

Analysis of Local Ecological Knowledge and Threat Factors of *Testudine* Species in the Riverine Areas of Ondo State, Nigeria

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Abstract

Effective management of natural resources require accurate data on the composition, distribution and abundance of the resources involved, the ecological parameters of sustainability and other relevant factors study on the Local Ecological Knowledge (LEK) of *Testudine* species and the perception on threat factors was conducted in the coastal area of Ondo State (comprising of four Local Government Areas: Irele, Ilaje, Okitipupa and Ese Odo.) from October, 2018 to September, 2019. Three methods: Inspection of fish landing/market survey, questionnaire administration (444 respondents) and oral interview (community leaders and traditional herbalist) were adopted for data collection. Data from the survey were analysed using *Chi square*. Results showed that the age group 40-49 years had the highest respondents (44.6%) while age group 20-29 years had the least (13.5%). Most (69.4%) of the respondents are males with few females (30.6%). Most of the respondents (55.4%) had secondary education. Fishing was the major occupation of the respondents (49.1%), Most of the respondents (65.3%) have stayed in the study areas more than 20 years. Five (5) species of *Testudines* were recorded in the study area (two species of sea turtles (Leatherback (*Dermochelys coriacea*) and Olive ridley (*Lepidochelys olivacea*)) recorded only in Ilaje LGA, two species of land tortoise found in Okitipupa and Irele LGAs and one species of fresh water turtle (West African Black mud turtle (*Pelusios niger*) present in all the four LGAs. The season of abundance corresponds to periods of food abundance. Size and carapace (colour, pattern, height and thickness) are used for species identification while genital openings are mostly used for sex differentiation. Harvest for consumption, by-catch, habitat loss and degradation, as well as illegal trade are the major threat factors of *Testudines* in the study area. It is therefore recommended that there should be education and awareness programmes on law prohibiting the harvest and conservation of *Testudines*.

Keywords: Local ecological knowledge • Land tortoise • Water turtles • Threat factors • Coastal area

Introduction

Reptiles represent the world's most diverse group of terrestrial vertebrate species and are a major component of the global biodiversity, remarkable from an ecological, evolutionary and conservation studies point of view [1-4]. There are currently 317 recognized species of turtles and tortoises in the world. Of those that have been assessed on the IUCN red list, 63% are considered threatened and 10% are critically endangered, with 42% of all known turtle species threatened [5]. This put turtles and tortoises as the most threatened group of vertebrates worldwide [6-9]. According to them, the largest driver of global species loss is habitat destruction and fragmentation, climate change and species introductions. Reptiles currently represent the second-most species-rich vertebrate class after

birds harvested in the international pet trade [10]. The rampant use of some of these species has caused the disappearance of various species of wild animals including sea turtle. Thus, the management of traditional hunting of wildlife must balance the sustainability of target species with the benefits of hunting to traditional communities.

The use of Local Ecological Knowledge (LEK) has been widely recognized as alternative cost effective means of data collection on various conservation aspects such as species absence/presence, population trends, current distribution, cultural importance, conservation status and hunting dynamics. It can also be used to generate quantitative data on occupancy estimates of elusive, cryptic and threatened species like sea turtles. In recent times LEK has been recommended as appropriate approach in the field of ecology most

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Received: 26 July, 2024, Manuscript No. IJBBD-24-143305; **Editor assigned:** 30 July, 2024, PreQC No. IJBBD-24-143305 (PQ); **Reviewed:** 13 August, 2024, QC No. IJBBD-24-143305; **Revised:** 11 April, 2025, Manuscript No. IJBBD-24-143305 (R); **Published:** 18 April, 2025, DOI: 10.37421/2376-0214.2025.11.143

especially in tropical regions where rural populace rely solely on biodiversity materials and where data collection on biological resources are limited.

Despite the special recognitions accorded to sea turtles across nearly all its range states as nationally protected species, they are further highly threatened by extensive hunting pressures, habitat loss and unprecedented levels of harvesting for local consumptions because of its meats, carapaces and its efficacy use in traditional medicine. Therefore, in order to effectively manage natural resources, especially in southwest Nigeria, there must be accurate data on the composition, distribution and abundance of the resources involved, the amount harvested from year to year, the ecological parameters of sustainability for each and other relevant factors. The riverine area of Ondo State in Southwest Nigeria could be a critical area for the conservation of *Testudine* species. Therefore, the study looked at the species composition, areas of occurrence, threats associated with the species and their values to the local residents.

