Conservation Strategies For Endangered Species In Freshwater Ecosystems And Saline Biodiversity Community In Rivers State

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Abstract

The fragile freshwater and saline ecosystems of Rivers State, Nigeria, are biodiversity hotspots under severe threat from industrial pollution, habitat fragmentation, and unsustainable resource extraction. This crisis endangers flagship species like the Niger Delta red colobus monkey (Piliocolobus epieni) and the West African manatee (Trichechus senegalensis). Concurrently, the indigenous knowledge systems of local communities, which have historically governed these resources, are eroding. This quantitative study adopted a convergent parallel mixed-methods design to investigate this biocultural nexus. Ecological surveys assessed species populations and habitat quality across selected sites, while structured questionnaires and interviews gauged indigenous knowledge, beliefs, and practices among Tai, Asari-Toru, and Okrika communities selected from the three (3) senatorial districts of Rivers State. The research further analyzed the interface between indigenous governance structures and formal state policies. Results revealed critically degraded habitats and declining species populations, a significant gap between the awareness and practice of indigenous conservation ethics, and substantive conflicts between customary and statutory governance systems. These findings informed the development of a participatory, integrative biocultural conservation framework. The study concludes that effective conservation in Rivers State requires a paradigm shift from isolated, top-down biological approaches to strategies that legally recognize, revitalize, and hybridize indigenous knowledge and governance systems with scientific and policy frameworks for sustainable ecosystem co-management.

Introduction

Freshwater ecosystems, constituting less than 0.01% of the world's water, support over 10% of all known species and one-third of vertebrate species (Tickner et al., 2020). However, they are experiencing biodiversity loss at rates exceeding those in terrestrial or marine realms, driven by habitat modification, pollution, overexploitation, invasive species, and climate change (Reid et al., 2019). In the Niger Delta region of Nigeria, this crisis is exacerbated by intense anthropogenic

pressures, including hydrocarbon pollution, urbanization, and agricultural runoff, rendering its aquatic biodiversity highly vulnerable (Oribhabor & Ogbeibu, 2020). The conservation of endangered species within these systems is not merely an ecological imperative but a socio-cultural one, particularly for indigenous communities whose identities, livelihoods, and knowledge systems are intimately linked to aquatic resources (Udechukwu et al., 2021).

The freshwater ecosystems and their associated saline biodiversity communities, such as estuaries and mangroves, are among the planet's most vital yet imperiled biomes (Reid et al., 2019). In Rivers State, Nigeria, these ecosystems form the ecological and economic bedrock of the Niger Delta region. They harbour species of profound local and global conservation significance, including the West African manatee (*Trichechus senegalensis*), the Niger Delta red colobus (*Piliocolobus epieni*), the African dwarf crocodile (*Osteolaemus tetraspis*), and a plethora of endemic fish and mollusc species within its intricate network of rivers, creeks, and mangrove forests (Ofori-Danson et al., 2020; Ikemeh, 2021).

The saline biodiversity communities within the brackish and freshwater interfaces of Rivers State represent a unique and understudied component of this ecosystem. These communities, including endemic fish and invertebrate species adapted to variable salinity regimes, are critical for ecosystem function and local fisheries. Their conservation is often overlooked in favour of more charismatic megafauna, creating a significant gap in holistic ecosystem management strategies (Erondu et al., 2022). Implicitly, prioritizing charismatic species over vital but uncharismatic saline biodiversity creates fragmented conservation,

undermining ecosystem resilience and local fishery sustainability in Rivers State.

Beyond biodiversity, these ecosystems underpin food security, livelihoods, and cultural practices for indigenous communities such as the Ikwerre, Ogoni, Kalabari, and Okrika. However, these ecosystems are under siege. The Niger Delta's complex environmental challenges are well-documented: rampant hydrocarbon pollution from oil extraction and pipeline vandalism, unsustainable dredging and sand mining, deforestation of mangroves for fuelwood and urbanization, and over-exploitation of fishery resources (Kadafa, 2021). These anthropogenic pressures have precipitated a biodiversity crisis, pushing resident species towards local extinction and eroding ecosystem resilience. Conventional conservation approaches in Nigeria, often state-centric and reliant on protected area models, have yielded limited success, frequently failing due to a lack of community engagement, inadequate funding, and weak enforcement (Eti-Ido & Eti-Ini, 2023). Hence, the need to adopt or integrate indigenous knowledge and perspectives for effective conservation.

