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Impact of Urbanization on Biodiversity in Some Selected Communities in Andoni LGA, Rivers State, Nigeria

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Abstract

The study assessed the impact of urbanization on biodiversity in some selected communities in Andoni LGA, Rivers State, Nigeria. The selected communities include Ikuru, Ekede, Ebukuma, Ngo, and Oyorokoto which were purposively chosen due to the peculiarity of their vast biodiversity. The study adopted the use of questionnaire for data gathering among 400 respondents randomly selected from the communities (5) of interest. Descriptive statistics such as frequency count, percentages, mean score and Shannon-Wiener diversity index was used to analyse the obtained data. The result shows that influence of land use on some species were habitat disturbance, habitat destruction, encroachment and extinction of species. Results on the biodiversity indices for the investigated communities shows that Oyorokoto Community had the highest number of zooplankton (1,817 individual), 1,326 phytoplankton individuals and 5,121 fish species individuals. Result on the effect of some industrial activities on species revealed that felling of trees accounted for the highest, followed by dredging activities, transportation construction and then mining. The study recommends creation of a national park for the conservation and sustainable use of areas of high significance for biodiversity.

Keywords: - Industrial Activities, Specie Diversity, Biodiversity, Urbanization, Landuse

Introduction

Nigeria's environment is rich in ecological potential, which is essential for human development and transformation, but it is currently under threat from over-exploitation and misuse, which is causing a decline in both quality and quantity at an alarming rate. The environment offers resources necessary for all socio-economic activities as well as a life support system, but the main threats to the environment in general and these abundant and finite natural resources, in particular, are human activity and natural resources (Gasu et al., 2005 in Anwadike 2020). Rapid population growth, excessive resource exploitation, poverty, poor economic performance, a weak institutional and legal framework, poor agricultural practices and a high reliance on biomass fuel, land disturbance, excessive grazing, soil contamination, deforestation, land degradation, environmental pollution, vehicular pollution, urbanization, and erosion are some of the potential causes of environmental degradation and potentially biodiversity loss (UN 2002 in Anwadike 2020). The effects are felt by the growing human population and by changes in the global environment, including climate change, rising sea levels, desertification, droughts, flooding, variations in rainfall, greenhouse effects, loss of biodiversity, degradation of coastal and marine habitats, freshwater contamination, land degradation, pollution of the air and water, and urbanization. The term "biological diversity" refers to the diversity of plant and animal life found throughout an environment, a community, a species, and even at the genetic level.

According to estimates of global species richness, there are between 3 million and 100 million species on Earth. The majority of these species are found in tropical and subtropical regions, which are home to many of the world's hot spots for conservation priority. The majority of biodiversity measurements and reports are made at the species level, considering traits including species richness, species diversity, and uniqueness to particular regions (UN 2002 in Anwadike 2020). The phrase is all-encompassing and comprehensive, covering both higher plants and animals as well as other lesser organisms, which is what conservation efforts are mostly focused on. In many regions of the world, unplanned development-related changes in land use and land cover are currently the main factors contributing to the loss of biodiversity (Hansen et al., 2020). Growing civilizations' urban areas and infrastructure do have a significant impact on biodiversity. The majority of developing-nation towns are finding it extremely difficult to manage how infrastructure affects biodiversity. Urban areas require a significant amount of fresh water daily, and careless abstraction can seriously affect the diversity and composition of species. Common occurrences in and around cities, including channelization, have the potential to significantly change the physical properties and decrease the variety of habitats that riparian vegetation offers. Urbanization undoubtedly plays a role in the decline of biodiversity.

One important way to protect biodiversity is to maintain sizable, unaltered regions of natural habitat. This might not be possible, though, in heavily populated areas where natural habitat is scarce. With more than half of the world's population currently residing in cities, humans have evolved into an urban species. The direct effects of urbanization on biodiversity have grown as more people relocate to cities in order to take advantage of better job prospects.