Materials and Methods

The study area

This study was carried out in the riverine area of Ondo state comprising of four local Government areas: Ilaje (with an area of 1,318 km², population figure of 277,034 and major occupation is fishing), Ese Odo (an area of 762 km², a population of 154,978 at the 2006 census and major occupation is fishing, and farming), Okitipupa (land mass of 803 km², population of 234,138 and major occupation is farming) and Irele (area of 963 square kilometres, population of 145,166 and major occupation is farming) local Government areas (Figure 1). The area experiences a tropical climate consisting of both wet and dry seasons. The wet and dry season average rainfall index and temperature is about 3000 mm; 28°C and 800 mm; 32°C respectively. Mangrove swamp is the dominant vegetation type in this area, especially the red mangrove, *Rhizophora racemose* and the white mangrove *Avicennia* spp. typical of swamps. A striking feature of vegetation in the area is the desiccation induced by marine water incursion into about 10,000 hectares of freshwater swamp forest. The area is drained by many perennial streams and rivers. The area supports a wide range of aquatic animals. These abundant aquatic resources are the primary source of livelihood for people in the area.

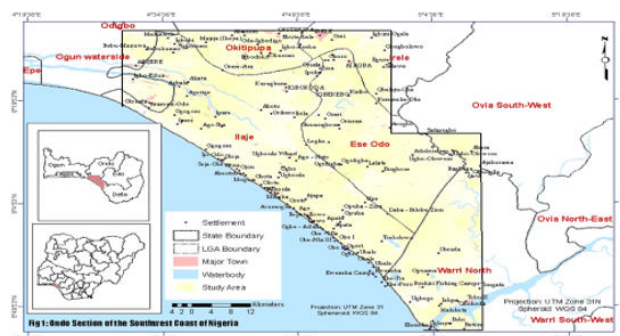


Figure 1. The delta region of Ondo state.

Methods of data collection

The survey was accomplished using three methods: Market survey/fish landing inspection, questionnaire administration and interview.

Market survey: Major markets in the four local government area were identified as follows Ilaje local government area (Ipore, Ugbo and Igbokoda), Irele local government area (Ode-Irele and Ajagba), Okitipupa local government area (Osoro/Igbotako and Okitipupa) and Ese-Odo local government area (Agadagba and Igbekebo). Each market was visited five (5) times *i.e.*, once in two months (December, 2018 to September, 2019) to collect data on the species of tortoise and turtles displayed for sale and the number of each species seen. Tortoise and turtles seen were identified to species level using the IUCN guide books and other materials while local names of the species were also obtained.

Oral interview was conducted for the community leaders and traditionalists in the selected communities as follows: Ilaje LGA (Araromi sea side, Ayetoro, Awoye, Eti Okun Abereke and Odofado), Ese-Odo LGA (Igbekebo, Ajagba, Ugbotu, Igbobini, Kiribo and Arogbo), Okitipupa LGA (Erinje, Ode aye, Oloto, Igodan, Igbotako), Irele LGA (Ode irele, Irele jare, Akotogbo, Ayadi, Josu).

Interviewees were selected based on their interest and readiness to be part of the informal interview. The ethical guidelines of the Social Research Association was followed in which all the respondents were guaranteed anonymity and confidentiality. The language of communication was local language (Yoruba) to ensure effectiveness and accuracy of data. Questions were semi-structured (open questions) to enable the conversation to flow and makes the lines of discussion to be interesting. The interview was recorded where allowed, otherwise, notes were taken and immediately transcribed thereafter when all uncertainties were trash out.

Questionnaire administration: A total of 444 questionnaires was administered to the fishermen, market women and farmers in the selected local communities across the four local Governments area as follows: Ese-Odo (114), Ilaje (140) Okitipupa (92) and Irele (98). The questionnaire seeks to collect information on the local community's knowledge on: Tortoise and turtle species identification and

ecology, values to the local communities and associated threats to *Testudines*.

Data analysis

Data were stored in Microsoft excel sheet prior to both descriptive and inferential analysis. Data on *Testudine* species, distribution, identification and sex differentiation were presented in tables and charts. Data on local community perception on threat factors were analysed using *Chi square*.