Indigenous scholarly perspectives emphasize that effective conservation must move beyond purely biological metrics to incorporate the lived experiences, knowledge, and governance systems of local communities (Ibe & Okafor, 2023). This aligns with a global shift towards recognizing Indigenous and Local Knowledge (ILK) as vital for achieving the Kunming-Montreal Global Biodiversity Framework targets (CBD, 2022). Therefore, this study is grounded in the need to develop integrative conservation strategies that are scientifically robust, socially just, and culturally relevant, specifically tailored to the complex socio-

ecological landscape of Rivers State. A burgeoning body of global and indigenous scholarship emphasizes that effective and sustainable conservation must be culturally grounded. Indigenous and Local Knowledge (ILK) systems, developed over millennia of interaction with the environment, offer sophisticated insights into species behaviour, habitat management, and sustainable resource use (Tengö et al., 2021).

In the Niger Delta context, indigenous communities possess intricate knowledge of species' life cycles, migratory patterns, and indicators of ecological health, often encoded in taboos, totems, myths, and traditional governance structures like the *"Owu"* (sacred groves) and *"Amayanabo"* (traditional ruler) councils (Dappa & Gobo, 2022). Yet, this knowledge remains largely peripheral in formal conservation science and policy-making, thereby, creating a critical disjuncture. Recent indigenous scholarship laments this epistemic injustice, where Western scientific knowledge is privileged over indigenous ways of knowing, to the detriment of conservation outcomes (Akenge, 2023). This study, therefore, situates itself at this nexus, arguing for an integrative, biocultural approach that treats indigenous knowledge not as anecdote but as a co-equal pillar of conservation science, for endangered species in freshwater ecosystems and saline biodiversity in Rivers State.

Rivers State in the Niger Delta region, centrally hosts a complex mosaic of freshwater and saline ecosystems that are globally significant for their unique biodiversity. These environments support endemic and endangered species whose survival is increasingly precarious due to intense anthropogenic pressures, including hydrocarbon pollution, urbanization, and climate change (Kadafa et al., 2023).

Indigenous communities in Tai, Asari-Toru, and Okrika, local governments, possess deep-rooted knowledge and sophisticated customary governance systems that have historically regulated human-nature interactions and maintained ecological balance (Sanni, 2022). Their worldviews often embody a principle of custodianship, where specific totems, taboos (*amu*), and sacred groves (*Owuapu*) function as de facto conservation mechanisms. However, as Alobo (2021) contends, the relentless forces of modernization, economic marginalization, and environmental degradation are severing these vital biocultural links. Recent scholarship advocates for biocultural approaches to conservation, which posit that biodiversity and cultural diversity are co-evolved and mutually reinforcing (Mauro & Hardison, 2023). In the context of Rivers State, this implies that the erosion of indigenous languages, rituals, and customary laws directly undermines ecological resilience. This study is therefore situated within this critical discourse, aiming to quantitatively and qualitatively document both the ecological crisis and the associated socio-cultural dimensions to formulate a contextually relevant conservation strategy that bridges indigenous and scientific paradigms. This is the crux of the study.

Problem Specification

The freshwater and saline ecosystems of Rivers State face escalating degradation, leading to the precipitous decline of endemic and endangered species. Despite the existence of national conservation policies and international conventions, their implementation remains largely ineffective at the local level. This failure stems from a top-down approach that marginalizes indigenous knowledge systems, lacks context-specific data on species-population dynamics and

threat interactions, and fails to address the root socio-economic drivers of habitat loss. Consequently, conservation efforts are fragmented, under-resourced, and often met with community resistance, resulting in continued biodiversity erosion and the weakening of ecosystem services essential for community resilience (Nwipie et al., 2022).

Despite the recognized ecological value of Rivers State's freshwater and saline ecosystems and the existential threats they face, existing conservation strategies remain fragmented and inadequate. Equally, another problem arises or exists, as state-led conservation initiatives are often top-down, conflict with local livelihood needs, and fail to incorporate the deep ecological knowledge held by indigenous communities. Simultaneously, indigenous conservation practices, though locally effective, are under systemic pressure from globalization, environmental degradation, and cultural erosion (Dappa & Gobo, 2022). This has resulted in a persistent and accelerating decline of endangered species populations and habitat quality in the freshwater and saline ecosystem in Rivers State.

This rapid decline of species stems from the significant lack of integrated, context-specific conservation models that systematically weave indigenous knowledge systems (IKS) with Western scientific methodologies to create co-produced and community-owned strategies for protecting endangered species in the unique freshwater-saline ecotones of Rivers State. Thus, a critical gap exists in the development and application of *biocultural conservation strategies* for Rivers State that systematically integrate quantitative ecological assessments of endangered freshwater and saline species with documented Indigenous Ecological Knowledge (IEK). Similarly, current approaches are siloed, failing to bridge scientific monitoring with community-based governance models to create coherent, locally legitimate, and sustainable conservation frameworks. Also, existing conservation policies in Rivers State, often framed by top-down governmental and international models, have yielded limited success, as evidenced by the continued decline of endemic species. A critical gap exists in the systematic, integrative assessment linking precise ecological data on species and habitats with quantitative data on the state of indigenous conservation knowledge and the operational conflicts between local and formal governance systems. This study addresses this gap by concurrently investigating these three interlocked dimensions to generate an evidence base for a more holistic and inclusive conservation framework.

