hours after collecting [2]. Dissections of the specimens were done between 3-5minutes after anaesthetizing them to be able to recover life parasites. The various sections of the gastrointestinal tract were cut out systematically, namely the stomach, oesophagus, and the intestine and put inside separate petri-dish containing normal saline. The skin and the bladder were observed directly under the dissecting microscope to view the presence of monogeneans and cysts. The organs were teased using dissecting needle to facilitate the escape of the parasites into the normal saline after which the Petri dishes were examined under the dissecting microscope. The parasites were lifted off the saline solution using Pasteur pipette and placed inside another saline solution before they will be fixed with 70% alcohol for observation [2].

The records for annual rainfall, temperature and relative humidity used were for a period of 1 year (January – December 2023) to give the weather characteristics. The data required for the rainfall, temperature and relative humidity was obtained from NASA/POWER CERES/MERRA2 native resolution monthly and annually. The data was subjected to Correspondence Canonical Analysis to test the association between climatic variables and the abundance of Anurans at the lake and Chi-square to test the difference level of parasitic infection among Anurans. Parasites were identified with appropriate keys from Yamaguti, 1961.

RESULTS

A total of 257 Anurans were examined comprising *Sclerophrys regularis, Xenopus tropicalis, Xenopus fiscgberi, Amnirana galamensis,* and *Hoplobatracus occipitalis*. Table 1 shows the result of prevalence of parasites infecting the different anuran hosts during the wet and dry season. Four (4) classes of parasites were identified in anuran species which are: *Arthropoda*, Cestoda, *Nematoda* and *Protozoa*. The prevalence on parasite species shows that *Cosmocera oronate* had the highest prevalence rate during the rainy season at 58.1% among *S. regularis*, while *Raillietiella spp*. had the lowest rate at just 2.3% in *S. regularis* during the same season. In the dry season the highest level of prevalence was recorded in *Amplicaecum africanum* (41.1%) from *S. regularis* with its lowest level of prevalence in *Raillietiella spp* and *Chabaudus leberrie* (0%) from *S. regularis* and *X. tropicalis* respectively. There was a

significant difference between the rate of prevalence during the rainy season and the dry season with a p-value of 0.042

Table 1: Prevalence of Anuran's Parasite during the Seasons.

Parasite	Host	Season					
		Dry season			Wet season		
		No. of host examined	No. of hosts infected	Prevalence (%)	No. of host examined	No. of hosts infected	Prevalence (%)
Arthropoda							
Raillietiella spp.	*S. regularis*	17	0	0	43	1	2.3
Cestoda							
Cephalochlamym compactus	*X.fischbergi*	29	6	20.4	37	11	29.7
	X.tropicalis	24	9	37.5	39	15	38.5
Nematoda							
Cosmocera ornate	*S. regularis*	17	4	23.5	43	25	58.1
Amplicaecum africanum	*S. regularis*	17	7	41.1	43	12	27.9
Ascaridida larvae	*S. regularis*	17	5	29.4	43	11	25.6
Chabaudus leberrie	*X. tropicalis*	24	0	0	39	6	15.4
Protozoa							
Entamoeba ranarum	*X. fischbergi*	29	8	27.6	37	16	43.2
	X. tropicalis	24	4	16.7	39	12	30.8
	H. occipitalis	5	0	0	18	7	38.8
	A.galamensis	13	0	0	35	15	42.8
G	*S. regularis*	17	1	5.9	43	11	25.5
Total				**20.4**			**30.9**

Additionally, the result regarding the sex-specific distribution of parasite infecting various anuran host shows a higher overall prevalence in females (31.1%) compared to males (20%) with no significant difference p=0.0028 (Table 2)

Table 2: Sex-Specific Prevalence of Anuran's Parasite.

