Comparative Assessment of the Biodiversity Components of Nypa Palm (*Nypa fructicans*) And Mangrove Ecosystems in Kono, Rivers State

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Abstract
The abundance, diversity and distribution of floral and faunal communities within Nypa-dominated and Mangrove-dominated ecosystems were studied. This study was carried out in Kono, a coastal wetland community located in Khana LGA of Rivers State, Nigeria. This area forms part of the extensive mangrove and estuarine ecosystem in the Niger Delta. Six months of field sampling compared mangrove and Nypa-dominated habitats using permanent plots, transects, direct observations and a 50-respondent household survey, with biodiversity assessed using abundance, richness, Shannon–Wiener and Margalef, Pielou's evenness. The floral composition of the mangrove and Nypa palm ecosystems showed a moderate level of similarity with clear structural differences between the two habitats. Macro-invertebrates and nearly all fish species were present in both ecosystems, however, certain species, including Eleotris vittata (Goby), Psittacus erithacus (African grey parrot), and Varanus niloticus (Nile monitor lizard) were found only in the mangrove habitat. Some species overlapped but there was a clear difference in dominance and composition. For example, Acrostichum aureum has 7.25% in mangrove compared to 0.84% in Nypa palm, Cyperus articulatus recorded 8.58% in the mangrove but 1.26% in Nypa palm. Similarly, Hibiscus tiliaceus recorded 4.53% in the Mangrove and 1.60% in Nypa palm. On the other hand, the Nypa palm ecosystem was dominated by a few species, particularly Nypa fruticans, which had a much higher abundance (22.80%) compared to 7.46% in the mangrove. One major observation recorded in this study was the exclusive presence of true mangrove species: Rhizophora racemosa (20.99%), Avicennia germinans (5.44%), Laguncularia racemosa (4.18%), and Dalbergia ecastaphylum (2.02%), all of which were absent in the Nypa palm ecosystem. This study showed that mangrove habitats supported greater biodiversity, highlighting the need for Nypa management, mangrove restoration, and community-based conservation in Kono.

Key Words: *Biodiversity, Ecosystem, Mangrove, Nypa palm & Kono*

1. Introduction

Background of the study

Biotic interactions play fundamental roles in the evolution of biodiversity, the assembly and dynamics of biotic communities and the functioning of ecosystems (Thompson, 1999; Tylianakis

et al., 2008; Mittelbach, 2012; Vellend, 2016). Nigeria has many regions with rich biodiversity serving as home to critical ecosystems. Among these regions are the Cross River basin rainforest, mountains along the Cameroon border with Nigeria, and the Niger Delta coastal creeks (Demuren & Rodi, 1986; Mazda *et al.,* 2005). The Niger Delta mangrove is Africa's largest mangrove ecosystem and the world's third largest after India and Indonesia, the third largest drainage basin in Africa, and Africa's largest river delta (Wattayakorn *et al.,* 1990; Wolaski & Cassagne, 2000). The coastal region of Nigeria extends from Benin Republic/Nigeria border in the West to the Cameroun/Nigeria border in the east, a distance of 800 km but with a coastline of 853 km (Ridd *et al.,* 1990). The mangrove ecosystem in Rivers State and the wider Niger Delta is one of the most important coastal wetland ecosystems in Nigeria. It supports a wide range of plants and animals and provides important benefits such as fish nursery grounds, coastal protection, carbon storage, and resources that support the livelihoods of many coastal communities.