Materials and Method

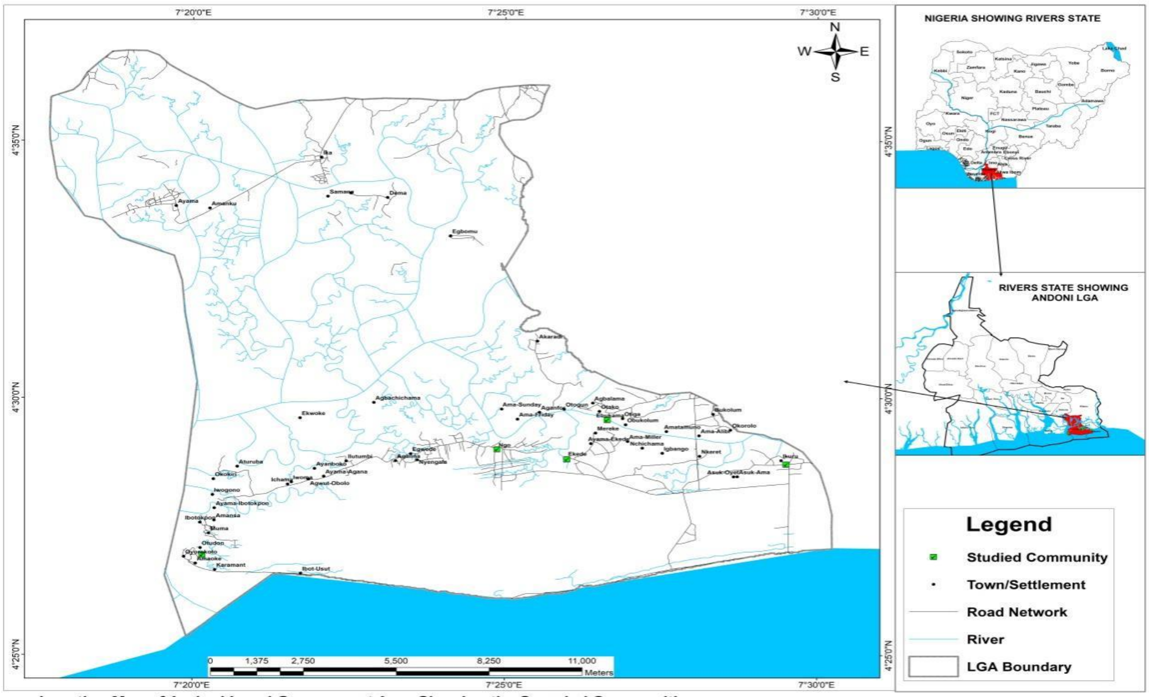
Study Area

This study was carried out in Andoni Local Government Areas of River State, Nigeria (Figure 1). Its headquarters is in Ngo Town. It has an area of over 233 km^2 and according to NPC 2006, the projected population of the LGA in 2022 is 311,500 spread among 218 settlements. Andoni was created in 1991 during the regime of General Ibrahim Badamosi Babangida. It is bounded in the north by Khana LGA, in the south by the Atlantic Ocean, in the east by Opobo/Nkoro, and in the west by Bonny LGA. The LGA occupies a landmass of 233sq. Km. The projected population of the LGA in 2022 is 360,271 spread among 218 settlements. The predominant occupation of the people is fishing, while the major religion is Christianity with a few adherents to African Traditional Religion. It forms part of the rainforest in Nigeria. The Andoni people are related to the Ijaw people of the Niger Delta in Nigeria they speak the Obolo language, their villages and towns are situated on islands and some of them are Ikuru, Unyeangala, Asukama, Agana, Egwede, Ayamboko, Agwut Obolo, Ilotombi, Ekede town and Oyorokoto (the largest fishing settlement in Rivers State). The people are predominantly fishermen. Some parts of the Andoni tribe can be assessed by road and all parts by sea. It is rich in wildlife elephants (*Loxodonta africana)*, monkeys (*Macaca fascicularis*), species of pythons (*Testudinidae),* tortoise (Testudinidae) etc. and mineral resources and It is a growing tourist location in Rivers State.