Results

Demographic characteristics of the respondents

Results from the study showed that the highest age group of the

respondents was between 40-49 years (n=198, 44.6%) while age group 20-29 years had the least respondent (n=60, 13.5%) (Table 1). Most of the respondents were male (n=308, 69.4%) with few female (n=136, 30.6%). Higher number of the respondent (n=252, 55.4%) had Secondary education while few (n=35, 7.88%) does not have formal education. Majority of the respondents were Christians (n=436, 98.2%) with few Muslims and traditionalists. Fishing was the major occupation of the respondents (n=218, 49.1%), 116 respondents were farmers while 24 of the respondents are herbalist. Most of the respondents (n=290, 65.3%) have stayed in the study areas more than 20 years.

Variables	Frequency (N=222)	Percentage (%)
Age		
20-29 years	60	13.5
30-39 years	90	20.3
40-49 years	198	44.6
50 years and above	96	21.6
Sex		
Male	308	69.4
Female	136	30.6
Level of education		
Primary education	60	13.5
Secondary education	246	55.4
Tertiary education	103	23.2
No formal education	35	7.88
Religion		
Christian	436	98.2
Traditionalist	4	0.9
Muslim	4	0.9
Ethnicity		
Apoi	92	20.7
Ikale	190	42.8
Ilaje	140	31.5
Ijaw	22	5
Occupation		
Fishing	218	49.1
Farming	116	26.13
Traditionalist	24	5.41
Trading	78	17.6
Student	8	1.8

Length of stay in the area		
1-5 years	10	2.3
6-10 years	40	9
11-15 years	42	9.5
16-20 years	62	14
Above 20 years	290	65.3

Table 1. Demographic characteristics of the respondents.

Tortoise and turtle species present in the riverine areas of Ondo State

The result of the species composition as presented in Figure 2 shows that majority (79.7%) of the respondents believed that there are 2-3 species of land tortoise, 89.6% of the respondents said only 1 species of fresh water turtle, 93.7% said there is only one species of brackish water turtle while 72.1% said there are 2-3 species of sea turtles in the area. Also, 40% and 33.8% of the respondents believed that fresh water turtle are the most common species in Irele and Ese Odo LGAs. However, 57.6% of them stated that sea turtles are the most common in Ilaje LGA while 74.2% of the respondents are of the opinion that land tortoise is the most common in Okitipupa LGA (Figures 3-8).

From the market survey and fish landing inspections, five (5) species of *Testudine* comprising of two land tortoises (Home's hinge-back tortoise (*Kinixys homeana*) and the Bell hinge-back (*Kinixys belliana*), locally called "Ijapa and Aron" respectively), two sea turtles (the Leatherback ((*Dermochelys coriacea*) and Olive ridley (*Lepidochelys olivacea*) locally called "loboyo or Oya okun") and one fresh water turtle (Black turtle (*Pelusios niger*) locally called "alukeluke") were seen physically with the local people (Plates 1-5). They are distributed across the four LGAs as follows: Two species of land tortoise, one species of fresh water turtle in Ese Odo, Irele and Okitipupa local Government areas while in Ilaje local government area there are two species of sea turtle, two species of land tortoise and one species of fresh water turtle.

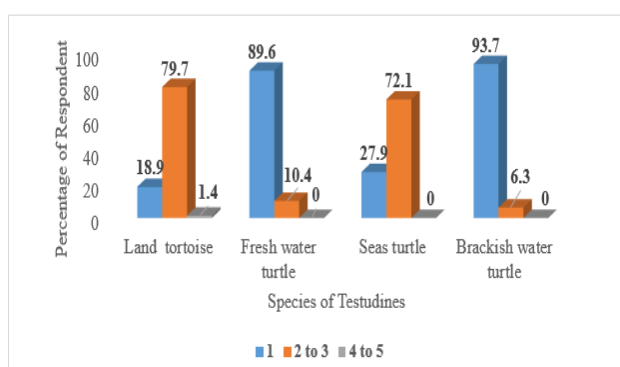


Figure 2. Number of species of tortoise and turtle available in the riverine area of Ondo state.



Figure 3. Olive' ridley (*Lepidochelys olivacea*), local name: Loboyo or Oya okun.



