Herpetofauna Diversity And Distribution Pattern Of Selected Ecological Sites Of Girei Local Government Area, Adamawa State – Nigeria

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Abstract:

Background: *This study aimed at understanding the diversity and distribution of herpetofauna resources with the specific objectives to: determine the relative abundance of herpetofauna resources; ascertain the distribution pattern of herpetofauna resources in relation to the ecological sites; and determine herpetofauna resource diversity in Girei Local Government Area of Adamawa State - Nigeria.*

Materials and Methods: *The study area was divided into seven ecological sites: home area, open land area, farmland area, rocky area, grassland area, shrubby area and woodland area. Direct observation method involving an intensive search for the presence of herpetofauna resources was employed for the census. Cluster analysis was used to determine the pattern of distribution of herpetofauna resources while diversity indices were calculated using Simpson's diversity index.*

Results: *The results obtained showed that herpetofauna resources belonging to seven families were inventoried: Bufonidae, Ranidae, Agamidae, Lacertidae, Scincidae, Ophidae and Chamaeleonidae. The single –linkage cluster analysis showed only one cluster, indicating similar herpetofauna resources distribution in all the ecological sites. The Simpson's diversity index of the herpetofauna resources was 0.2870. The results therefore suggest high diversity of herpetofauna resources, irrespective of ecological sites in the study area. It was concluded that there should be creation of herpetofauna refuge by encouraging people to establish hedgerows, fencerows, wood piles and preserve forest thickets between farmlands in the study area.*

Key Word: *Herpetofauna resources, Diversity, Distribution, Cluster Analysis, Girei.*

I. Introduction

The abundance and distribution of species have been an obvious topic of interest in the study of communities. The distribution and diversity of species in a habitat is a reflection of the adaptability and success of the species in the habitat, the impact of human activities on the habitat and the overall importance of the site for biodiversity conservation [1]. Species distribution tells which animals are found and where they are found. Information on species distribution is necessary for effective management and conservation of animals in a given habitat. Despite the value place of diversity studies in ecosystems management, only an estimated 1.7 million species of animals have been described to date [2]. The vertebrates, with about 43,000 known species make up a very minor proportion of the global total of the 1.7 million described [1, 3]. However, by virtue of their size, adaptation and ecological roles, they do have impacts on the structure of communities and habitat.

The four classes of vertebrates: Amphibia (amphibians), Reptilia (reptiles), Aves (birds) and Mammalia (mammals) are often referred to as the higher vertebrates or tetrapods [4]. However, herpetofauna as the main focus of herpetology have been of particular interest to ecologist in recent decades [5, 6]. They are important to the maintenance of biodiversity. In recent time, amphibians and reptiles has been identified as the most threatened vertebrates worldwide, some are endangered while others are already extinct [5]. The reason been amphibians, primarily frogs and salamanders, are collected from the wild for a variety of reasons including human consumption, medicine and the international pet trade. Other reasons are habitat degradation, anthropogenic threats, diseases, and so on [7].

The amphibians mark the beginning of the vertebrate transition from water to land 5. Presently, over 8,000 species of amphibians have been described and they are divided into approximately 400 genera, 34 families and 3 orders [8, 9]. The three orders include Urodela or Caudata (e.g. salamander and newts), Anura or Salienta (e.g. frogs and toads), and the Apoda or Gymnophonia (e.r. caecilians). The reptiles are believed to have evolved from the ancient labyrinthodont amphibians [8]. Approximately 8,000 species of living reptiles have been described and

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are classified into 905 genera, 48 families and 4 orders [8, 10]. These comprise the Chelonia (tortoise, turtles and terrapins), Crocodilians (crocodiles and alligators), the Rhynchocephalia which contains two species of tuatara and the Squamata (lizards and snakes). Unlike most amphibians, reptiles are truly terrestrial and do not require environment rich in water; however, some species have been able to adapt to marine habitats [11].