Ikuru, Ekede, Ebukuma, Ngo, and Oyorokoto were purposively selected out of the communities in Andoni LGA due to the peculiarity of their vast biodiversity. Four hundred (400) respondents were randomly selected. The purpose of utilization of the random sampling technique is to avoid bias by giving every native an equal chance of being selected in the study. A total of eighty (80) respondents were selected from each community to form the sample size for the study.

Data Collection and Analysis

Data for the study were collected through the administration of a structured questionnaire on adults in the selected communities. Also, informed persons were carefully selected to have a focused group discussion and interviewed using a well-structured questionnaire to get information from them. To facilitate successful communication, the questionnaire was written in English and interpreted in the native tongue by an indigenous person. Data was also collected by taking a physical assessment of the biophysical (terrestrial and aquatic) environment of the study area. The primary data was collected and coded using the Statistical Package for the Social Sciences (SPSS) version 23, and descriptive statistics such as frequency count, percentages, mean score and Shannon-Wiener diversity index were used to analyse the objectives.



Location Map of Andoni Local Government Area Showing the Sampled Communities

Figure1: A Map showing Andoni LGA (Study Area)

Results

Industrial Activities on Species Diversity

Results from the field show that the felling of trees accounted for the highest industrial activity that affected species in the study area with 83.33%, followed by dredging which accounted for 63.1% and mining has the least effect on species in the study area. Results on the effects of Some industrial activities affecting species diversity in the study area are presented in Table 1 and Figure 1.

Species Richness and Biodiversity

Results on diversity indices of Fish species were presented in Table 2. During the study of fish species in Andoni LGA of Rivers state, Nigeria as presented in Table 4.23, dominance was highest in Ekede (0.083) and lowest in Ikuru (0.073). The values of the Shannon-Wiener diversity index obtained for the study areas were 2.914 (Ikuru), 2.979 (Ebukuma), 3.318 (Ekede), 3.177 (Ngo) and 2.935 (Oyorokoto). The value recorded in the three communities was lower than the values recorded in River Niger at Agenebode, Edo State, Nigeria by Agbugui, Abhulimen, Inobeme and Olori (2019). The species evenness index values were 0.359, 0.374, 0.427, 0.396 and 0.342 for Ikuru, Ebukuma, Ekede, Ngo and Oyorokoto. Simpson's diversity index ranged from 0.917 (Ekede) to 0.927 (Ikuru).

Table 1: Some industrial activities affecting specie diversity in the study area

Influence	Freq.	%
Felling of trees	70	30.57
Dredging	53	23.14
Transportation of raw materials	47	20.52
Road construction	39	17.03
Mining	20	8.73

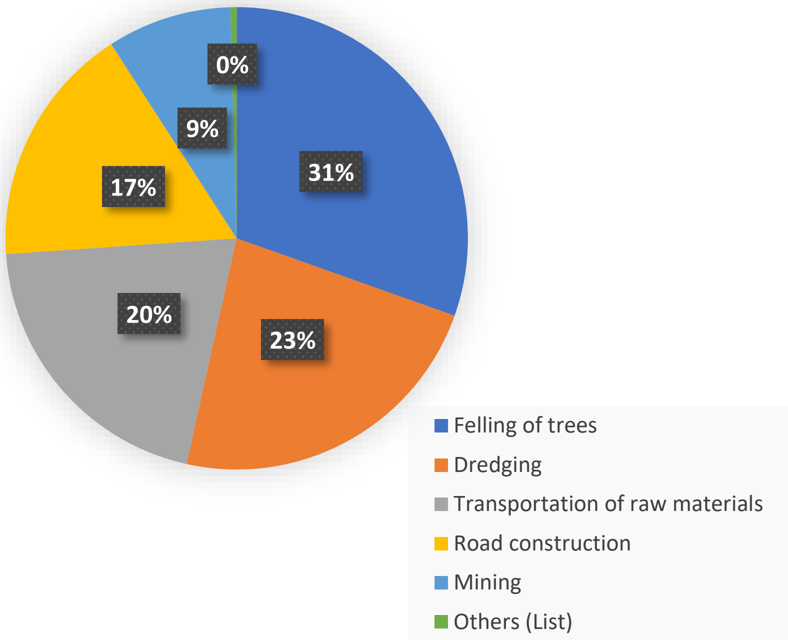


Figure 1: Summary of Some industrial activities affecting species diversity in the study area