Parasite	Host	Sex					
		Male			Female		
		No. of host examined	No. of hosts infected	Prevalence (%)	No. of host examined	No. of hosts infected	Prevalence (%)
Arthropoda							
Raillietiella spp.	*S. regularis*	23	0	0	37	2	5.4
Cestoda							
Cephalochlamym compactus	*X. fischbergi*	30	6	20	36	11	30.6
	X. tropicalis	29	8	28.6	34	16	47.1
Nematoda							
Cosmocera ornate	*S. regularis*	23	11	47.8	37	18	48.6
Amplicaecum africanum	*S. regularis*	23	6	26.0	37	13	35.1
Ascaridida larvae	*S. regularis*	23	7	30.4	37	9	24.3
Chabaudus leberrie	*X. tropicalis*	29	1	3.3	34	0	0
Protozoa							
Entamoeba ranarum	*X. fischbergi*	30	7	23.3	36	17	47.2
	S. regularis	23	2	8.7	37	10	27.0
	X. tropicalis	29	4	13.8	34	12	33.3
	H. occipitalis	9	2	22.2	14	5	35.7
	A.galamensis	29	6	20.7	19	9	47.4
Total				**20**			**31.1**

The results in relation to the association of anuran species with the climatic paramters, the climatic parameters recorded were the relative humidity, precipitation and temperature (Figure 2). *Sclerephyl regularis* are adapted to high environmental temperature and precipitation than other as shown in the map. However, *S. regualris* are not completely affected by relative humidity. This explained why they were observed even during the dry season when other anuran species aestivate.

Xenopus fischbergri and *A. galamensis* are associated with low environmental temperature, precipitation and relative humidity. The graph (Figure 2) indicate

that both anuran are close together at centre of the map indicating their ability to survive in ambient and average weather condition.

Hoplobatracus occipitalis and *X. tropicalis* are adapted to high relative humidity compared to other environmental parameters but *H. occipitalis* require higher relative humidity. The environmental parameters are closely related as seen on the map especially the relative humidity and precipitation have a positive correlation.

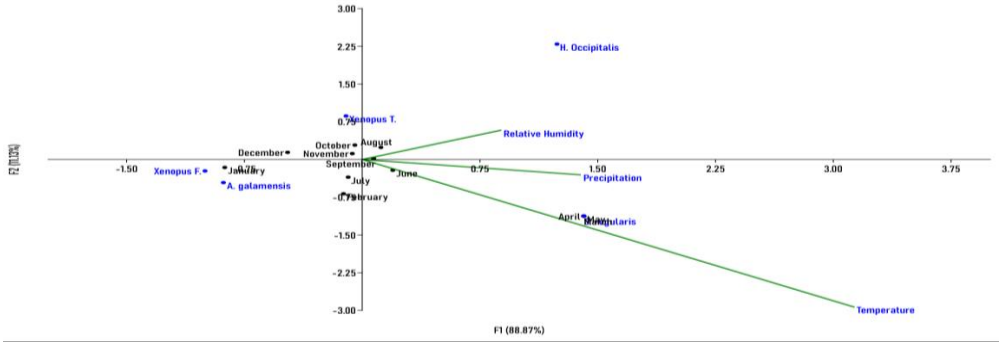
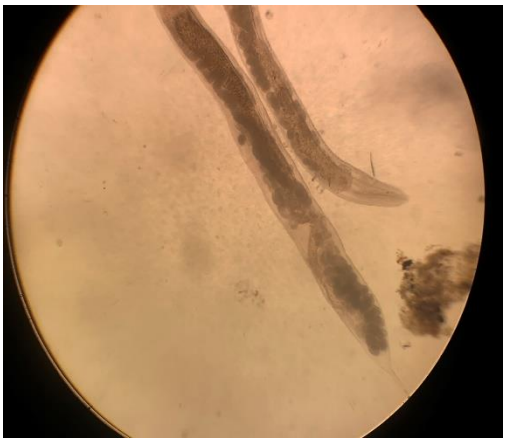


Figure 2: Canonical Correspondence graph showing association between the Climatic parameters at the Jabi Lake and Anurans species

