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Research Article

Species Diversity, Richness and Abundance of Tortoise and Turtles (Testudines) In Yenagoa, Bayelsa State, Nigeria

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Abstract— A seasonal baseline assessment of the diversity and abundance of the Testudine reptiles (Tortoise and Turtles) in Yenagoa, Bayelsa State, Nigeria was conducted from January to December 2021. This was done to determine the current status of the distribution and abundance of Tortoise and Turtles and to measure the effect of weather on the availability of Testudines and the stability of the ecosystem. Testudine samples were obtained using traps, fences, visual searches and by hand while snorkeling and surveying. Result show that a total of 342 individuals from 3 families and 6 species were observed in the dry season while a total of 419 individuals from 3 families and 6 species were observed in the wet season. Of these *Testudinidae* has (3 species), *Emydidae* (2 species) and *Pelomedusidae* (1 species). Shannon weaver index was lower in the wet season (1.59) than in the dry season (1.649). Equitability index (Evenness) is also lower in the wet season (0.892) than in the dry season (0.920). Also, Simpson's Index is lower in the wet season (4.34) than in the dry season (4.86). There are more number of individuals captured in the wet season than in the dry season. This may be due to the fact that Testudines are more prevalent in the wet season as most of them are aquatic organisms or rely on water. The amounts of testudines recorded in this study although seem low, compares favourably with those recorded in similar tropical and subtropical environments of similar survey area. It can therefore be concluded that testudines populations in the Bayelsa state are not under any serious threat. Environmental sustainability and improvement is therefore advocated.

Keywords— Species, Distribution, Abundance, Turtle, Tortoise, Bayelsa State, Nigeria

1. Introduction

Tortoise and turtles (Testudines) are unique and important reptiles. They are important as seed and spore dispersants for many plants, trees and fungi. They also act as important scavengers that help maintain clean aquatic ecosystem. Despite their importance to the ecosystem, their numbers continue to dwindle due to over harvesting by humans for their meat, skin for leather making, medicinal use, aesthetic values, shells for beautification and other purposes. Tortoise shell for instance has become a popular material for jewellery, comb, and decoration purposes [1]. Therefore, they may be now considered endangered and require protection.
Globally, freshwater turtle species are considered threatened with extinction. These species have shown decline in population density and distribution attributed primarily to deforestation, predation, food, pollution and introduction of exotic species, disease, reduced habitat complexity, and habitat fragmentation [2].

Fortunately, species inventories at regional or localized scales can provide essential data for conservation and resource management [3], [4]. Data on local species diversity, richness, and abundance is fundamental to understanding local communities and, on a larger scale, ecosystem function and dynamics.
Information on the diversity and distribution of most reptiles in Bayelsa State is sparse and virtually non-existent in scientific literature. Among all reptiles, turtles and tortoise are the most under studied in Bayelsa State and the Niger Delta region of Nigeria. These understudied species are now commonly referred to as data deficient (DD) meaning there is no real knowledge regarding their conservation status or what role the species take in their environment [5], [6], [7].

Therefore, there is a need for baseline data on the distribution and status of the Testudines in Bayelsa State. A detailed study of the diversity, distribution and abundance of tortoise and turtles is urgently needed to provide a data base for their present population status; inter-specific and intra-specific variations; and, to provide needed indicators for necessary management strategies.

This research is therefore a small step towards providing localized baseline data on the diversity and abundance of the Testudines in Bayelsa State.

2. Experimental Method/Procedure/Design

2.1 Study area
Three (3) sampling stations were selected for this study with different activities taking place within and around the environment. These stations are located in Yenagoa, in Yenagoa, Local Government Area.

Table 1. Coordinate of the Sampling Stations

S/No	Station	Coordinates	
		Latitude	Longitude
1	Bayelsa palm (Elebele)	04^0 53' 13.1'' N	006^0 18' 52.3'' E
2	Oxbow lake (Swali)	04^0 54'27.6'' N	006^0 16' 50.1'' E
3	Ovom	04^0 55' 44.1'' N	006^0 16' 03.6'' E

2.2 Sampling Technique/ Capture Method
Extensive survey of Turtles and Tortoise was made during day and night throughout the forests, and aquatic habitats such as streams, rivers, lakes, ponds, rice paddies, ditches and pools in these sampling locations. Drift fences and pitfall traps and refuge traps. Turtles were captured using a variety of methods: by hand while snorkeling, by hand while surveying and by an assortment of bait trap types. Trap types included collapsible crab traps; Collapsible Crawfish/ bait traps; collapsible turtle trap and large cylinder-shaped traps made from chicken wire [8]

2.3 Identification of Samples
After making careful observations, the collected specimens were identified; morphometric and meristematic measurements were taken and classified. Samples were identified using keys provided by [9], [10], [11] & [12].

