Wetland Ecosystems: Hotspots for Biodiversity

A Keynote Address delivered by Prof. Nenibarini Zabbey* at the Ecological Society of Nigeria (ECOSON) Hybrid Conference 2024 held at the Delta State University, Abraka, Nigeria, 5 – 9 May 2024.

Summary

Globally, habitat loss is driving species extinction and depletion of livelihood support systems. This is the case with the Niger Delta, the world's third-largest wetland, and other wetlands in Nigeria. Wetlands are critical ecological hotspots renowned for their diverse flora and fauna. The Niger Delta also has the largest expanse of mangroves in Africa, the fifth largest in the world. It is a center of endemism. This keynote speech provides an overview of wetland ecosystems in the Niger Delta, with a specific emphasis on the mangrove ecosystem. Firstly, efforts are made to highlight the exceptional biodiversity found within the wetlands of the Niger Delta, especially in the mangrove ecosystems. These ecosystems support various plant and animal species, ranging from mangroves and mangrove-associated plants and mammals to birds, reptiles, finfish, shellfish, and other invertebrates. Wetlands also render numerous ecosystem services, including food production, nutrient cycling, water purification, flood regulation, carbon sequestration, shoreline stabilization, and cultural functions. However, despite their socio-ecological importance, wetlands face increasing threats from human activities. Oil and gas exploration, deforestation, pollution, overexploitation of natural resources, and habitat loss are among the key anthropogenic pressures debasing the integrity of wetlands. In response to these challenges, this keynote speech explores various conservation and management strategies to safeguard wetlands. A case in point is the large-scale restoration of oil-degraded mangroves and shoreline clean-up in Ogoniland by the Hydrocarbon Pollution Remediation Project (HYPREP). Other sustainable management strategies include establishing protected areas, community-based conservation initiatives, integrated watershed management approaches, and policy reforms to promote sustainable development and environmental stewardship. By prioritizing the protection and restoration of these vital habitats, we can ensure the continued provision of ecosystem services, safeguard biodiversity, and promote the well-being of human communities.

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Introduction

The Niger Delta region of Nigeria is globally recognized for its extensive wetland ecosystems, which serve as critical hotspots for biodiversity. This keynote speech explores the ecological significance of wetlands in the Niger Delta, examining their diverse flora and fauna, the ecological processes that sustain them, and the anthropogenic threats they face. This paper aims to underscore the importance of preserving these unique ecosystems to achieve biodiversity conservation and sustainable development.

The Niger Delta is characterized by a complex network of wetlands comprising mangrove forests, freshwater swamps, tidal flats, and estuaries (Wekpe et al., 2024). These wetland ecosystems play a pivotal role in supporting biodiversity, providing habitat for various plant and animal species. However, the ecosystem has been undergoing tremendous change occasioned by oil exploration, rapid urbanization, industrialization, conversion for settlement, and agricultural expansion, exerting significant pressure on these fragile ecosystems, threatening the integrity and the services they provide to both human communities and the environment (Ogbeibu and Oribhabor, 2023). Oil exploration, for example, has degraded immeasurable hectares of mangroves, thereby depleting mangrove ecosystems (Sam et al., 2023; Uche et al., 2023), limiting biodiversity and the services they provide (Pegg and Zabbey, 2013). In the Ogoni area of the Niger Delta, over 3,000 hectares of mangroves have been degraded by oil-related activities. Approximately 27% of the global oil impact on mangroves has occurred in the Niger Delta (Duke, 2016).

The Niger Delta wetlands are characterised by exceptional biodiversity, hosting a diverse assemblage of flora and fauna adapted to a range of aquatic and terrestrial habitats. Mangrove forests, with species such as *Rhizophora* spp., *Avicennia germinas*, *Laguncularia racemosa*, and *Conocapus erectus*, dominate the coastal fringes of the delta and provide critical nursery grounds for fish and crustaceans (Sarada and Okosodo, 2024). These mangrove habitats support a variety of bird species, including grey parrots, kingfishers, cormorants, hammerheads, egrets, herons, Senegal coucal, palm-nut vulture, hooded vulture, and endangered species (e.g., Anambra Waxbill). In addition to avifauna, the wetlands harbour numerous mammalian species, including the West African manatee (*Trichechus senegalensis*), African dwarf crocodile (*Osteolaemus tetraspis*), mona monkey, speckle-spotted otter,

long-nose mongoose, Egyptian mongoose and various species of primates, rodents, reptiles (e.g., West African black mud turtle, green turtle, and loggerheads) and amphibians. The freshwater swamps and floodplains of the Niger Delta are inhabited by an array of amphibians, reptiles, and fish species, some of which are endemic to the region. Furthermore, the estuarine and marine environments support diverse aquatic communities, including mollusks, crustaceans, and commercially important fishes.