Figure 4. Home's hinge-back tortoise (*Kinixys homeana*), local name: Ijapa.



Figure 5. Leatherback (*Dermochelyidae coriacea*), local name: Loboyo or Oya okun.



Figure 6. Bell's hinged-back tortoise (*Kinixys belliana*), local name: Aron.



Figure 7. West African Black mud turtle (*Pelusios niger*), local name: Alukeluke.

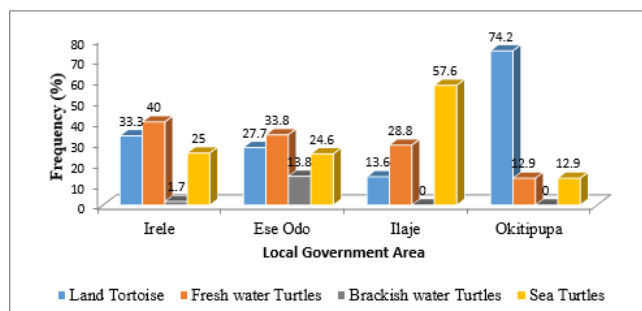


Figure 8. Occurrence of *Testudines* species in the riverine area of Ondo state.

Features used for *Testudine* species identification

There are two features used for identification of *Testudines* species by the local communities in the study area which are size and carapace (colour, pattern, height, thickness). In the study, 38.3% revealed that the means of identification of tortoise and turtle species was colour of the carapace this was followed by 29.3% respondents who claimed identification was by size while 27.0% respondents said by pattern of carapace (Figure 9). Also, 79.3%, 81.1% and 39.6% of the respondents affirmed genital opening as means of sex identification for land tortoise, fresh water turtle and sea turtle. Meanwhile, 76.6% and 39.6% respondents were undecided on the means of sex identification for brackish water and sea s respectively (Figure 10).

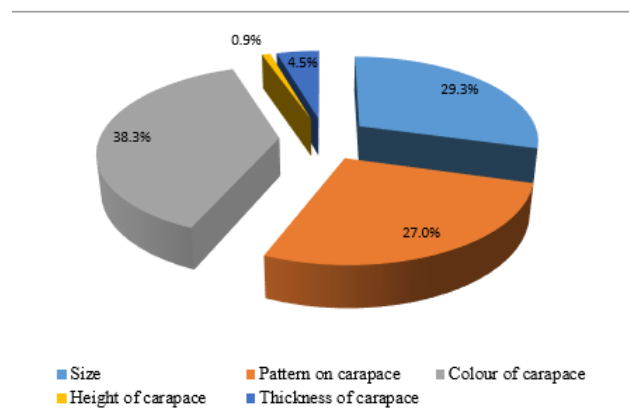


Figure 9. Means of identification of tortoise and turtle .

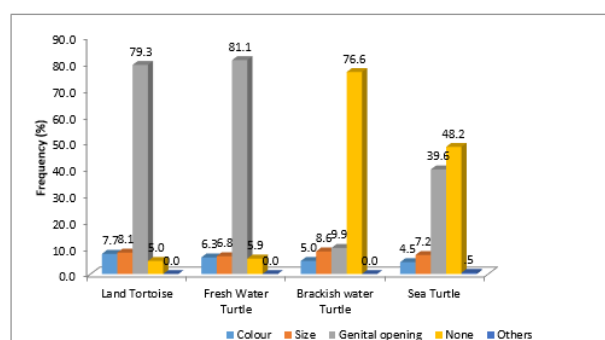


Figure 10. Sex identification of tortoise and turtle.

Population trend seasonal abundance of tortoise and turtle in the last five years

From the study higher percentage (41.0%) of the respondents believed that the population of land tortoise is highly decreasing while 64.9% and 53.6% of the respondents affirm a decrease in the population of fresh water turtle and brackish water turtle in the last 5 years. However, greater proportion (44.6%) of the respondents were undecided on the population trend of sea turtle in the study area (Figure 11).