2.4 Data Analysis
Turtle and Tortoise were identified and counted monthly and the seasonally counts recorded for each species counted. (The dry season spanned from January – March and From November –December. The wet season spanned from April – October). Percentage Numerical Abundance for each family and percentage Species abundance was calculated for each season.

Diversity indices were calculated for each season to determine the ecological status of the survey areas and determine seasonal implications. Shannon-weaver diversity index was calculated using the following;

Shannon-weaver diversity index

$$(Hs) = -\sum Pi \ In \ Pi \quad \text{...................................... ……………….. (1)}$$

Where:

Hs = Shannon-weaver diversity index

I = count denoting the ith species ranging from 1n

Where Pi = proportion of the ith species represented

Equitability or Evenness index using the formular:

Equitability or Evenness

$$(E) = Hs/Log_2S \quad \text{……………………………………………(2)}$$

Where:

E = Equitability index

Hs = Shannon weaver index

Simpson's diversity index using the following:

Simpson's diversity index

$$(D) = 1/Pi^2 \quad \text{…………………………...……...…………… (3)}$$

3. Results and Discussion

3.1 Result
The result of this study is presented from Tables 2 – 5.

Table 2 below, show the seasonal species abundance of Turtles and tortoise in the study sites. *Kinixys erosa* (Hinge-back tortoise) has 54 individual in the dry season and 33 individual in the wet season. *Testudo graeca (*Spur-thighed tortoise) has 85 indiduals in the dry season and 106 individuals in the wet season. *Testudo hermanni (*Hermann's tortoise) has 71 individuals in the dry season and 59 individuals in the wet season. *Graptemys pseudogeographica (*False map turtle) has 13 individuals in the dry season 21 individuals in the wet season. *Sternotherus odoratus (*Common musk turtle) has 30 individuals in the dry season and 53 individual in the wet season. *Pelomedusa subrufa (*African helmeted turtle) has 89 individuals in the dry season and 147 individual in the wet season.

Table 2. Seasonal diversity and Richness of Testudines

Taxa	Common Name	No. of individual in dry season	No. of individual in wet season.
Testudinidae			
Kinixys erosa	Hinge-back tortoise	54	33
Testudo graeca	Spur-thighed tortoise	85	106
Testudo hermanni	Hermann's tortoise	71	59
Emydidae			
Graptemys pseudogeographica	False map turtle	13	21
Sternotherus odoratus	Common musk turtle	30	53
Pelomedusidae			
Pelomedusa subrufa	African helmeted turtle	89	147
Total		342	419

Table 3 below show the % abundance of the different family groups of Testudines in both seasons. Testudinidae has 47.25% abundance in the wet season and 61.40%. in the dry

season. Emydidae has 17.66% abundance in the wet season and 12.57% abundance in the dry season. Pelomedusidae has 35.08% abundance in the wet season and 26.02% abundance in the dry season

Table 3. Seasonal % Abundance of Testudines

Taxa **(Family)**	Wet (No. of Individuals)	% Abundance	Dry (No. of Individuals)	% Abundance
Testudinidae	198	47.25	210	61.4
Emydidae	74	17.66	43	12.57
Pelomedusidae	147	35.08	89	26.02
Total	419	100	342	100

Table 4 show the seasonal % diversity of various families of testudines recorded.
Testudinidae has 50% diversity in both seasons. Emydidae has 33.33% diversity in both seasons and Pelomedusidae has 16.66% diversity in both seasons.

Table 4. Seasonal % Species Diversity of Testudines

Taxa	Wet (No. of Species)	% Species Diversity	Dry (No. of Species)	% Species Diversity
Testudinidae	3	50.0	3	50.0
Emydidae	2	33.33	2	33.33
Pelomedusidae	1	16.66	1	16.66
Total	6	100	6	100

Table 5 show the diversity indices of turtle and tortoise in Yenagoa
Shannon weaver index was lower in the wet season (1.59) than in the dry season (1.649). Equitability index (Evenness) is also lower in the wet season (0.892) than in the dry season (0.920). Also, Simpson's Index is lower in the wet season (4.34) than in the dry season (4.86).