Table 2: Diversity indices of Fish Species

Diversity Indices	Ikuru	Ebukuma	Ekede	Ngo	Oyorokoto
Number of Taxa	70	65	66	74	81
Total Abundance	3292	2806	2374	3032	5249
Species diversity (H) (Shannon-Wiener Index)	2.914	2.979	3.318	3.177	2.935
Species evenness (Pielou Evenness Index)	0.359	0.374	0.427	0.396	0.342
Species dominance (Simpson's Index (λ)	0.073	0.074	0.083	0.082	0.076
Simpson's Diversity Index (1-λ)	0.927	0.926	0.917	0.918	0.924

Discussion

The reduction in mangrove and thick forests in Andoni LGA as demonstrated in the mapping shows that many species (both plant and animal) have reduced. With the mapping showing an expansion in built-up area and farming portion, it indicates that as urbanization increases in Andoni, building and road surfaces are coming up to replace thick vegetation thereby driving away much biodiversity. More so, as agricultural activities increase in the area, thick forests and mangroves are destroyed thereby forcing animal species to migrate while others are killed. Similarly, these activities lead to the destruction of many plant species in the area.

Among the locations, Oyorokoto stands out with the highest number of taxa (64) and the greatest overall abundance (1,802 individuals). However, this numerical richness belies a potential imbalance, as evidenced by its relatively low evenness index. This suggests that while many species are present, a few dominant taxa exert a strong influence on the community's structure, potentially overshadowing rarer species. In contrast, Ekede and Ngo, with their abundant populations (1,252 and 1,394 individuals, respectively) and high Shannon-Wiener diversity values, appear to foster communities where species are more evenly distributed. Their high evenness values indicate that no single species disproportionately dominates the system, a characteristic often associated with greater ecosystem resilience.

Ikuru and Ebukuma offer additional layers of insight. Ikuru, with a moderate count of 53 taxa and a total abundance of 743 individuals, exhibits a lower diversity index alongside a higher Simpson's dominance value, pointing to a community where a few species play a disproportionate role. Ebukuma, though recording the lowest taxa count (45) and abundance (526 individuals), maintains a relatively balanced distribution among species. This balance suggests that even systems with lower overall richness can maintain equilibrium if the species present are relatively equally represented. These intra-categorical comparisons align closely with findings from recent scholarly work. For instance, Sharma et al. (2018) and Wang et al. (2019) have documented that environments boasting high species richness may still display low evenness when opportunistic or tolerant species become overly dominant. Such dynamics are reflected in the case of Oyorokoto, where a high number of species does not translate into an evenly distributed community. Similarly, studies by Li et al. (2021) have shown that communities characterized by high biodiversity indices and balanced species distributions tend to be more resilient to environmental disturbances—a pattern that mirrors the observations from Ekede and Ngo. Further reinforcing these insights, Garcia et al. (2017) have highlighted how environmental stressors, such as excessive nutrient loads, can alter the structure of zooplankton communities by promoting the dominance of certain species. This phenomenon offers a plausible explanation for the higher dominance indices observed in areas like Ikuru, where the community balance appears compromised despite moderate taxonomic richness. In conjunction with these studies, Zhang et al. (2020) emphasized the importance of using a composite of biodiversity indices to capture the true ecological status of an aquatic ecosystem, rather than relying on singular metrics. This comprehensive approach is reflected in the current study and underscores the need to consider both abundance and evenness when evaluating ecosystem health.

The species richness in the study indicated that Oyorokoto town (80) recorded the highest followed by Ngo town (75), while Ekede (66) recorded the least. Marine ecosystems represent a mosaic of habitats—from coral reefs and seagrass meadows to sandy plains and deep-sea vents—each characterized by its unique assemblage of species.