The wetland ecosystems perform a myriad of ecological functions that are vital for both natural and human systems. These include nutrient cycling, water purification, sediment trapping, flood regulation, shoreline stabilization, and fish production functions. Mangroves are excellent breeding and nursery grounds for commercial fishes. Estimates show that 80% of global fish catch depends directly or indirectly on mangroves. Mangrove forests, with their extensive root systems, act as buffers against coastal erosion and storm surges, protecting coastal communities and infrastructure. Also, mangrove wetlands serve as important carbon sinks, sequestering 11% of terrestrial carbon and helping to mitigate climate change. The intricate network of waterways in the delta facilitates the movement of nutrients and energy, supporting the productivity of adjacent terrestrial and aquatic ecosystems. Thus, wetlands provide invaluable ecosystem services to local communities, including fisheries, agriculture, tourism, and cultural heritage (Dabalà et al., 2023).

Despite their ecological importance, wetland ecosystems in the Niger Delta are under severe threat from anthropogenic activities. Oil pollution results in habitat degradation and biodiversity loss. Oil spills (caused by sabotage, artisanal refining, pipeline rupture, and human error) and gas flaring have polluted waterways and disrupted ecosystem functioning, leading to declines in fish stocks and degraded mangrove forests. Oil released into the environment enters the roots and leaves of mangrove trees, suffocating them and preventing oxygen exchange, which leads to their death (Numbere, 2023). The toxic components of crude oil also contaminate the sediment and water, further inhibiting the growth of mangroves and disrupting the ecosystem's delicate balance. Before and after oil spill studies of benthic macrofauna in Bodo Creek revealed 81% loss of the animals three years post spills (Zabbey and Hart, 2014; Zabbey and Uyi, 2014). It is important to highlight that deforestation and land conversion for agriculture, urban development, and infrastructure projects have further

exacerbated wetland habitat loss and fragmentation in the Niger Delta. Pollution from domestic, industrial, and agricultural sources has degraded water quality, posing risks to aquatic life and human health. Additionally, overexploitation of natural resources, such as overfishing and unsustainable logging, has further pressured wetland biodiversity.

The infrastructure associated with oil exploration, such as roads, pipelines, drilling platforms, and road construction, fragments and disrupts mangrove habitats (Zabbey et al., 2020). Clearing mangrove forests to make way for these structures directly removes important habitats for numerous plant and animal species. It increases erosion and sedimentation, altering the delta's hydrology and leading to further habitat degradation. Additionally, the noise, pollution, and human disturbances associated with oil exploration activities can disrupt the breeding, feeding, and migration patterns of wildlife, further exacerbating the ecological impacts on mangrove ecosystems in the Niger Delta. Mangrove ecosystems support traditional livelihood structures and preserve the cultural heritage of the communities. Thus, a nexus exists between mangrove loss and increased poverty and exacerbated social vices in our local communities.

Considering the scale of ecological damage in the region, urgent actions are needed to halt further degradation and rehabilitate and restore degraded mangrove ecosystems and other wetlands. The Hydrocarbon Pollution Remediation Project (HYPREP), a project of the Federal Ministry of Environment (HYPREP) is currently undertaking the most extensive restoration programme of oil-degraded mangrove globally. In 2011, UNEP launched a classic report on the Environmental Assessment of Ogoniland, which indicated significant oil damage to the area’s shoreline, especially mangrove biodiversity and associated ecosystem services, with profound limitations on the livelihoods of the region’s population. HYPREP was created by the Nigerian government in 2016 to implement the recommendations of the UNEP report and clean up oil spills in Nigeria. HYPREP’s roles include restoring Ogoniland's oil-degraded environment and livelihoods to promote peacebuilding, social security, and sustainability. As part of HYPREP’s efforts to remediate the oil-contaminated shoreline and restore the mangroves, it carried out a Rapid Shoreline Cleanup Assessment Technique (SCAT) and chemistry sampling across 18 shoreline communities of Ogoniland, covering 5,876.23 ha to ascertain visual pit oiling in sediments and