Table 5. Seasonal Diversity Indices of Testudines

Taxa	Wet Season (No. of Individuals	Dry (No. of Individuals)
Testudinidae	198	210
Emydidae	74	43
Pelomedusidae	147	89
Shannon weaver index	1.599	1.649
Equitability index (Evenness)	0.892	0.9207
Simpson's Index	4.34	4.866

3.2 Discussion

The study recorded a total of 342 individuals from 3 families and 6 species in the dry season while a total of 419 individuals from 3 families and 6 species were observed in the wet season. Of these *Testudinidae* has (3 species), *Emydidae* (2 species) and *Pelomedusidae* (1 species). However, fewer numbers of tortoises (Testudinidae) were recorded in the wet season (198) than in the dry season (210). Also, more individual of turtles belonging to families Emydidae and Pelomedusidae were recorded in the wet season than in the dry season.

The higher abundance of turtles observed in the wet season could be due to the abundant aquatic vegetation, and thus potential diverse food sources which is characteristic of increase rainfall and increased water depth. Also, variations in capture rate, species richness, and species diversity among habitats are likely functions of season and/or capture method. For example, mud turtles may aestivate underground during the dry season [13], which may influence capture rates seasonally [14]**.** This may have accounted for the seasonal variations in numbers of individuals sampled.

Overall, the study observed a few numbers of testudines over the one year sampling period. The few number of species recorded in this duty seem to support the assertion that testudines are indeed threatened species and may be going to extinction in some areas. This result is in agreement with the findings of [16] who determined the reptile species richness, composition, and habitat use in three areas in the municipality of Niquelaˆndia, northern Goiás state, central Brazil. The study despite recording the presence of 47 distinct species of reptiles did not record a single species of testudines (turtles and tortoise). One reason for this low level of prevalence may be due to destruction of natural habitats and degradation, environmental pollution, various diseases of reptiles, unsustainable use of reptiles as food, other purposes and rapid global climate change.

Shannon weaver index was lower in the wet season (1.59) than in the dry season (1.649). Equitability index (Evenness) is also lower in the wet season (0.892) than in the dry season (0.920). Also, Simpson's Index is lower in the wet season (4.34) than in the dry season (4.86)
This suggests that ecosystem stability was greater in the wet season than in the dry season.

4. Conclusion and Future Scope

The study was conducted basically to obtain baseline information on the diversity and abundance of the testudine reptiles in order to gauge the threat to their existence and ascertain the present level of species stability in the ecosystem. A survey was conducted for 12 months encompassing both wet and dry seasons. Samples were obtained marked, identified and released back into the environment.

The study recorded a total of 342 individuals from 3 families and 6 species were observed in the dry season while a total of 419 individuals from 3 families and 6 species were observed in the wet season. Of these *Testudinidae* has (3 species), *Emydidae* (2 species) and *Pelomedusidae* (1 species). There was more number of individuals captured in the wet season than in the dry season.

Shannon weaver index was lower in the wet season (1.59) than in the dry season (1.649). Equitability index (Evenness) is also lower in the wet season (0.892) than in the dry season (0.920). Also, Simpson's Index is lower in the wet season (4.34) than in the dry season (4.86).

The result of this study reveal that although the population and diversity of testudines was small, it compares favourably

with surveys done in similar tropical and subtropical environments

In conclusion, this study recommends that continued surveys and life history studies should be done on Yenagoa as well as other areas of Bayelsa State to better understand testudine species demographics, ranges, and distribution limits. This will provide data for future conservation efforts.

Future Scope

The future scope will be to study the diversity and abundance of all reptiles in Bayels State in order to see the relationship and cross connectivity of other reptile population with the the testudines. This will provide a clearer picture of ecosystem stability and help us gauge the ecological status of the entire study area.

Data Availability

Primary data were collected entirely from field surveys while the secondary data were collected from books, e-libraries and other internet sources.

Conflict of Interest

The authors hereby affirm that there is no conflict of interest between the authors in the design and execution of this research work.

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Authors' Contributions

This research was jointly designed by the authors. Charles Embelemi Edure was engaged in the field collecting samples and data while Ogamba, Emmanuel. N. was engaged in the statistical analysis procedures and drafting of the manuscript for Publication.

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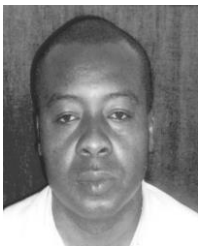
Charles Embelemi Edure holds a Master of Science Degree in Biological Sciences. He just completed a Doctor of Philosophy (Ph.D) degree in Environmental Biology in the prestigious Niger Delta University Amassoma In 2024. He has published more than 10 journal articles in the area of Environmental Biology.



Professor Ogamba Emmanuel Nwabueze is a renowned professor of the prestigious Niger Delta University, Amassoma, Bayelsa State. He has A Ph.D degree in Marine Biology and is an expert in Aquatic Ecology and Eco-toxicolgy. He has mentored and drained several PhD students who are also experts in their own right He has published more than 60 research papers in reputed international Journals. He has over 20 years of teaching and research.