Hoplobatrachus occipitalis

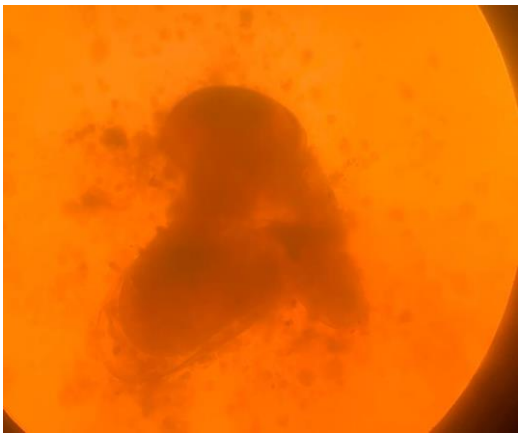
Amnirana galamensis

Sclerophrys regularis



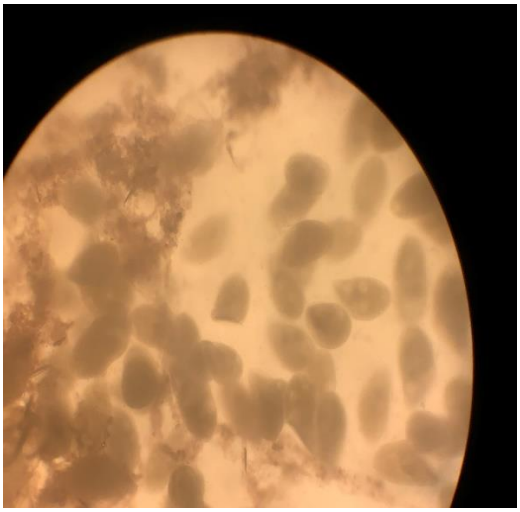
Cosmocera ornate

Xenopus tropicalis



Raillietiella spp.

Xenopus fischbergri



Entamoeba ranarum

Cephalochlamym compactus

Amplicaecum africanum

Chabaudus leberrie

Ascaridida larvae

DISCUSSION

New important information about the ecology of Anuran species is provided by the study's findings on parasite prevalence and distribution in relation to host sex and season. The increased wetness and ideal circumstances for parasite development during the rainy season may be the cause of the higher parasite prevalence. Studies by [4] that discovered comparable seasonal trends in the incidence of parasites in amphibian hosts are in line with this. The results of this study demonstrate the substantial influence of seasonal variations on parasite-host dynamics, with the overall parasite prevalence rising to 30.9% during the rainy season and 20.4% during the dry season. A possible difference in susceptibility or behaviors between the sexes is suggested by the sex-specific distribution of parasites, where female anurans had a higher prevalence of the parasite (31.1%) than male anurans (20%). Sex-specific parameters influencing the incidence of parasites in amphibians were also documented by [12]. Possible causes for this include variations in male and female reproductive habits, immunological responses, or exposure. Also, [6] in their study done at Zaria Nigeria with similar factors to the FCT-Abuja also recorded a higher prevalence of parasites during the rainy season when compared to the dry season. The research also recorded a higher parasitic prevalence in female anurans when compared with male anurans this may be due to physiological differences between males and females' anurans (female anurans are bulkier in size than male anurans). They also recorded similar number of anuran species present in their study except for *Amnirana galamensis* which was recorded in this research. Also, in the Guinea savanna at New Bussa, Niger state Nigeria [3] only recorded 4 anuran species (*A.galamensis, H. occipitalis, S. maculata* and *S. regularis*) in their study although this was to be expected since the study took a short period of time in contrast to the this investigation which span two seasons and thus provided a higher possibility for more anuran species to be inclusive or encountered. Nevertheless, the number of parasites species (7) recorded in this study is less than the 12 recorded by [3]. Parasites such as Cestodes has been reported more frequently and in most cases in greater diversity in anurans from the southern part of the Nigeria [5] but interestingly Nematodes have been of a greater diversity in this study. [6] recorded 4 Nematode species (*C. macrocephalus, C. dimitrovi, Aplectana spp* and an unidentified nematode) like this study with 4 nematodes (*C. oronate, A. africanum, A larvae* and *C. leberrie*) but with a different diversity of nematodes. Although [9] recorded a greater number of nematodes in their study on amphibians in a more humid southern Nigeria and [5] in an altered environment.

Temperature, precipitation, and relative humidity are examples of environmental factors that have a big impact on anuran distribution. The fact that *S. regularis* can withstand high precipitation and temperature even during the dry season indicates that it is resilient enough to survive under a variety of circumstances. This flexibility is consistent with research by [8] on amphibians' reactions to environmental changes.

To sum up, this research adds important information to the field of herpetology and provides insights that can direct further investigation and conservation initiatives.

We can better safeguard these important species and their ecosystems if we comprehend the intricate relationships that exist between anurans and their surroundings.

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