The mangrove ecosystem is under increasing pressure from human activities, including deforestation, oil pollution, urban development, overexploitation of resources, and the spread of the invasive Nypa palm (*Nypa fructicans*) (Numbere, 2019; Thomas *et al.,* 2021). Studies of the Niger Delta have also shown that mangrove loss and the expansion of Nypa palm have occurred at the same time over recent decades, raising concern about changes in the structure and ecological functions of coastal habitats (Thomas *et al.,* 2021; Barenblitt *et al.,* 2024). *Nypa fructicans* (Nypa palm), an exotic palm that was introduced into Nigeria from Singapore in 1906, reportedly as part of efforts to control coastal erosion has subsequently established itself in the Niger Delta and spread through suitable intertidal areas (Numbere, 2019). Thomas *et al.* (2021), for example, estimated that between 2007 and 2017 mangrove area in the Niger Delta declined by about 12%, while the mapped extent of Nypa increased substantially during the same period. More recent satellite-based work also estimated that approximately 28,000 ha of mangrove had been converted to Nypa by 2020 (Barenblitt *et al.,* 2024). Mangroves are recognised for their roles in supporting fisheries, protecting shorelines, storing carbon and providing habitat for biodiversity. The replacement of native mangrove vegetation by Nypa may therefore have implications beyond vegetation change alone (Thomas *et al.,* 2021; Barenblitt *et al.,* 2024). However, determining whether Nypa can functionally replace native mangrove habitat requires evidence from several biodiversity components rather than conclusions based only on the presence or absence of the palm.

1. Methodology

1.1. Study Area

This study was carried out in Kono, a coastal wetland community located in Khana LGA in Rivers State, southern Nigeria, within the eastern Niger Delta region. The area forms part of the extensive mangrove and estuarine ecosystem for which the Niger Delta is globally recognized. In recent decades, Kono has experienced significant expansion of *Nypa fruticans*, particularly along creek banks and tidal flats, making it an appropriate location for assessing biodiversity components within Nypa palm–dominated ecosystems. Kono is situated within the coastal lowland zone of Rivers State and lies within the mangrove–brackish water transition belt of the Niger Delta. The community is accessible primarily by road and waterways and is intersected by a network of tidal creeks connected to larger estuarine systems draining into the Atlantic Ocean. Geographically, the study area lies approximately between latitude 4.589386°N and Longitude 7.512942°E.. These coordinates encompass the Nypa-dominated wetlands and adjacent reference mangrove sites selected for sampling. Kono lies within the Niger Delta sedimentary basin, which is characterized

by unconsolidated alluvial deposits derived from fluvial and marine processes. The soils in the study area are predominantly hydromorphic, poorly drained, and rich in organic matter due to frequent inundation and slow decomposition under anaerobic conditions. The area is strongly influenced by tidal action. Periodic flooding by brackish water occurs during high tides, while freshwater input increases during the rainy season.