Despite the importance of biodiversity studies in various ecosystems, the knowledge of ecology, distribution, reproduction and management of herpetofauna in Girei Local Government Area is non-existent. The dearth of this information makes management, improvement and development impossible to carry out. To this extent, this study aims at understanding the diversity and distribution of herpetofauna with the specific objectives to: determine the relative abundance of herpetofauna resources; ascertain the distribution pattern of herpetofauna resources in relation to the ecological sites; and determine herpetofauna resource diversity in the study area.

II. Material And Methods

Study Area

The study was carried out in Girei Local Government Area of Adamawa State (Figure 1). Girei lies between latitude 9° 15' and 9° 23' North and longitude 12° 31' and 12° 41' East [12]. The minimal rainfall is 0.4 mm while the maximum rainfall is 475 mm with a total rainfall of 1030 mm per annum [13]. Maximum temperature can reach 40 $^\circ$C particularly in April while the minimum temperature can be as low as 18 $^\circ$C between December and January. The vegetation is Guinea Savannah region of north eastern Nigeria, the geology of the area is dominated by Bima sand stones, which is coarse grained, light to brown in colour[12].
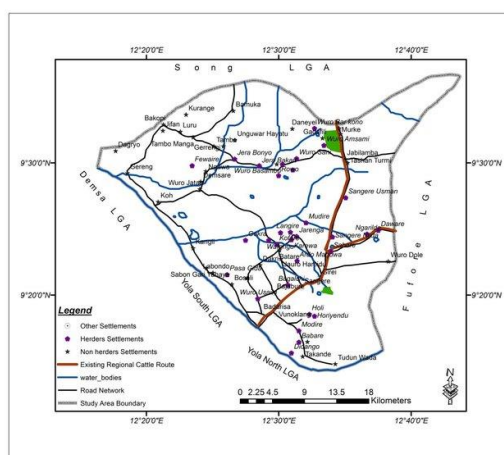
Figure 1: Map of of Girei Local Government Area in Adamawa State
Source: Adamawa State in Maps, 1999

Study Duration: February 2023 to November 2023.

Sampling Techniques:

The study area was traversed to identify the seven ecological sampling sites: home areas, open land areas, farmland areas, rocky areas, grassland areas, shrubby areas and woodland areas. A minimum of 5 visits were made to each ecological site per month.

Method of Data Collection

Data were collected by direct field observation with the aid of a binocular, bush beating stick, cutlass, field guide book, data collection sheet and pen. The ecological sites were traversed on foot and intensively searched for the presence of herpetofauna resources; between the periods of 8:00 am and 12:00 noon as well as between 2:00 pm and 6:00 pm. The binocular was used at difficult and long-range distances to enhance observation. Detailed information on the species, the number, location and activities were recorded as described by Dunn [14].

Method of Data Analysis

Data collected were subjected to descriptive (Frequency, Tables and Charts) and inferential statistics (cluster analysis) which was used to determine the distribution pattern of herpetofauna resources in the study location. The Macnanghton and Wolf similarity index was used to determine the distribution pattern of herpetofauna resources as shown in equation (1) 15. The diversity of herpetofauna resources was determined using Simpson's diversity index 16 as shown in equation (2).

$$C = \frac{\sum(2mi)}{\sum(ai+bi)} \ldots\ldots\ldots\ldots\ldots (1)$$

Where C = Similarity index
a = abundance of species i in community a
b = abundance of species i in community b
mi = the minimum values for the species.

The calculation produced a matrix of similarity coefficients from which a dendrogram was constructed. The dendrogram shows the distribution pattern of herpetofauna resources in the study area.

$$D = -\sum_{i=1}^{N}(Pi)^2 \ldots\ldots\ldots\ldots (2)$$

Where D = Simpson's diversity index
Pi= The proportion of a species to the total number of individuals in the community.
The lower the Simpson's diversity index (D) the higher the diversity.

III. Result
Distribution of Herpetofauna Resources in the study area
The result of Table 1 revealed that Agama lizard, Common lizard and Skink are well distributed as they were all occurring in all the seven ecological sites. Toad was sighted in six ecological sites but was not encountered in grassland area. The Frog was sighted in five sites but was absent in farmland area and shrubby area. On the contrary, the Snake and Chameleon were encountered in all ecological sites except for the farmland area.