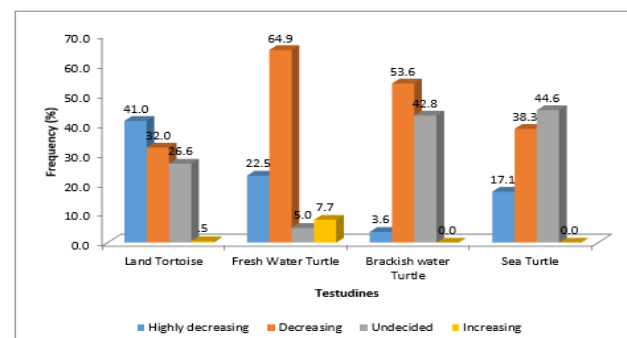


Figure 11. Population trend for tortoise and turtle in the last 5 years.

According to the study, 209 respondents (94.1%) responded that land tortoise was abundant during dry season while sea turtle, brackish

water turtle and fresh water turtle were abundance at wet season as reported by 215 respondents (96.8%), 212 respondents (95.5%) and 204 respondents (91.9%) respectively (Figure 12).

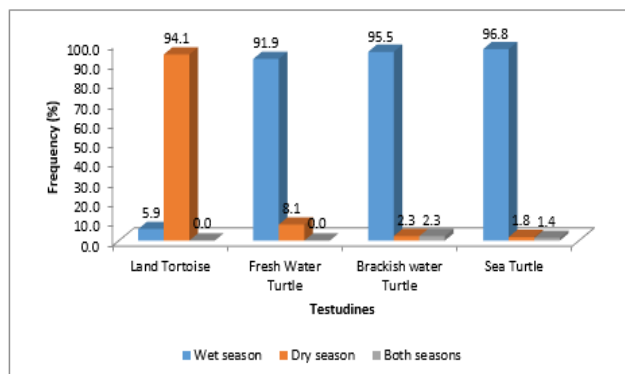


Figure 12. Seasons of abundance of tortoise and turtle.

Breeding season of tortoise and turtle

From the study, 118 respondents (53.2%), 104 respondents (46.8%), 100 respondents (46.8%) and 74 respondents (45.0%) affirmed that land tortoise, brackish water turtle, sea turtle and fresh water turtle respectively breed during mid-wet while 66 respondents (29.7%), 41 respondents (18.5%), 39 respondents (17.6%) and 34 respondents (15.3%) responded that sea turtle, land tortoise, fresh water turtle and brackish water turtle breed during early wet. However, brackish water turtle, sea turtle, land tortoise and fresh water turtle were said to breed during late wet responded by 61

respondents (27.3%), 39 respondents (17.6%), 32 respondents (14.4%) and 32 respondents (14.4%) respectively (Figure 13).

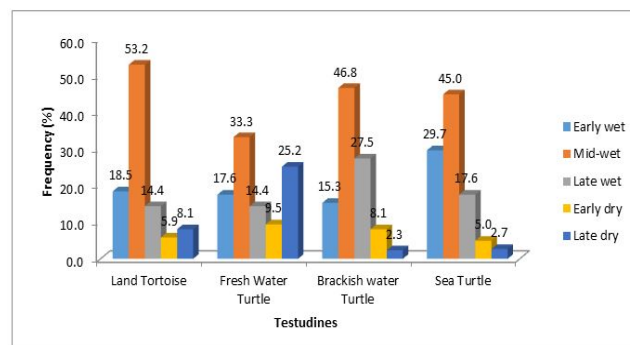


Figure 13. Breeding season of tortoise and turtle.

Local community's perception on threats associated with turtle and tortoise in the riverine area of Ondo state

The result of the perceived threats to Testudines in the study area shows that harvest for consumption ranked highest for both water turtles and land tortoise with weighted mean of 2.95 and 2.49 respectively while infections/disease ranked the lowest for both water turtles and land tortoise with weighted mean of 1.11 and 1.05 respectively (Table 2). However, majority of the respondents were not in agreement with the fact that the animals are threatened from the weighted mean interpretation.