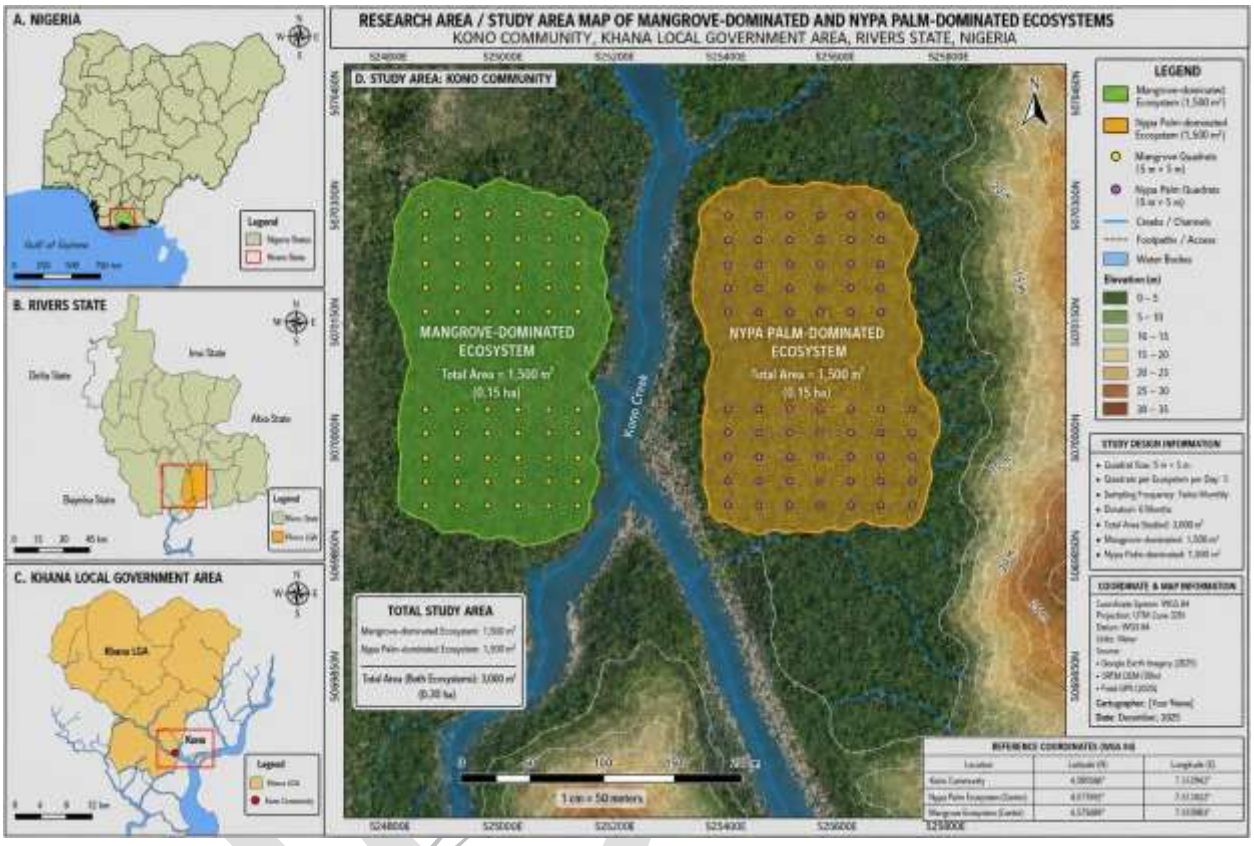


Figure 1: Map of study area; Nwinoa, Kono, Rivers State

1.2.Study Design and Sampling

This study adopted a descriptive–comparative ecological research design focused on assessing plant and animal biodiversity within Nypa palm–dominated ecosystems and mangrove-dominated ecosystems in Nwinoa, Kono, and Rivers State. The design was structured to generate robust, field-based biological data under natural conditions, without reliance on laboratory-intensive analyses that were beyond the scope of available resources. The research design emphasizes direct observation, standardized biodiversity sampling, and comparative analysis between Nypa-dominated habitats and the native mangrove ecosystem at Nwinoa in Kono. This approach is widely applied in ecological and invasion biology studies where the objective is to evaluate species composition and habitat-level impacts rather than underlying biochemical processes.

Sampling was conducted within a defined temporal window of six (6) months to maintain comparability across sites. A cross-sectional field survey approach was employed to document biodiversity patterns across selected sampling sites. Data collection was carried out during a defined study period to ensure consistency across sites and to minimize confounding effects associated with short-term environmental fluctuations. The approach relied primarily on systematic field surveys, standardized sampling protocols for flora and fauna and direct

measurements of species presence, abundance, and distribution. The study area was stratified into two primary habitat types based on dominant vegetation cover which includes the Nypa palm–dominated sites, characterized by extensive stands of *Nypa fructicans* along tidal creeks and wetlands and a native mangrove ecosystem comprising areas where native mangrove species such as *Rhizophora* and *Avicennia* remain relatively intact. This stratification was adopted to facilitate comparative analysis of biodiversity patterns across contrasting vegetation types while minimizing confounding environmental variation related to geography and tidal influence.

Multiple sampling points using permanent plot sizes of 5m × 5m were established within each habitat type to provide replication and improve the robustness of biodiversity estimates with sixty (60) plots being established in each of the ecosystems. All sampling locations were georeferenced using GPS to enable spatial analysis and future replication using the GLand Measure app and the tidal flow of the study area was to known using the High Tide app. Vegetation assessment focused on documenting plant species composition, abundance, and structural characteristics. Plot sizes of 5m × 5m ($25m^2$) were used during sampling to assess understorey and ground vegetation, with plots placed systematically along transects within each habitat type. Transect walks (25m) were used to record canopy and mid-storey plant species, particularly in areas where dense vegetation limited plot placement. Within each sampling unit, plant species were identified in situ where possible, while unidentified species were recorded and later identified using standard taxonomic keys and regional floras such as Plant of the World (POWO), INaturalist and PlantNet. Data collected included species presence, frequency, and relative dominance.

