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Comparative study of fauna species diversity of Makurdi Zoological Garden, Benue State, Nigeria

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Abstract

Fauna diversity is the sum total of all the different species of animals both mega and macro species living in a particular habitat/region per time. The fauna diversity of Makurdi Zoological Garden, Benue State, was determined using species inventory survey, Transect sampling method with a monolith of size 2.5cm x 30 cm x 30 cm to identify the macrofaunal groups. Descriptive statistic and diversity indices were used to analysis the data obtained. The result shows that twenty-five captive species from thirteen different species represented in 11 families were identified, amongst these 4 species have been identified as threatened ones. The relative abundance of the different classes of both megafauna and macrofauna revealed that class mammals (2.147%) and class insects (91.90%) were most dominant. The determination of fauna diversity using diversity index showed species richness of 44, Shannon-Weiner index of 2.688, maximum diversity of 3.784, species evenness of 0.710, equivalent common species of 0.004 and a total species abundance of 506. These species could be used as indicator species to determine the faunal diversity of Makurdi Zoological Garden to understand die faunal dynamics in conservancy for periodic analysis that makes institution for breeding.

Keywords: Diversity; Fauna Species; Megefauna; Macrofauna; Makurdi Zoological Garden

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1. Introduction

Fauna diversity is the sum total of all the different species of animals, organisms living on earth and the variety of habitat in which they live of any particular region or time (Meng, 2009). Diverse fauna are due to their unique biogeographic location, varied climatic conditions and enormous eco- and geodiversity. However, keeping animals in zoos raises concerns for animals rights (Meng, 2009). Few zoos seem interested in assisting with the breeding program. Captive populations with genetic variability have been lost through generations, with current gene diversity and biodiversity lost through urban landscape development (Babagana et al., 2012; Ahmed, 2013; Ibimilua, 2013). Limited populations pose difficulties to meeting each of these goals of population management with respect to both demography (numbers of animals) and genetics limited populations are often characterized by uncertainty or unpredictability lack of control and risks of catastrophic declines (Miller and Lacy, 1999). There is evidence that inbreeding causes reduced infant survival in many zoo populations (Lacy, 1995; Ralls et al., 1988). Moreover, the hypothesis that the effects of inbreeding in captive populations can be easily reduced by selectively breeding healthy inbred animals has not been well supported by surveys of zoo populations both free range and caged ones (Ballou, 1997). Many wild animal species that were once large, widespread and diverse have drastically reduced to an isolated number in a few remaining natural areas and zoological gardens.

Rangeland inventory and monitoring are the processes of describing and evaluating the resources at a rangeland site (Manske, 2004) which offer opportunity to evaluate rangeland resources. Features to be assessed depend on the purpose of the inventory, but in most rangeland situations are likely to entail vegetation types, range condition, carrying capacity, soil types and soil macrofauna, utilization patterns and habitat assessments for wildlife improvements. The focus on individual animals within individual institutions contrast with the trend over the past two decades toward cooperative management of many other species held in captivity. Populations can be managed at a number of levels of intensity.

For the Mammals, Aves, Reptilian, Amphibian, Insect, Gastropoda, Diplopoda, Chilopoda, Arachnida and Annelids of the Makurdi zoological garden, all of the elements that make the forest suitable habitat for these species to live and breed in need to be present. Apart from using macrofauna to compare natural ecosystems (forests) and in controlled experiments (Lavelle et al., 1997), several groups of soil macrofauna (e.g, earthworms, millipedes, isopods, centipedes, spiders, ants, termites and beetles) can serve as bio-indicators of land use (Paoletti et al., 1999). Inventory must supply information on the occurrence of each species in order to provide a basis for the preparation of a management plan in accordance with the aim of sustainable production for both free range animals.

Makurdi Zoological Garden has no reliable information on the fauna resources especially the macro-species which serves as indicator species to environmental condition. This work will serve as baseline information for further study. The research seeks to determine the fauna diversity of the zoological garden, whilst seeking specifically to determine the species list of mega fauna of the zoological garden, the relative abundance of different classes of animals within the park and the macro fauna diversity of the zoological garden.

2. Materials and method

2.1. Study area

The Makurdi zoological garden (now named Riverville Resort) is under the ministry of commerce, culture and tourism and is situated in the Eastern part of Makurdi town sand-witched within Benue State University, Makurdi. It is located within the Guinea Savannah zone between latitude 7ºE and 75ºN and longitude 80ºE and 80ºN (Uloko and Iwar, 2011); it is on the Southern bank of river Benue and about 1.5km along Makurdi-Gboko express way. The zoo has captive indigenous species and exotic stocks in their respective cages and fences. It is also half a kilometre off Makurdi-Gboko express road and covers about 25 hectares of land. Some of the features of the zoo are presented below.