Table 1: The distribution of Herpetofauna in seven ecological sites in the study area

Herpetofauna Resources	Ecological Sites						
	Home area	Open land area	Farm area	Rocky area	Grassland area	Shrubby area	Woodland area
Agama lizard	26	24	25	10	29	17	18
Common lizard	54	43	36	16	40	31	38
Skink	20	8	36	36	27	51	40
Toad	0.1	26	2	0.2	-	1	2
Frog	0.1	0.3	-	38	3	-	2
Snake	-	-	0.3	-	-	-	-
Chameleon	-	-	0.6	-	-	-	-

Source: Field Survey, 2023

Distribution of Similarity pattern of herpetofauna resources in relation to ecological sites
Table 2 and Figure 2 shows the matrix of similarity coefficients for herpetofauna at seven ecological sites in the study area and the dendrogram constructed from the matrix respectively. The matrix of similarity coefficients indicated that the most similar pairs of sites include farmland area and shrubby area; shrubby area and woodland area; grassland area and woodland area; farmland area and grassland area; open land area and rocky area; as well as home area and farmland area. The dendrogram consist of one cluster. This is an indication of similarity in herpetofauna resources composition and relative abundance between the ecological sites.

Table 2: Matrix of similarity coefficients for herpetofauna at seven ecological sites in Girei Local Government Area

	OA	FA	RA	GA	SA	WA
HA	0.45	0.61	0.45	0.39	0.63	0.61
OA		0.69	0.39	0.61	0.57	0.67
FA			0.59	0.69	0.77	0.63
RA				0.48	0.65	0.63
GA					0.50	0.72
SA						0.76

Legend:
HA = Home area
OA = openland area
FA = Farmland area
RA = Rocky area
GA = Grassland area
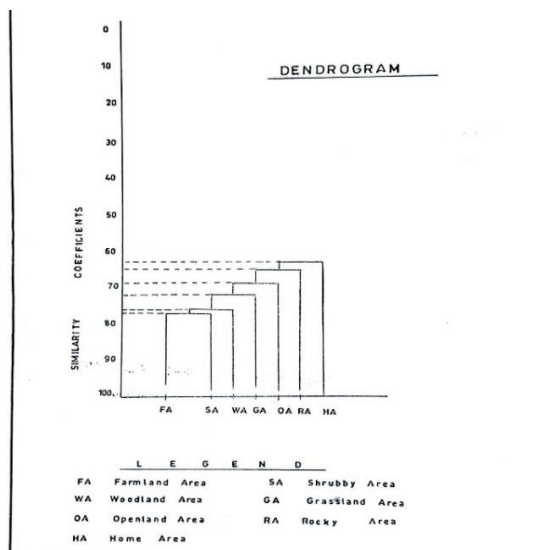SA = Shrubby area
WA = Woodland area

Figure 2: Dendrogram Showing Herpetofauna Distribution Similarities in the Study Area

Diversity of Herpetofauna Resources in the Study Area

The result of diversity index of herpetofauna resources in the study area presented in Table 3 revealed that, the Simpson's diversity index for the Herpetofauna Resources was 0.2870. This is indicative that the herpetofauna resource in the study are is diverse.

Table 3: Diversity index of Herpetofauna Resources in Girei Local Government Area

Herpetofauna Resources	Number sighted	Pi	Simpson's diversity Indices $D = \sum (Pi)^2$
Agama Lizard	582	0.20	0.04
Common Lizard	1,068	0.37	0.14
Skink	922	0.32	0.10
Toad	100	0.03	0.001
Frog	227	0.08	0.006
Snake	1	0.0003	0.0000001
Chameleon	2	0.0007	0.0000005
Total	2,902		0.2870

Herpetofauna Diversity index in the study area = 0.2870

Comparative Analysis of Simpson's Diversity Indices of Herpetofauna resources

The results in Table 4 and 5 indicated that there was no significant difference ($p > 0.05$) in herpetofauna resources diversity among the seven ecological sites studied. This suggests that the ecological requirements of the herpetofauna resources were being provided by the various habitat types.