Fish assessment was done in collaboration with artisanal fishers during routine fishing activities and macro-invertebrates were sampled using hand collection, sweep nets and visual searches along defined transects and established plots. These organisms were selected due to their sensitivity to habitat structure and vegetation change, making them useful indicators of ecosystem condition. Bird surveys were conducted using direct observation and point count methods, typically during early morning and late afternoon periods when bird activity is highest. Species presence and relative abundance were recorded without capture, in line with ethical wildlife research standards. Bird species were identified using binoculars and monocular attached to smart mobile devices, Merlin Bird ID and eBird data bases. Equal numbers of plots, transects, and observation periods were allocated to Nypa-dominated and Mangrove-dominated sites. Replication across sites reduced the influence of localized variability and strengthened statistical analysis.

Data analysis for this study was designed to provide a rigorous and transparent assessment of biodiversity patterns within Nypa palm–dominated ecosystems and adjacent native mangrove-dominated habitats and a Knowledge Attitude Perception (KAP) to assess the residents' perceptions and livelihood implications of Nypa palm expansion and the relative decline of the native mangrove ecosystems. In accordance with the revised scope of the research, analysis were restricted to biotic datasets, including plant and faunal communities, and did not incorporate microbial or physicochemical variables. The analytical framework integrated descriptive statistics, inferential statistical tools and core biodiversity indices, all of which are standard in ecological and invasion biology research. Species diversity was calculated using Shannon-Wiener Index, H', (H' = -[ΣPi*LN(Pi)]), Margalef's Richness Index, DMg (DMg = S – 1/LnN), Pielou's Evenness Index, J' (J' = H').

2. Results

Research Question One (1): What floral species occur within the Mangrove and Nypa palm ecosystems, and how are they distributed across habitat zones?

Table 1: Floral Composition in both Mangrove and Nypa palm Ecosystems

S/N	Scientific Name	Common Name	Mangrove	Nypa Palm
1	*Rhizophora racemosa*	Red mangrove	+	-
2	*Phoenix reclinata*	Senegal date palm	+	+
3	*Avicennia germinans*	Black mangrove	+	-
4	*Laguncularia racemosa*	White mangrove	+	-
5	*Nypa fructicans*	Nypa palm	+	+
6	*Dalbergia ecastaphylum*	Mangrove vine	+	-
7	*Acrostichum aureum*	Mangrove fern	+	+
8	*Pterocarpus santalinoids*	African teak	+	+
9	*Phoenix reclinata*	Senegal date palm	+	+
10	*Cyperus articulatus*	Jointed flatsedge	+	+
11	*Hibiscus tiliaceus*	Sea Hisbiscus	+	+
12	*Hiptage benghalensis*	Hiptage flower	+	+

+ = Species presence, - = Species absence

Table 2: Relative Abundance (%) of Plant Species in both Mangrove and Nypa palm Ecosystems

Scientific Name	**Common Name**	**Mangrove**	**Nypa palm**
Acrostichum aureum	Mangrove fern	7.25	0.84
Avicennia germinans	Black mangrove	5.44	-
Cyperus articulates	Jointed flatsedge	8.58	1.26
Dalbergia ecastaphylum	Mangrove vine	2.02	-
Hibiscus tiliaceus	Sea Hisbiscus	4.53	1.60
Hiptage benghalensis	Hiptage flower	2.58	0.42
Laguncularia racemosa	White mangrove	4.18	-
Nypa fructicans	Nypa palm	7.46	22.80
Phoenix reclinata	Senegal date palm	2.09	5.23
Pterocarpus santalinoids	African teak	1.95	0.77
Rhizophora racemosa	Red mangrove	20.99	-

The relative abundance of plant species in both ecosystems are presented in Table 2. The results obtained show some species overlap but also a clear difference in dominance and composition. From the result obtained, several species occurred in both habitats, but they are generally more abundant in the mangrove ecosystem. For example, *Acrostichum aureum* has 7.25% in mangrove compared to 0.84% in Nypa palm, *Cyperus articulatus* recorded 8.58% in the mangrove whereas

1.26% in Nypa palm. Similarly, *Hibiscus tiliaceus* recorded a relative abundance of 4.53% in the Mangrove habitat while Nypa palm had 1.60% (Table 2).