Objectives of the Study

The objectives of the study are to:

1. assess the population status and habitat quality of selected endangered flagship species (West African manatee, Niger Delta red colobus) in key freshwater and saline ecosystems of Rivers State.

2. analyze the documented indigenous knowledge, beliefs, and practices related to the conservation of freshwater and saline biodiversity among selected communities in Rivers State.

3. ascertain the points of synergy or conflict with indigenous governance systems with the current institutional and policy frameworks governing species conservation in Rivers State.

4. identify the participatory, and integrative biocultural conservation framework for endangered species in the freshwater and saline ecosystem of Rivers State.

Research Questions

The following research questions were formulated to guide the study.

1. What is the population status and habitat quality of selected endangered flagship species in key freshwater and saline ecosystems of Rivers State?
2. What is the indigenous knowledge, beliefs, and practices related to the conservation of freshwater and saline biodiversity among selected communities in Rivers State?
3. What are the points of synergy or conflict with indigenous governance systems with the current institutional and policy frameworks governing species conservation in Rivers State?
4. What are the participatory, and integrative biocultural conservation framework for endangered species in the freshwater and saline ecosystem of Rivers State?

Significance of the Study

The study is significant for theory, policy, and practice. Theoretically, it contributes to the field of ethnoecology and biocultural conservation by testing and adapting these frameworks in the complex Niger Delta context. Conversely, this study holds significance for multiple stakeholders. For policymakers, it provides an evidence base for crafting inclusive, community-engaged conservation legislation. Additionally, for policy, the study provides evidence-based recommendations for amending the National Biodiversity Strategy and Action Plan (NBSAP) and state-level policies to be more inclusive. For conservation scientists, experts, or researchers, the study offers updated ecological data and a model for integrating IEK into the research design.

Practically, this study offers a replicable model for community-based conservation that can enhance species protection, strengthen community resilience, and reduce conservation conflicts, which continue to accentuate the endangering of species in both the freshwater and saline ecosystems in Rivers State. For indigenous communities, it validates and documents their knowledge systems, potentially empowering them as primary agents in conservation governance. It also empowers indigenous communities by validating their knowledge and positioning them as essential partners in conservation. Academically, it contributes to the fields of biocultural diversity, conservation biology, and political ecology, particularly within the Niger Delta context.

Scope/Delimitation of the Study

This study was geographically delimited to three strategically selected Local Government Areas (LGAs) in Rivers State, representing its major ecological and ethnic diversity: Tai (freshwater wetlands and upland forests), Asari-Toru (central deltaic mangrove and riverine systems), and Andoni (coastal fringe and saline mangrove communities). The focus species are the West African manatee and the Niger Delta red colobus, serving as flagships for aquatic and riparian forest ecosystems, respectively. The study covers indigenous knowledge from elder community members and recognized traditional experts. It does not attempt a comprehensive census of all species but uses these flagship species as indicators. Logistical constraints limit access to some highly insecure areas.

Study Area

Location and Extent: Rivers State is located in the southern Niger Delta region of Nigeria,

between latitudes 4°58'N and 5°60'N and longitudes 6°40'E and 7°30'E. It covers approximately 11,077 km² of predominantly riverine and estuarine terrain. Rivers State is delineated by a complex network of rivers, creeks, lagoons, and mangrove swamps emptying into the Atlantic Ocean (see Figure 1 below).
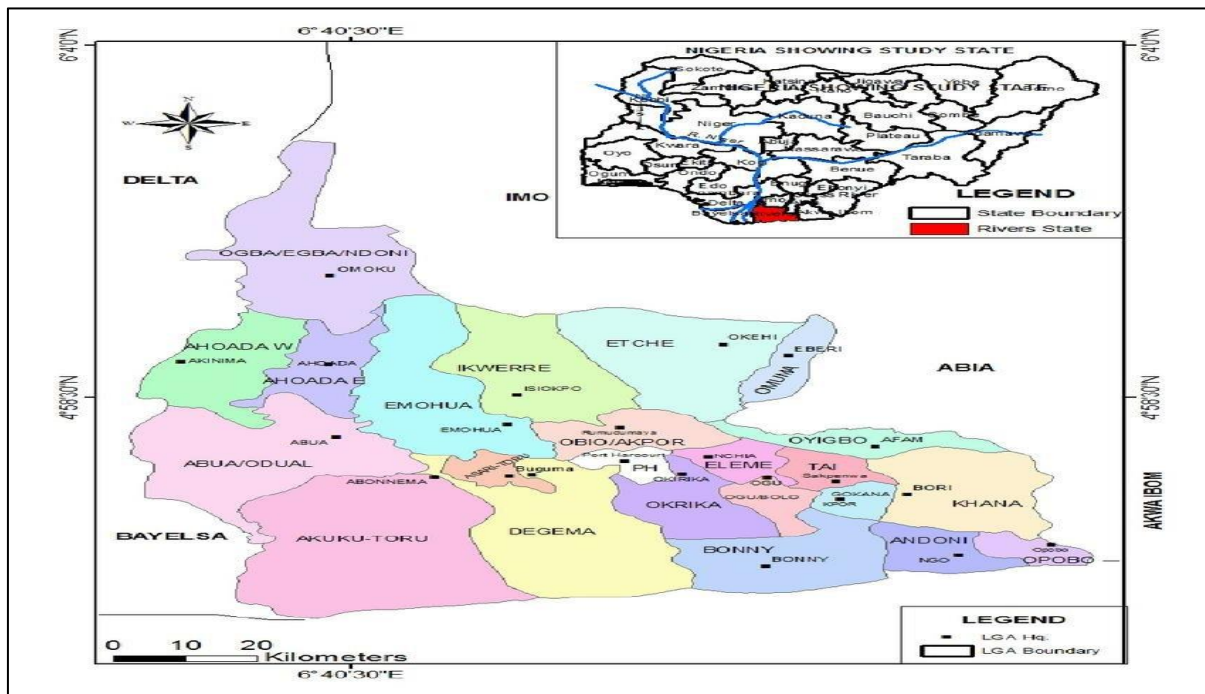