Threat factors	Water turtles			Land tortoise		
	Weighted mean	Rank	Remark	Weighted mean	Rank	Remark
Harvest for consumption	2.95	1 st	N	2.49	1 st	D
By catch	2.56	2 nd	D	0	0	
Poor fishing practice	2.54	3 rd	D	0	0	
Illegal shell trade	2.46	4 th	D	2.44	2 nd	D
Boat props	2.11	5 th	D	0	0	
Climate change	1.95	6 th	D	0	0	
Marine pollution	1.63	7 th	SD	0	0	
Marine debris/wastes	1.45	9 th	SD	0	0	
Artificial lightening	1.41	10 th	SD	0	0	
Beacherosion/Coastal Armouring	1.15	11 th	SD	0	0	
Infections/Diseases	1.11	12 th	SD	1.05	7 th	SD
Predation	1.5	8 th	SD	1.9	6 th	D
Loss of habitat	0	0		2.4	3 rd	D
Degradation of vegetation	0	0		2.22	4 th	D
Bush burning	0	0		2.02	5 th	D

Note: SA: Strongly Agree (4.20-5.00), A: Agree (3.40-4.19), N: Neutral (2.60-3.39), D: Disagree (1.80-2.59), SD: Strongly Disagree (1.00-1.79)

Table 2. Level of agreement with the threat factors associated with *Testudines* in the study area.

Discussion

The five different species of tortoise and turtle recorded in the delta region of Ondo state is as a result of the heterogenous condition of the habitat. The land tortoise was largely found in Okitipupa and Irele local government areas with more land areas and are not linked to the ocean. The sea turtles: Leatherback (*Dermochelys coriacea*) and Olive ridley (*Lepidochelys olivacea*) are restricted to Ilaje and Ese-Odo LGAs because of the presence of ocean. The presence of both Home's hinge-back tortoise (*Kinixys homeana*) and the Bell hinge-back (*Kinixys bellianna*) in the study area is in consonance with the study of Luiselli which states that, in Nigeria, *Kinixys homeana* is found only in the southern regions, notably in the moist swamp forests of Niger Delta. *Kinixys homeana* was the dominant land tortoise species in the riverine areas of Ondo State as it is linked to wetter areas of the forest regions than *Kinixys erosa* in Nigeria.

The West African Black mud turtle (*Pelusios niger*) found in the study area is a common species in the fresh water ecosystem. This is in support of what was previously reported that *Pelusios niger* is a coastal West African species that ranges from Benin continuously through coastal southern Nigeria and western Cameroon and Equatorial Guinea to southwestern coastal Gabon. They are known to occur in the rainforest region in a variety of standing and slow-flowing permanent waters, such as lakes, lagoons and marshes, as well as rivers. Of the five species of sea turtle known to be present in Nigeria only two (Leatherback (*Dermochelys coriacea*) and Olive ridley (*Lepidochelys olivacea*) was recorded in Ondo state during the survey. This is in agreement with the report by Ogunjobi and Surulere of the presence of the two species of sea turtle in Ilaje LGA of Ondo state.

The respondents' information on the tortoise and turtle species identifying features and sex differentiation features is a clear evidence of the local communities' knowledge on the ecology of the studied species in the area. These features are among the identification keys for tortoise and turtles as reported. The breeding season and the season of abundance for the different species coincide with the periods of abundance of their food resources.

The study revealed that the general threat factors that have significant effects on the species of tortoise and turtle both in aquatic and terrestrial habitat in the riverine area of Ondo state are: Harvest for consumption, by-catch, habitat loss and degradation, as well as illegal trade. This is in agreement with the findings of Raxworthy and Nussbaum, who identified that factors that have caused widespread declines in the abundance and distribution of tortoises to include habitat destruction, pollution and over-exploitation for trade in meat, as pets and for traditional medicines.

Conclusion

The study recorded five species of *Testudines* comprising of two land tortoise, one fresh water turtle and two sea turtle in the study area. The respondents confirmed that there had been significant reduction of tortoise and turtle in the last two years to five years. However, the season of abundance corresponds to periods of food abundance. Size and carapace (colour, pattern, height and thickness) are used for species identification while genital openings are mostly used for sex differentiation. Harvest for consumption, by-catch, habitat loss and degradation, as well as illegal trade are the major threat factors of *Testudines* in the study area. It is therefore recommended that there should be Education and awareness programmes as well as creation of conservation group for people living in local communities on law prohibiting the harvest and conservation of wild animals.

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How to cite this article: Odewumi OS, Eniomodun IE. "Analysis of Local Ecological Knowledge and Threat Factors of Testudine Species in the Riverine Areas of Ondo State, Nigeria." *J Biodivers Biopros Dev* 11 (2025): 143.