Plate 1. The Main Gate of Makurdi Zoological Garden under-construction

Plate. 2. An Abandoned Canteen alongside Dilapidated Water Fountain in Makurdi Zoological Garden

Plate 3. Small Size Cage of Chimpanzee (*Pan troglodytes*) in Makurdi Zoological Garden

Plate 4: Some Sculptural Artefacts' in Makurdi Zoological Garden

2.2. Sample collection

The species list of megafauan (caged animals) of Makurdi zoological garden was determined using an inventory field survey. Macrofauna diversity sampling was done using transect sampling method, a monolith of size 2.5cm x 30 cm x 30 cm was established to identify the macrofaunal groups. The monolith was placed at randomly selected points within the niche and driven into the soil using a metal mallet. The macrofauna were hand sorted and placed into different plastic buckets, preserved in 70% alcohol and taken to the laboratory for identification.

2.3. Fauna species identification

Manual identification keys were used to identify species and pictures relevant to species collected on a white board were sorted out by counting. Secondly, Rangeland monitoring which requires random, repeated observations or measurements of fixed locations was carried out.

2.4. Data analysis

The fauna diversity was calculated using Shannon-Wiener diversity index ($H= -\Sigma((pi)\ ln(pi))$, species richness (S), Maximum diversity possible (H_{max} = In(S)), Evenness of species (H/H_{max}) and Equivalently common species were calculated (Kolmogorov, 1933 and Smirnov, 1948).

3. Results

The result presented in Table 1 shows that the mega fauna species of the Makurdi Zoological Garden had 13 different species represented in 11 families. The relative abundance of the mega and macrofuana reveaved in (Table 2) indicates that vertebrate (class mammalia: 2.2%, aves: 1.6% and reptilia: 1.2%) and the invertebrate were present. The class insecta, as the most abundant macrofauna class accounted for over 91% of all the fauna classes. The results of the fauna species diversity estimated from data obtained from the Makurdi Zoological Garden is presented in (Table 3). The Shannon-Weiner Diversity Index (H) estimated to be 2.6833. The summary of all the diversity indices are presented in Table 4.

Table 1. List of Mega Fauna Species of the Makurdi Zoological Garden

S/N	Common Name	Scientific name	Family	Number
1	Chimpanzee	*Pan troglodytes*	*Hominidae*	2*
2	Mona monkey	*Cercopithecus mona*	*Cercopithecidae*	1
3	Tantalus monkey	*Chlorocebus*	Cercopithecidae	3
4	Duiker	*Sylvicapra grimmia*	*Bovidae*	2
5	Lion	*Panthera leo*	*Felidae*	2
6	Striped Hyaena	*Hyaena hyaena*	*Hyaenidae*	1*
7	Ostrich	*Struthio camelus*	*Struthionidae*	2

8	Geese	*Anser abifrons*	*Anatidae*	1*
9	Grey Crown Crane	*Balearica*	*Gruidae*	2
10	Peacock (peafowl)	*Afropava congensis*	*Phasianidae*	3
11	Nile crocodile	*Crocodylus niloticus*	*Crocodylidae*	1*
12	Dwarf crocodile	*Osteolaemus Tetraspis*	*Crocodylidae*	2
13	Giant Tortoise	Kinixys erosa	Testudinidae	3

***Source**: Field survey, 2013 (*Endangered indigenous species at risks)*

Table 2. Relative Abundance of Fauna Classes at the Makurdi Zoological Garden

Types of fauna	Classification	Total number of species seen	Total number of animals sighted	Relative % of abundance
Megafauna	Mammalia	6	11	2.17
	Aves	4	8	1.58
	Reptilia	3	6	1.19
	Amphibia	-	-	-
Macrofauna	Insecta	23	465	91.90
	Arachnida	1	8	1.58
	Gastropoda	1	3	0.59
	Diplopoda	1	3	0.59
	Chilopoda	1	2	0.40