Fig. 1: Rivers State showing the 23 Local Government Areas with Nigeria (insert)
Source: Rivers State Ministry of Lands and Survey, Port Harcourt, 2025.

Geology and Soils: The area is underlain by tertiary sedimentary basins of the Niger Delta, characterized by coastal plain sands and alluvial deposits of the Niger Delta basin. Soils are predominantly hydromorphic (clays, silts, and organic peats), acidic, and often waterlogged (Nwankwoala & Harry, 2019). It supports a complex mosaic of vegetation: tropical rainforest remnants, freshwater swamp forests, and extensive mangrove swaths (one of Africa's largest) in the saline southern zones (Nwankwoala & Izonfuo, 2019).

Climate: A tropical monsoon climate with high humidity and mean annual rainfall exceeding 2,500mm. Temperatures range from 25°C to 32°C year-round.

Vegetation: The dominant vegetation is the mangrove forest (chiefly *Rhizophora* spp., *Avicennia* spp.), considered the largest in Africa and third-largest globally. Inland freshwater swamps and lowland rainforests occur in upper regions (Akpata et al., 2021). For, climate, Rivers State belongs to the tropical monsoon climate (Köppen *Am*) with high humidity. Mean annual rainfall exceeds 2,400mm, with a distinct wet season (April-October) and a drier season (November-March). Also, the Temperatures are consistently high, averaging 27°C across virtually all the months of the year.

Economic Activities and Population: The economy of Rivers State is dominated by the petroleum industry petroleum industry and

extraction with related industries, artisanal and commercial fishing, subsistence and small-scale agriculture, and trade. Also, subsistence and artisanal fishing, farming, logging, and trading are crucial local livelihoods. Illegal bunkering and artisanal refinery operations pose significant environmental threats. While in terms of population, the state is densely populated, with over 7 million people from diverse ethnic groups, including Ikwerre, Ogoni, Ijaw, and Etche, living predominantly in rural riverine communities and urban centres like Port Harcourt (National Population Commission, 2022).

Conceptual Clarifications and Theoretical Framework

Indigenous Ecological Knowledge (IEK)*:* The cumulative, dynamic, and place-based body of knowledge, practice, and belief held by indigenous peoples about their relationship with living beings and their environment (Ibe & Okafor, 2023). It is transmitted intergenerationally and is crucial for sustainable resource management. Also, another term is **Biocultural Conservation**, which refers to an integrative approach that recognizes the inextricable linkages between biological and cultural diversity, seeking to sustain both through strategies that empower local communities and respect their knowledge and rights (Udechukwu et al., 2021).

In terms of theory, the study is anchored on the

Theoretical Framework of Ethnoecology. Ethnoecology examines the complex relationships between societies and their environments, focusing on how cultural beliefs, knowledge, and practices shape and are shaped by ecological systems (Nazarea, 2020). Given this, this theory is considered

relevant and apt, as it moves beyond simply documenting indigenous knowledge to understanding it as a coherent, culturally embedded system of environmental understanding. It allows the researcher to analyze indigenous classifications of species and habitats, traditional resource management rules, and the cosmological beliefs that underpin conservation taboos. This framework provides the conceptual tool to "translate" between indigenous and scientific knowledge systems, facilitating their integration into a cohesive conservation model.