baseline concentrations. Total petroleum hydrocarbon (TPH) and polycyclic aromatic hydrocarbons (PAHs) levels of 52,842 mg/kg and 189 mg/kg, respectively, have been recorded. In the tidal flats of Bodo Creek, TPH in the class C4 – C44 before cleanup ranges between <5000 – 100,000 mg/kg (Little *et al*., 2018). An area of 1,818.56 ha of the impacted shoreline had been delineated by HYPREP into working grids for cleanup using a controlled mechanical flushing technique. Similarly, pilot rehabilitation of 560 ha of naturally attenuated mangrove area is underway. The HYPREP mangrove restoration initiative is ecologically sound as the natural zonation pattern of the red, black, and white mangroves is mimicked. To mainstream participation and ownership of the mangrove rehabilitation process, Ogoni youths and women have been trained in mangrove restoration techniques and provided grants to establish mangrove nurseries. We called them mangrove vanguards. The vanguards are now supplying the mangrove seedlings to the mangrove revegetation contractors. The vanguards are also involved in planting and monitoring the planted mangroves. HYPREP's Ogoniland shoreline cleanup and mangrove rehabilitation is the world's largest restoration of oil-damaged mangrove ecosystems. HYPREP has also published user-friendly manuals for mangrove restoration in the Niger Delta.

Despite HYPREP's efforts to conserve and sustainably manage wetland ecosystems in the Niger Delta, success will require a multi-faceted approach that addresses both ecological and socio-economic dimensions. Key conservation strategies that need to form the foundation of policy instruments should include establishing and expanding protected areas, such as national parks, wildlife reserves, and marine protected areas, to safeguard critical habitats and species. Community-based conservation initiatives involving local communities in resource management (co-management) and decision-making processes have shown promise in promoting sustainable livelihoods and biodiversity conservation. Citizen stewardship and community science should be prioritized (Zabbey et al., 2021). Mobilizing citizens' actions for environmental sustainability and using non-science citizens to collect scientific data through training to bridge data scarcity for improved management is essential. Individual conservation and restoration action counts. For example, three years ago, I rescued eight West African mud turtles (*Pelusios niger*) from a hunter, sensitized him, and placed him on a monthly stipend to dissuade him from further exploiting the turtle bed he discovered in a swampy section of a sacred forest in Ogoniland. Plans are underway to resettle

the turtles from my house *refugium* to a relatively safe wetland in Ogoniland. A low-tech eco-friendly vivarium is being constructed at the chosen swamp for the resettlement. The hunter has been recruited and trained to work on the ongoing shoreline cleanup in the area. However, the source forest is in dire need of protection to protect the turtle bed.

Integrated catchment management approaches, focusing on holistic management of land and water resources, are essential for addressing upstream threats and mitigating downstream impacts on wetlands (Tang and Adesina, 2022). Non-governmental organizations must be incorporated to lead awareness programmes and champion behavioural changes towards sustainable natural resource use and avoidance of harmful ecological norms. We must prioritize policy reforms, awareness creation, enforcement of environmental regulations, and corporate accountability to prevent further degradation of wetland ecosystems and promote sustainable development in Nigeria.

In conclusion**,** wetland ecosystems in the Niger Delta are invaluable reservoirs of biodiversity and provide essential ecosystem services to both human communities and the environment. However, these ecosystems are under increasing pressure from anthropogenic activities, threatening their integrity and the services they provide. Urgent action is needed to conserve and sustainably manage wetland biodiversity in the Niger Delta, including the implementation of effective conservation measures, the promotion of sustainable livelihoods, and the enhancement of stakeholder participation in decision-making processes. By safeguarding wetlands, they will continue to provide ecosystem services and conserve biodiversity for the present and future generations. Therefore, I charge members of ECOSON to provide leadership in awareness raising and local ownership of wetlands, build local capacity (citizen science) for wetland restoration and conservation, and continue to conduct cutting-edge research (combining indigenous knowledge and conventional science) on wetland biodiversity. They should evolve and test ecological theories for contextual knowledge development of wetland science and advancement of data-driven wetland policy and practice in Nigeria.

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