Table 4: Comparative Analysis of Simpson's Diversity Indices of Herpetofauna resources in the Study Area

Enumeration Month			Ecological Sites				
			Simpson's Diversity Indices				
	HA	OA	FA	RA	GA	SA	WA
February	0.44	0.31	0.35	0.3	0.3	0.31	0.34
March	0.47	0.26	0.38	0.48	0.34	0.35	0.30
April	0.37	0.57	0.35	0.44	0.4	0.43	0.40
May	0.36	0.64	0.32	0.41	0.35	0.48	0.38
Total	1.64	1.78	1.40	1.63	1.39	1.57	1.42
Mean value	0.41[NS]	0.445[NS]	0.35[NS]	0.4075[NS]	0.3478[NS]	0.3925[NS]	0.355[NS]

Key: NS = No significant difference

Table 5: Analysis of Variance of Herpetofauna Simpson diversity indices for the seven Ecological sites in the Study Area

Source of Variation	Degree of freedom	Sum of square	Mean square	F_{cal} (P=0.05)	F_{tab} (P=0.05)
Site	6	0.0331	0.0055		
Error	21	0.1631	0.0078	0.71	2.87
Total	27	0.1962	0.0073		

IV. Discussion

Distribution of Herpetofauna resources in the study area

The result revealed that herpetofauna resources were widely distributed in all sites in the study area. This may be because species prominence of both amphibians and reptiles are most notable in the warmer, more humid, temperate and tropic regions [17]. The abundance and distribution of Agama lizard, Common Lizard and Skink in all seven ecological sites agrees with the findings of Razzetti and Msuya [18] who reported that reptiles are the most diversified and successful group as they are well adapted for walking, running, climbing, swimming, burrowing and tolerant to anthropogenic activities. Amphibians and reptiles only differ in that the later are more present in conditions such as extremely xeric deserts than amphibian species [17].

Similarity Distribution pattern of herpetofauna resources in relation to ecological sites

The matrix of similarity coefficients for herpetofauna at the seven ecological studied sites in the study area revealed that there were similar pairs between some sites. The single –linkage cluster analysis showed only one cluster, and this means that there were similar herpetofauna resources distribution in all the ecological sites. This finding indicates that the herpetofauna resources were capable of associating with all the sites in the study area. The analysis therefore, suggest that the variations that occurred might have been by chance.

Diversity of Herpetofauna Resources in the Study Area

The total number of Herpetofauna Resources sighted in the study area is 2,902 and the Simpson's diversity index for the was calculated as 0.2870. The Simpson's index revealed that the diversity of Herpetofauna Resources in the study area is high. Usher [19] reported that Simpson's index has a maximum value of 1 in a monoculture, and becomes smaller as the community becomes more diverse. This is therefore indicative of the fact that the herpetofauna resources in the study area were very diverse.

Comparative Simpson's Diversity Indices of Herpetofauna resources in the Study Area

The comparative analysis of simpson's diversity indices of herpetofauna revealed that there were no significant differences (P >0.05) in the herpetofauna resource diversity among the various studied ecological sites of the study area. The diversity and distribution of herpetofauna resources in all the ecological sites is indicative of the fact that all the sites provide adequate space to rest, bask or search for food and water for living and reproduction. According to some scientists [20, 21], the availability of food and cover are the major determinants of wild animal's occurrence and distribution.

V. Conclusion

The findings from this study indicates that the poikilothermic nature of the herpetofauna resources did not affect their availability and distribution in the various ecological sites surveyed in the study area. The diversity of herpetofauna resources was equally found to be the same in the seven ecological sites of the study area. The Lacertidae was the most predominant in all the ecological sites, followed by Scincidae, Agamidae, Ranidae and Bufonidae respectively. The presence of Ophidae and Chamaeleonidae were recorded in only the farmland area. In view of the findings from this study, there should be creation of herpetofauna refuge in the study area by encouraging the people to establish hedgerows, fencerows, wood piles and preserve forest thickets between farmlands.

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