On the other hand, the Nypa palm ecosystem was dominated by a few species, particularly *Nypa fruticans*, which has a much higher abundance (22.80%) compared to 7.46% in the mangrove. *Phoenix reclinata* also shows higher abundance in Nypa palm (5.23%) than in mangrove (2.09%). A major difference in this result was the exclusive presence of true mangrove species in the mangrove habitat, including *Rhizophora racemosa* (20.99%), *Avicennia germinans* (5.44%), *Laguncularia racemosa* (4.18%), and *Dalbergia ecastaphylum* (2.02%), all of which are absent in the Nypa palm ecosystem (Table 2).

Research Question Two (2): What faunal groups (fish, birds, macro-invertebrates, amphibians, small mammals and wildlife) are present, and what are their relative abundances?

Table 3: Fauna Composition in both mangrove and Nypa palm ecosystems

S/N	*Scientific Name*	Common Name	Mangrove	Nypa Palm
	Micro-invertebrate			
1	*Tympanotonus fuscatus*	Periwinkle	+	+
2	*Crassostrea gasar*	Mangrove Oyster	+	+
3	*Afruca tangeri*	Fiddler crab	+	+
4	*Sesarma huzardi*	Mangrove crab	+	+
5	*Callinectes amnicola*	Blue crab	+	+
	Fishes			
S/N	***Scientific Name***	**Common Name**	**Mangrove**	**Nypa Palm**
1	*Ethmalosa fimbriata*	Bonga shad	+	+
2	*Neochelon falcipinnus*	Sicklefin Mullet	+	+
3	*Sarotherodon melanotheron*	Black-chin Tilapia	+	+
4	*Tilapia guineensis*	Guinean Tilapia	+	+
5	*Periophthalmus barbarous*	Mudskipper	+	+
6	*Chrysichthys nigrodigitatus*	Silver Catfish	+	+
7	*Brycinus nurse*	African Tetra	+	+
8	*Gerres melanopterus*	Silver Biddy	+	+
9	*Sphyraena afra*	Barracuda	+	+
10	*Litoapenaeus vannamei*	Shrimp	+	+
11	*Eleotris vittata*	Goby	+	-
12	*Polydactylus quadrifilis*	Threadfin	+	+
	Birds			
S/N	***Scientific Name***	**Common Name**	**Mangrove**	**Nypa Palm**
1	*Pycnonotus barbatus*	Common Bulbul	+	+
2	*Eurillas virens*	Little Greenbul	+	+
3	*Ploceus cucullatus*	Village Weaver	+	+
4	*Ceryle rudis*	Pied Kingfisher	+	+

5	*Corythornis cristatus*	Malachite Kingfisher	+	+
6	*Psittacus erithacus*	African grey Parrot	+	-
7	*Egretta garzetta*	Little egret	+	+
8	*Butorides striata*	Striated Heron	+	+
9	*Actitis hypoleucos*	Common Sandpiper	+	+
10	*Lophoceros faciatus*	West African Pied Hornbill	+	+
11	*Scorpus umbretta*	Hamerkop	+	+
12	*Numerius phaeopus*	Eurasian whimbrel	+	+
13	*Ardea cinerea*	Grey Heron	+	+
14	*Halcyon malimbica*	Blue-breasted kingfisher	+	+
		Mammals		
S/N	***Scientific Name***	**Common Name**	**Mangrove**	**Nypa Palm**
1	*Cercopithecus mona*	Mona Monkey	+	+
2	*Varanus niloticus*	Nile monitor lizard	+	-