Differences in species richness among these habitats have long intrigued ecologists, as they reflect the interplay of physical, chemical, biological, and anthropogenic forces. This essay explores the primary causes behind the observed variations in species richness across marine habitats, drawing on research published since 2017 to illuminate contemporary insights in the field. One of the foremost drivers of high species richness in marine environments is habitat complexity. Complex habitats, such as coral reefs, offer a myriad of microhabitats—crevices, overhangs, and varied substrate types—that provide shelters, breeding grounds, and feeding opportunities for diverse organisms. Such structural heterogeneity increases niche availability, thereby allowing a greater number of species to coexist. Johnson, Lee, and Torres (2018) demonstrated in their study that coastal habitats with pronounced structural complexity harbour significantly higher species richness compared to more homogeneous environments like sandy or muddy plains. This relationship is attributed to the fact that varied physical structures not only offer refuge from predators but also support diverse food resources that bolster community diversity.

Marine habitats differ considerably in their exposure to environmental gradients such as temperature, salinity, and pH—factors that fundamentally shape species distributions. Areas with stable thermal regimes and optimal salinity levels tend to support higher diversity because they enable species to maintain their metabolic activities with minimal stress. Martin and Smith (2020) found that coastal ecosystems characterized by gentle environmental gradients typically exhibit richer species assemblages than habitats subjected to extreme or fluctuating conditions. Moreover, variation in light penetration and oxygen availability further influences the distribution and productivity of primary producers, thereby indirectly setting the stage for higher trophic levels to flourish.

Nutrient availability is a crucial determinant of primary productivity in marine ecosystems, which in turn sustains diverse biological communities. Moderate nutrient levels tend to enhance plant and algal growth, providing a robust food base for herbivores and their predators. However, when nutrient inputs exceed certain thresholds, the plants' exuberant growth can lead to eutrophication and hypoxic conditions—a scenario that may reduce species richness instead of enhancing it. Ramirez, Nguyen, and Patel (2021) conducted a comprehensive meta-analysis that underscores this nuanced relationship: while appropriate nutrient enrichment fosters biodiversity by increasing resource availability, over-enrichment frequently results in a loss of diversity through habitat degradation and destabilization of food webs.

Connectivity among marine habitats plays an indispensable role in maintaining species richness. Many marine organisms have planktonic larval stages that rely on water currents for dispersal between habitats. Well-connected systems can receive a continual influx of larvae from neighbouring ecosystems, thereby reinforcing local biodiversity and enhancing genetic exchange. Conversely, isolated habitats may suffer from reduced recruitment rates and, consequently, lower species richness. Cavalcante, Silva, and Almeida (2019) emphasized that connectivity is a vital factor in tropical marine regions, where the merging of dispersal pathways contributes to more resilient and diverse communities. In this context, the spatial arrangement and the permeability of seascapes serve as critical determinants of the observed patterns in species richness.

In recent decades, human activities have increasingly intertwined with natural processes, markedly influencing marine biodiversity. Coastal development, overfishing, pollution, and climate change have all emerged as potent modifiers of species richness. Climate change, in particular, imposes shifts in ocean temperature, acidity, and storm frequency that can irreversibly alter community composition. Research by Zhou, Chen, and Wang (2022) (and echoed by similar studies published after 2017) has linked rising sea temperatures and ocean acidification to alterations in species distributions and local extinctions in vulnerable habitats. These findings underscore the susceptibility of already marginal habitats and the importance of adopting adaptive management strategies aimed at mitigating human impacts.

Conclusion

Andoni is still currently under serious threat despite previous studies and recommendations posed by researchers. According to research it is one of the areas with the largest biodiversity but will lose this status if this loss and depletion continues as reported. The concern for biodiversity protection against all manner of development has reached maturity in Nigeria. However, the complexities of the issues involved call for urgent solutions that recognize the differences in developmental levels of states as well as how people relate to the environment. The most appealing way of urbanization that preserves biodiversity is Sustainable development. Considering the disclosures of this survey, the going with proposition made was that there is a strident call to the state for the protection of the marine and coastal biodiversity in the study area to save the depleting habitats in the region taking it from mere ''Paper Parks ie, Parks on Paper to Real parks and funds be allocated for the protection of this area.

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