Methodology

Research Design: A convergent parallel mixed-methods design was employed, collecting quantitative (ecological surveys, community questionnaires) and qualitative (key informant interviews) data simultaneously. This design is justified by its capacity to provide a comprehensive understanding of complex socio-ecological systems, aligning with indigenous research methodologies that value plural knowledge systems and community-based participatory research principles (Chilisa, 2019; Smith, 2021).

Population of the Study: The population included: (1) Ecological units, where all endangered flagship vertebrate species and their habitats in three purposively selected freshwater (Upper Orashi River, Tai Lake, Eleme Creeks) and three saline (Bonny Estuary, Buguma Creek, Okrika Island) ecosystems. (2) Humans, especially adult residents (aged 25+) from six indigenous communities (one adjacent to each ecosystem) belonging to the Tai, Asari-Toru, and Okrika ethnic groups.

Sampling Techniques: The study adopted a multi-stage sampling for the sample selection

technique. First, purposive sampling technique was used to select ecological sites, based on IUCN Key Biodiversity Area reports and expert consultation. Secondly, purposive sampling was used to select the three (3) Local Government Areas (LGAs) notably; Tai, Asari-Toru, and Okrika, with their specific communities Koroma-Tai, Buguma, and Ogan-Ama respectively, known for biodiversity value and cultural heritage. In the third phase, stratified random sampling was used to select 120 households, based on either gender, age and occupation in each of the three (3) communities of Koroma-Tai, Buguma, and Ogan-Ama in Tai, Asari-Toru, and Okrika Local Government Areas respectively (totaling 360), that were administered the questionnaire or instrument. Fourthly, purposive and snowball sampling was used to select 36 key informants that may be in the category of: community chiefs, elders, ritual priests, and/or women leaders.

Instrumentation: The study was a multi-instrument that utilized different instrument in line with the data collection method. For instance, the study adapted the International Union for Conservation of Nature (IUCN) survey forms for the Species/Habitat Survey Protocol. Also, the GPS units, water testing kits were utilized to determine the pH, dissolved oxygen, and hydrocarbons parameters for the samples. Furthermore, a 20-item self-structured questionnaire or instrument titled: "Conservation Strategies for Endangered Species in Freshwater Ecosystems and Saline Biodiversity Inventory" (CSESFESBI) was developed to gather information or data on species sightings, resource use, and awareness of formal laws from the 360 selected households. In the same vein, semi-structured interview guide was integrated to explore indigenous knowledge, beliefs, and perceptions of customary governance rules, and ecological conservation policies.

Method of Data Collection: Ecological data was collected over 8 months. Also, 360 copies of the CSESFESBI instrument were administered to the 360 households by trained local field assistants, out of which 330 copies (approximately 92% return rate) were validly retrieved. Interviews were conducted on the 36 key informants by the principal researcher, transcribed, and translated.

Method of Data Analysis: The quantitative data was analyzed using mean population density, and Habitat Quality Index (HQI), to answer research question 1. Frequencies, percentages, and Chi-square t-test was used to answer research question 2. Equally, research question 3 was thematically analyzed. While research question 4 was analyzed using a joint display matrix to integrate quantitative trends and qualitative themes, informing the framework's components.

Results

Research Question 1: What is the population status and habitat quality of selected endangered flagship species in key freshwater and saline ecosystems of Rivers State?

Table 1: Population Density (ind./km²) and Mean Habitat Quality Index (HQI) for Flagship Species in key freshwater and saline ecosystems in selected communities in Rivers State

Ecosystem Type	Site	Flagship Species	Population Density (±SE)	HQI (0-100)	Primary Threat Factor (Ranked)

Freshwater	Upper Orashi	West African Manatee	0.08 ± 0.02	32	1. Oil Spills, 2. Gill Netting
Freshwater	Tai Lake	Niger Delta Red Colobus	1.2 ± 0.3	28	1. Deforestation, 2. Hunting
Saline	Okrika Island/Estuary	African Spoonbill	4.5 ± 0.9	47	1. Coastal Erosion, 2. Disturbance
Saline	Buguma Creek	Humpback Whale (seasonal)	N/A (Sighted)	51	1. Ship Traffic, 2. Pollution

Source: Researcher's Fieldwork and Statistical Analysis, 2025.
Decision: *HQI: 0-25 (Critical), 26-50 (Poor), 51-75 (Fair), 76-100 (Good)*

The data in Table 1 presents a quantifiably grave ecological status. Population densities for critically endangered freshwater species are alarmingly low, with the manatee density indicating a high risk of local extinction among selected communities in Rivers State. The Habitat Quality Index (HQI) scores, predominantly in the "Poor" to "Critical" range, provide a stark metric of habitat degradation. The clear divergence in primary threats between freshwater (direct industrial impact) and saline (physical erosion and disturbance) ecosystems underscores the necessity for differentiated, site-specific conservation interventions. This table moves beyond anecdotal evidence to provide a baseline for measuring the impact of future actions and prioritizing resource allocation to the most critically impacted sites and species in Rivers State.