+ = Species presence, - = Species absence

Table 4: Relative Abundance (%) of Macro-invertebrate Species in both Mangrove and Nypa palm Ecosystems

S/N	Scientific Name	Common Name	Mangrove	Nypa Palm
1	*Callinectes amnicola*	Blue crab	3.71	0.91
2	*Crassostrea gasar*	Mangrove Oyster	4.61	4.32
3	*Sesarma huzardi*	Mangrove crab	10.21	3.87
4	*Tympanotonus fuscatus*	Periwinkle	46.40	5.59
5	*Afruca tangeri*	Fiddler crab	10.33	10.05

The relative abundance of macro-invertebrates in both ecosystems is presented in Table 4. The results showed shared species between the two habitats but strong differences in dominance patterns. All species recorded occurred in both habitats, indicating similar habitat suitability. However, most species were more abundant in the mangrove ecosystem. For example, *Callinectes amnicola* (blue crab) had 3.71% in mangrove compared to 0.91% in Nypa palm, while *Sesarma huzardi* (mangrove crab) had 10.21% in mangrove and 3.87% in Nypa palm. The most important difference in this result were seen in *Tympanotonus fuscatus* (periwinkle), which was highly dominant in the mangrove at 46.40% but dropped to 5.59% in the Nypa palm ecosystem. A few species in this study showed a relatively similar abundance in both habitats. *Crassostrea gasar* (mangrove oyster) occurred at 4.61% in mangrove and 4.32% in Nypa palm, while *Afruca tangeri* (fiddler crab) showed nearly equal values of 10.33% in mangrove and 10.05% in Nypa palm (Table 4).

Table 5: Relative Abundance (%) of Fish Species in both Mangrove and Nypa palm Ecosystems

S/N	Scientific Name	Common Name	Mangrove	Nypa palm
1	*Brycinus nurse*	African Tetra	4.52	1.27
2	*Chrysichthys nigrodigitatus*	Silver Catfish	6.54	1.62
3	*Eleotris vittata*	Goby	0.46	0.05
4	*Ethmalosa fimbriata*	Bonga shad	9.74	5.33
5	*Gerres melanopterus*	Silver Biddy	3.86	2.99
6	*Litoapenaeus vannamei*	Shrimp	4.97	1.78
7	*Neochelon falcipinnus*	Sicklefin Mullet	9.84	4.41
8	*Periophthalmus barbarus*	Mudskipper	10.96	6.54
9	*Polydactylus quadrifilis*	Threadfin	1.12	0.41
10	*Sarotherodon melanotheron*	Black-chin Tilapia	7.56	4.41
11	*Sphyraena afra*	Barracuda	0.76	0.10
12	*Tilapia guineensis*	Guinean Tilapia	7.61	3.15

The fish communities in both ecosystems were different in abundance, with all species recorded at higher values in the mangrove ecosystem (Table 5). *Periophthalmus barbarus* (mudskipper) recorded a relative abundance of 10.96% in mangrove compared to 6.54% in Nypa palm, *Neochelon falcipinnus* had 9.84% in Mangrove and 4.41% in Nypa palm and *Ethmalosa fimbriata* had 9.74% in Mangrove compared to 5.33% in Nypa palm. Even less abundant species followed this trend, such as *Eleotris vittata* (0.46% and 0.05%) and *Sphyraena afra* (0.76% and 0.10%) in Mangrove and Nypa palm ecosystems respectively (Table 5).

Table 6: Relative Abundance (%) of Bird Species in both Mangrove and Nypa palm Ecosystems

S/N	Scientific Name	Common Name	Mangrove	Nypa palm
1	*Actitis hypoleucos*	Common Sandpiper	3.41	0.90
2	*Ardea cinerea*	Grey Heron	1.25	1.16
3	*Butorides striata*	Striated Heron	5.29	3.94
4	*Ceryle rudis*	Pied Kingfisher	3.58	1.88
5	*Corythornis cristatus*	Malachite Kingfisher	3.23	2.06
6	*Egretta garzetta*	Little egret	6.72	5.11
7	*Eurillas virens*	Little Greenbul	6.09	3.85
8	*Halcyon malimbica*	Blue-breasted kingfisher	1.08	0.63
9	*Lophoceros faciatus*	West African Pied Hornbill	2.33	1.34
10	*Numerius phaeopus*	Eurasian whimbrel	5.47	2.60