***Source**: Field survey, 2013*

Table 3. Fauna Species Diversity of the Makurdi Zoological Garden

Common name	Number	P_i	$I_n P_i$	n(n-l)	$P_i I_n P_i$
Chimpanzee	2	0.00395	-5.3540	2	-0.0219
Mona monkey	1	0.00198	-6.2247	0	-0.0123
Tantalus monkey	3	0.00593	-5.1277	6	-0.0304
Duiker	2	0.00395	-5.5340	2	-0.0219
Lion	2	0.00395	-5.5340	2	-0.0219
Striped Hyaena	1	0.00198	-6.2247	0	-0.0123
Nile crocodile	1	0.00198	-6.2247	0	-0.0123
Dwarf crocodile	2	0.00395	-5.5340	2	-0.0219
Giant Tortoise	3	0.00593	-5.1277	6	-0.0304
Ostrich	2	0.00395	-5.5340	2	-0.0219
Geese	1	0.00198	-6.2247	0	-0.0123
Grey Crown Crane	2	0.00395	-5.5340	2	-0.0219
Peacock(peafowl)	3	0.00593	-5.1277	6	-0.0304
Termites	54	0.10672	-2.2375	2862	-0.2388
Ants	162	0.32016	-1.1389	26082	-0.3646
Beetles	14	0.02767	-3.5874	182	-0.0993
Wasp	3	0.00593	-5.1277	6	-0.0304
Bug	6	0.01186	-4.4346	30	-0.0526
Grasshopper(Katydids, locust)	56	0.11067	-2.2012	3080	-0.2436
Flies	7	0.01383	-4.2809	42	-0.0526
Damsel fly	16	0.03162	-3.4539	240	-0.1092
Earwig	4	0.00791	-4.8396	12	-0.0383
Butterfly	6	0.01186	-4.4346	30	-0.0526
ladybird beetle	8	0.01581	-4.1471	56	-0.0656
Flea	20	0.03953	-3.2307	380	-0.1277
Mosquitoes	44	0.08696	-2.4423	1892	-0.2124
Dragon fly	13	0.02569	-3.6617	156	-0.0941
Spittle bug	4	0.00791	-4.8396	12	-0.0383
Water Strider	3	0.00593	-5.1277	6	-0.0304
Giant waterbug	1	0.00198	-6.2247	0	-0.0123
Scarab beetle	2	0.00395	-5.5340	2	-0.0219
Field Crickets	6	0.01186	-4.4346	30	-0.0526
Beewolf	4	0.00791	-4.8396	12	-0.0383
Snails	3	0.00593	-5.1277	6	-0.0304
Sand wasp	2	0.00395	-5.5340	2	-0.0219
Centipede	2	0.00395	-5.5340	2	-0.0219
Millipede	3	0.00593	-5.1277	6	-0.0304
Spider	8	0.01581	-4.1471	56	-0.0656
Horse flies	6	0.01186	-4.4346	30	-0.0526
Black flies	3	0.00593	-5.1277	6	-0.0304
Stable flies	11	0.02174	-3.8286	110	-0.0835
reen flies	2	0.00393	-5.5340	2	-0.0219
White flies	3	0.00593	-5.1277	6	-0.0304
Deer flies	5	0.00988	-4.6172	20	-0.0456
Total (Species richness 44)	**N506**				ΣH=2.6883

Table 4. Summary of Diversity Indices of Fauna Species of Makurdi Zoological Garden

S/no	Diversity Measures	Makurdi Zoological Garden
1	Shannon-Weiner Index	2.6883
2	Maximum diversity	3.7842
3	Species evenness	0.7104
4	Equivalently common species	0.00395
5	Species richness	44
	Total species	506

4. Discussions

Total population of mega fauna (captive animals) found in the Zoo garden was 25 only from thirteen different species represented in 11 families, amongst these were 4 species that have been identified as threatened species (IUCN, 2006). Mammalian class was the dominant with the family Cercopithecidae the highest while reptilian class second with family Crocodylidae been highest. However, the diversity of captive species was low. This could probably as a result of negligence from managers of the garden. This confirms the findings of Alarape et al. (2015); Yager et al. (2015) who report dissatisfaction from tourist during their visit, low patronage and demand for restocking and rehabilitation of the garden. The total population of macrofauna observed in the Zoo garden was 481 from twenty-seven different species with class insect been the most dominant.

The relative abundance of combined classes of the megafauna and macrofauna based on species number of the families revealed that families in class insect in the Zoological Garden were dominant. This agrees with Yang and Gratton (2014) that insects are the most important group for analyzing diversity and abundance in running waters biome, the relative abundance of class insect in the present study indicates their ability to support relatively very few species of the fauna classes. The explanations for high diversity have traditionally been based on the equilibrium concept of community structures and a high degree of resource/niche partitioning (Giller, 1984) with habitat food and time amongst the most important niches dimensions.

The species list of all the fauna at the zoological garden and Shannon Weiner diversity index was based on result that was obtained from individuals randomly sampled; all the species that were represented in the sample area under study. The species richness of 44 and Evenness = H/H_{max}, $= 0.7104$ was obtained which shows a relatively high degree of dominance (by abundance or biomass) of certain *gr*oups within the entire soil faunal community, with a few dominants and a majority of species at relatively low numbers.

The levels of diversity or measure of community structures of Makurdi Zoological Garden has a Shannon-Weiner index of 2.6883, Maximum diversity of 3.7842, species evenness of 0.7104, equivalent common species of 0.00395 and a total species abundance of 506. This result follows the stability diversity hypothesis which states that the more diverse a community is the more stable, so there are correlations with stability

measures like constancy of community. However, the fate of an organism in a habitat is determined by habitat equilibrium, free space, disturbance and settlement.

5. Conclusion

This study has demonstrated the fauna diversity given a list of species present in understanding the faunal dynamics in the conservancy of Makurdi Zoological Garden. A number of fauna species particularly class insecta may serve as useful organisms that contribute significantly to the determination and regulation of ecosystem productivity. The niches had different diversity indices confirms further the wildlife spatial-temporal management was translated into variations in biological status of use in macrofauna as bio-indicators thus need further work i.e. relating with keystone species and associated processes. The zoo is not too harsh to prevent colonization by many species but competitive exclusion of inferior competitors that are prevented by reduction in the dominant species during the disturbances (visitation), thus, establishing a non equilibrium community with a higher diversity that would arise if the community is allowed to reach a stable equilibrium state. It is recommend that management strategies towards conservation and rehabilitation of the garden be intensified and at the same time device possible ways of curbing the menace posed on the available megafuana species. Animals' species require an understanding of the geography of diverse and risk utilization and development of natural ecosystems for zoo habitation.

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