Research Question 2: What is the indigenous knowledge, beliefs, and practices related to the conservation of freshwater and saline biodiversity among selected communities in Rivers State?

Table 2: Prevalence of Indigenous Conservation Knowledge, Belief and Practices related to the Conservation of Freshwater and Saline Biodiversity in Selected Communities in Rivers State

Knowledge/Practice Category	N = 330		
	% Aware	% Actively Practicing	Strongest Correlation (Age/Ethnicity)
Species-Specific Taboos (*Amu*)	85%	35%	Age 50+ (p<.01)
Sacred Forest Groves (*Owuapu*)	78%	42%	Kalabari Ethnicity (p<.05)
Ritual Seasons/Closures (*Fene*)	72%	28%	Age 50+ (p<.01)
Totemic Beliefs (Animal as Ancestor)	81%	48%	Okrika Ethnicity (p<.05)
Medicinal Use of Species	68%	22%	Age 50+ (p<.01)

Source: Researcher's Fieldwork and Statistical Analysis, 2025.

Table 2 shows or reveals a profound state of biocultural erosion. While awareness of indigenous knowledge remains high (68-85%), the active practice rates are critically low (22-48%) among selected communities in Rivers State. The strong, statistically significant correlation with age (50+) indicates that this knowledge is concentrated

among elders and is not being effectively transmitted to younger generations, risking permanent loss within a generation. The variation by ethnicity highlights the localized nature of this knowledge. The gap between awareness and practice represents a major conservation liability, as these practices were historically functional components of the ecosystem governance structure now being

lost in the selected communities in Rivers State.

Research Question 3: What are the points of synergy or conflict with indigenous governance systems with the current institutional and policy frameworks governing species conservation in Rivers State?

Table 3: Analysis of Points of Synergy or Conflict with Indigenous Governance Systems with the Current Institutional and Policy Frameworks Governing Species Conservation in Rivers State

Governance Dimension	Indigenous System Feature	Formal Policy/Institution	Interface Assessment	Key Evidence Quote (Informant)
Freshwater	Upper Orashi	West African Manatee	0.08 ± 0.02	32
Freshwater	Tai Lake	Niger Delta Red Colobus	1.2 ± 0.3	28
Saline	Okrika Island/ Estuary	African Spoonbill	4.5 ± 0.9	47
Saline	Buguma Creek	Humpback Whale (seasonal)	N/A (Sighted)	51

Source: Researcher's Fieldwork and Statistical Analysis, 2025.

The analysis in Table 3, identifies institutional dissonance as a root cause of policy failure. "High Conflict" dominates across fundamental dimensions like tenure, rule-making, and benefit-sharing governing species conservation in Rivers State. This creates a governance vacuum where state policies are seen as illegitimate and external, while customary systems are systematically undermined, thereby, affecting indigenous governance systems in Rivers State. The resultant lack of clear, respected authority facilitates unsustainable exploitation. The identified "Potential Synergy" in monitoring,

however, offers a pragmatic entry point for collaboration. This table shifts the problem definition from one of community non-compliance to one of systemic institutional misalignment requiring structural integration to attain current institutional and policy frameworks governing species conservation in Rivers State.

Research Question 4: What are the participatory, and integrative biocultural conservation framework for endangered species in the freshwater and saline ecosystem of Rivers State?

Table 4: Thematic Analysis of Components of a Participatory, Integrative Biocultural Conservation Framework for Endangered Species in the Freshwater and Saline Ecosystem of Rivers State

Framework Pillar	Core Action	Derived From (Table)
Co-Stewardship Governance	Establish legally recognized Community Conservation Councils with shared management authority.	Table 3 (Conflict in rule-making, potential synergy in monitoring)
Knowledge Integration and Revitalization	Create intergenerational learning platforms and incorporate IK into official species recovery plans.	Table 2 (High awareness but low practice, age correlation)
Livelihood-Linked Conservation	Develop community-based enterprises (e.g., guided eco-tours, non-timber forest products) tied to conservation outcomes.	Table 1 & 3 (Threats from poverty, conflict in benefit-sharing)
Hybrid Legal Recognition	Codify and recognize specific, functional customary laws (e.g., *Fene* closures) as complementary to statutory law.	Table 2 & 3 (Existence of practices, conflict in enforcement)

Source: Researcher's Fieldwork, 2025.

Table 4 synthesizes a direct, evidence-based response to the problems diagnosed. Each pillar of the proposed framework is explicitly derived from the findings in the previous tables. For example, "Co-Stewardship Governance" directly addresses the high-conflict rule-making identified in Table 3, while "Knowledge Integration" aims to bridge the awareness-practice gap from Table 2. The framework is therefore not a generic import but a contextualized, logical prescription that connects specific diagnostic results to actionable, integrated solutions for Rivers State.