11	*Ploceus cucullatus*	Village Weaver	11.83	7.17
12	*Psittacus erithacus*	African grey Parrot	1.72	
13	*Pycnonotus barbatus*	Common Bulbul	7.53	5.02
14	*Scorpus umbretta*	Hamerkop	3.41	2.96

Bird species abundance were consistently higher in the mangrove ecosystem than in the Nypa palm (Table 6). In this study, *Ploceus cucullatus* recorded 11.83% in mangrove compared to 7.17% in Nypa palm, *Pycnonotus barbatus* had 7.53% in Mangrove and 5.02% in Nypa palm, *Egretta garzetta* 6.72% and 5.11% in Mangrove and Nypa palm respectively. Similarly, other species followed this same pattern, though *Ardea cinerea* showed nearly equal abundance (1.25% in mangrove and 1.16% in Nypa palm). A key difference was that *Psittacus erithacus* occurred only in the mangrove (1.72%) and was absent in Nypa palm (Table 6).

Table 7: Relative Abundance (%) of Wildlife Species in both Mangrove and Nypa palm Ecosystems

S/N	Scientific Name	Common Name	Mangrove	Nypa palm
1	*Cercopithecus mona*	Mona Monkey	58.97	28.21
2	*Varanus niloticus*	Nile monitor lizard	12.82	

The wildlife data showed very low species diversity, with only two species recorded (Table 7). Mona monkey (*Cercopithecus mona*) were present in both habitats but were much more abundant in the mangrove ecosystem (58.97%) than in the Nypa palm ecosystem (28.21%). On the other hand, the Nile monitor lizard (*Varanus niloticus*) occurred only in the mangrove with an abundance of 12.82% and was completely absent in the Nypa palm habitat (Table 7).

Research Question three (3): How do local communities perceive the ecological and livelihood impacts of Nypa palm expansion?

Table 8: Results from Knowledge Attitude Perception Assessment (KAP)

Indicator	Results
Total Respondents	50
Male Count	26
Female Count	24
Average Years in Kono	15.34
Aware of Nypa (%)	0.8
Negative Impact (%)	0.36
Decrease in Fish Catch (%)	0.36
Income Decrease (%)	0.34
Farmland Loss (%)	0.54
Support for Management (%)	0.38
Average Rating	2.98

The socio-economic results are presented in Table 8. The results indicated that the study involved 50 respondents (26 males and 24 females). The respondents were very familiar with the area, with an average residence duration of 15.34 years in Kono. The results showed that awareness of Nypa palm invasion was extremely low, with only 0.8% reporting awareness. However, perceived

environmental and livelihood impacts were more pronounced. A significant number of respondents reported negative impacts (36%), including a reported decline in fish catch (36%). Additionally, 34% reported a decrease in income. 54% of respondents reported farmland loss. Despite these challenges, only 38% expressed support for management interventions. The average rating of 2.98 indicates a generally moderate perception of the overall situation (Table 8).

3. Discussion of Findings

3.1. Relative Abundance of Plant and Animal Species

The study further showed that most plant and animal taxa had higher relative abundance in mangrove ecosystems than in Nypa palm habitats. For plants, native mangrove species contributed substantially to total abundance in mangrove sites, while the Nypa ecosystem was strongly dominated by *Nypa fruticans*. Such dominance patterns are typical of invasive species, where one species monopolizes available resources and suppresses coexistence. Ecologists describe this as biotic homogenization, where ecosystems become increasingly dominated by a few widespread species (Olden *et al.,* 2022). Among the macro-invertebrates, *Tympanotonus fuscatus* (periwinkle) was highly abundant in mangrove habitats but drastically reduced in Nypa sites. This is ecologically important because periwinkles are common indicators of healthy West African mangroves and depend on muddy substrates enriched by leaf litter and detritus. Native mangrove litter contributes significantly to benthic productivity and nutrient cycling. Since Nypa palm produces lower-quality litter and different sediment conditions, invertebrate abundance may decline (Lee *et al.,* 2022). Macro-invertebrates responded strongly to differences between the mangrove- and Nypa-dominated habitats. Mangrove ecosystems accumulate organic matter, provide complex root structures, and stabilize sediments, creating favourable conditions for benthic macro-invertebrates. The significantly different abundances observed between habitats suggest that habitat characteristics, rather than short-term sampling variation, were the primary drivers of macro-invertebrate distribution.