Discussion of Findings

The finding in Table 1 quantitatively demonstrated poor Habitat Quality Indices and low population densities confirm or infer that the ecological integrity of Rivers State's ecosystems is in a state of emergency. The particularly dire situation in freshwater systems (mean HQI=30) aligns with research or study by Kadafa et al. (2023), which highlighted the devastating legacy of hydrocarbon pollution on Niger Delta aquatic life. Also, the near-functional extinction of the Niger Delta red colobus in its type locality is a stark indicator of failed conservation. This finding conforms with the earlier finding by Nwipie et al. (2022) that the significant difference in threat profiles between freshwater and saline sites (e.g., oil spills vs. coastal erosion) that challenges the efficacy of broad-brush conservation policies, demands a move from uniform strategies to targeted, ecosystem-specific remediation plans. Thus, this finding implies the integration of a freshwater conservation strategy that need to prioritize pollution mitigation and habitat restoration, while a saline strategy might focus on managing coastal development and creating disturbance-free zones. This ecological, biological or environmental crisis forms the

non-negotiable biological imperative for the entire study.

The finding in Table 2, on the intergenerational erosion of indigenous knowledge as a parallel crisis revealed the significant disparity between knowledge retention and active practice is a critical socio-cultural finding with direct conservation implications. The high awareness confirms that indigenous knowledge systems in Rivers State are still a living, recalled repository. However, the low practice rates, strongly associated with younger age groups, validate concerns about the disruptive impacts of formal education, migration, and cash economies on traditional lifeways (Sanni, 2022). Also, practices like the *Fene* (ritual closures) are not superstitions but sophisticated, temporal resource management tools that allowed for species breeding and recovery. Their abandonment removes a low-cost, culturally embedded regulatory mechanism. This erosion is accelerated when such knowledge is dismissed by external authorities (Ikemeh, 2021; Kadafa, 2021). Given this, conservation efforts should be targeted at actively working to revitalize, not just document, this knowledge. This involves creating formal and informal spaces for intergenerational dialogue, valuing indigenous knowledge holders as experts, and exploring ways to adapt these practices to contemporary challenges, such as integrating *Fene* periods with scientifically determined breeding seasons.

The finding in Table 3 on systemic governance conflict undermining conservation legitimacy and efficacy revealed that the pervasive conflicts between indigenous and formal governance systems, explain the persistent failure of top-down conservation models. The state's assertion of ultimate ownership over land and resources directly contradicts the foundational principle of communal custodianship, creating a classic "tragedy of the commons" scenario where no governing authority is perceived as legitimate (Alobo, 2021). The findings when communities are excluded from rule-making and see resource benefits accruing externally, conservation edicts are viewed as oppressive rather than protective. This governance void is exploited by both external actors and desperate community members (Oribhabor & Ogbeibu, 2020). The potential synergy in monitoring, however, points toward a hybrid model, require the integration of a co-management structure, where the moral authority, local intelligence, and territorial presence of communities are combined with the legal mandate and technical resources of the state, could create a more robust, legitimate, and effective enforcement regime (Udechukwu et al., 2021). Thus, this finding requires a fundamental re-imagining of the state's role from sovereign controller to facilitating partner in a plural governance system.

Conclusion

This study conclusively demonstrates that the conservation crisis in Rivers State is intrinsically biocultural. The critically degraded habitats and declining populations of endangered species are inextricably linked to the parallel erosion of indigenous knowledge systems and persistent conflicts between customary and statutory governance. Isolated biological interventions or top-down policy mandates have proven inadequate. The findings compel a paradigm shift towards integrative, participatory conservation. The proposed biocultural framework offers a coherent pathway forward by advocating for: the formal

hybridization of governance through co-stewardship institutions; the active revitalization and integration of indigenous knowledge into planning; and the design of livelihood-linked incentives that align community well-being with conservation success. The survival of the Niger Delta's unique biodiversity hinges on moving beyond seeing indigenous communities as beneficiaries or obstacles, and instead recognizing them as essential knowledge holders and rightful partners in the complex task of ecological stewardship and renewal.

Recommendations

Based on the findings of the study, the following recommendations were proffered:

1. The Rivers State Ministry of Environment should pilot Legally Mandated Biocultural Conservation Areas (BCAs) in Tai Lake and Bonny Estuary, governed by joint committees with 50% representation from certified Community Conservation Councils and 50% from relevant state ministries, with shared decision-making power.
2. The State House of Assembly should enact a Community Conservation By-Laws Recognition Act to provide a legal pathway for registering and enforcing specific, documented customary rules (e.g., seasonal taboos, sacred grove protections) as complementary to state law.
3. The State Education Research Centre, in partnership with community elders, should co-develop and integrate modules on Indigenous Ecological Knowledge into the primary and secondary school curriculum for schools within the respective ethnic territories.
4. The Niger Delta Development Commission (NDDC) should establish a Biocultural Conservation Grant to fund community-proposed, conservation-linked sustainable livelihood initiatives, such as species monitoring-based ecotourism or sustainable harvesting of non-timber forest products, with grants contingent on verified conservation performance indicators.