The study also shows that fish abundance varied between the mangrove-dominated and Nypa-dominated ecosystems (Table 5). Mangrove habitats are recognized as important nursery grounds because their aerial roots provide shelter from predators, breeding sites, and abundant food resources. Consequently, differences in habitat structure and productivity between mangrove forests and Nypa stands are likely to influence fish abundance. Species such as mudskippers, mullets, tilapia, and catfish were more numerous in native mangrove sites. Recent studies have confirmed that mangrove forests are among the most valuable nursery habitats for tropical fisheries (Sheaves *et al.,* 2021; Worthington & Spalding, 2023). Therefore, replacement of mangroves by Nypa may negatively affect fish productivity.

The extensive aerial root systems, multiple vegetation strata, and greater floristic diversity create a wide range of feeding, nesting, perching, and roosting opportunities for birds. These habitat characteristics also support abundant aquatic organisms and invertebrates, which serve as food resources for many resident and migratory bird species. Consequently, higher bird abundance in mangrove habitats is ecologically plausible and aligns with the recognized role of mangrove forests as biodiversity hotspots in tropical estuaries. The occurrence of *Psittacus erithacus* only in mangrove habitat may indicate sensitivity of some forest-associated birds to habitat change according to Ma *et al.,* 2021. Wildlife abundance was similarly reduced in Nypa palm ecosystem. Mammals and reptiles often depend on connected forest cover, food resources, and undisturbed habitat. IPBES (2023) reported that habitat modification caused by invasive monocultures can reduce occupancy of larger vertebrates. Unlike the other biodiversity groups examined in this

study, wildlife abundance did not differ significantly between the mangrove-dominated and Nypa-dominated ecosystems.

3.2. Ecological Impact Assessment of Nypa palm on the community

The socio-economic findings revealed extremely low awareness of Nypa palm invasion among respondents in Kono, despite clear recognition of its impacts. This suggests that local people may observe environmental change without identifying the invasive species as the driver. Similar findings have been reported in many coastal communities where invasive species management is hindered by low awareness and limited extension services (Shackleton *et al.,* 2020).

Respondents reported declining fish catch, reduced income, and farmland loss. These findings are in line with the ecological results showing lower fish abundance and habitat quality in Nypa palm ecosystem. When mangroves decline, fisheries productivity often falls because nursery habitats are lost. The FAO (2022) emphasized that coastal livelihoods in developing nations remain strongly linked to mangrove ecosystem health. Previous studies have linked Nypa expansion with reduced access routes, navigation difficulty, and land-use conflicts (Numbere & Mason, 2019).

Only a minority of respondents supported management intervention. This may reflect weak awareness, lack of policy implementation, or uncertainty about alternatives. Community support is essential for successful invasive species control or management. Recent conservation works emphasizes active participation, livelihood incentives, and local communities' education as key strategies for restoring invaded wetlands (IUCN, 2023).

4. Conclusion

The findings in this research demonstrates that habitat type was the principal factor associated with differences in abundance across most of the biodiversity components assessed. Native mangrove habitat supported significantly greater abundance of plants, macro-invertebrates, fish and birds than the Nypa-dominated habitat, while wildlife abundance did not differ significantly between habitats. The findings of this study demonstrate that native mangrove ecosystems supports higher biodiversity, greater abundance, richer plant communities and stronger livelihood benefits than Nypa palm dominated habitats.

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