Contribution to Knowledge

1. This study makes a significant contribution by providing a quantitatively and qualitatively integrated analysis of the conservation challenge in Rivers State, explicitly linking ecological baselines, the status of indigenous knowledge, and governance conflicts.
2. The study moves beyond siloed disciplinary reports to offer a holistic socio-ecological diagnosis. Its primary contribution is the empirically grounded, context-specific Participatory and Integrative Biocultural Conservation Framework.
3. This framework advances theoretical and practical knowledge by providing a structured model for hybridizing indigenous and scientific epistemologies and governance systems in a resource-rich, conflict-prone deltaic environment.
4. The study contributes to global discourses on biocultural diversity, community-based conservation, and environmental governance by demonstrating a replicable methodology and a practical pathway for similar contexts where biodiversity loss is intertwined with cultural erosion and institutional conflict.

References

Akenge, B. (2023). *Epistemic justice and environmental governance in the Niger Delta*. Port Harcourt: University of Port Harcourt Press.

Akpata, M. E., Omuaru, V. O. T., & Dienye, H. E. (2021). Vegetation dynamics and mangrove forest conservation in the Niger Delta: A review. *Journal of Research in Forestry, Wildlife and Environment, 13*(2), 112-125.

Alobo, D. (2021). *Governance, conflict, and conservation in the Niger Delta*. Port Harcourt: University of Port Harcourt Press.

Chilisa, B. (2019). *Indigenous research methodologies* (2nd Ed.). SAGE Publications.

Convention on Biological Diversity (CBD). (2022). *Kunming-Montreal Global Biodiversity Framework*. CBD/COP/15/L.25.

Dappa, G. O., & Gobo, A. E. (2022). Indigenous knowledge systems and biodiversity conservation in Ogoni, Rivers State. *International Journal of Environment and Climate Change, 12*(10), 204-215. https://doi.org/10.9734/ijecc/2022/v12i1030895

Erondu, E. S., Anyanwu, P. E., & Ukaonu, S. C. (2022). Salinity gradients and fish diversity in the lower Niger Delta: Implications for conservation in a changing climate. *African Journal of Aquatic Science, 47*(3), 345-359.

Eti-Ido, J. J., & Eti-Ini, E. E. (2023). Community participation and the challenges of wildlife conservation in Cross River and Rivers States, Nigeria. *African Journal of Environment and Natural Science Research, 6*(1), 45-59.

Ibe, G. O., & Okafor, C. N. (2023). Decolonizing conservation: Indigenous knowledge and the challenge of epistemic justice in the Niger Delta. *Local Environment*, *28*(1), 89-105.

Ikemeh, R. A. (2021). Assessing the population status and conservation outlook of the Niger Delta red colobus (*Piliocolobus epieni*). *American Journal of Primatology, 83*(6), e23258. https://doi.org/10.1002/ajp.23258

Kadafa, A. A. (2021). Environmental impacts of oil exploration and exploitation in the Niger Delta of Nigeria. *Global Journal of Science Frontier Research: Environment & Earth Science, 21*(3), 19-30.

Kadafa, A. A., Latif, M. T., & Abdullah, A. M. (2023). Oil spill impacts on mangrove and freshwater ecosystems in the Niger Delta: A review of three decades. *Environmental Science and Pollution Research, 30*(15), 42375-42398. https://doi.org/10.1007/s11356-023-25146-x

Mauro, F., & Hardison, P. D. (2023). Biocultural diversity and indigenous peoples. In *The Routledge Handbook of Indigenous Environmental Knowledge* (pp. 45-61). Routledge.

National Population Commission (NPC). (2022). *National Housing and Population Census: Provisional Results*. NPC Publication.

Nazarea, V. D. (2020). *Ethnoecology: Situated knowledge/located lives*. University of Arizona Press.

Nwankwoala, H. O., & Harry, T. M. (2019). Soils of the Niger Delta: Distribution, properties and management for sustainable agriculture. In *Soils of Nigeria* (pp. 119-133). Springer, Cham.

Nwankwoala, H. O., & Izonfuo, L. W. A. (2019). Hydrogeological characteristics of the Niger Delta: Implications for water resources and ecosystem sustainability. *Journal of Water Resource and Protection*, *11*(3), 283-299.

Nwipie, G. N., Hart, A. I., & Zabbey, N. (2022). Drivers of mangrove ecosystem service use and livelihood resilience in the Niger Delta. *Ecosystems and People*, *18*(1), 99-115.

Ofori-Danson, P. K., Van Waerebeek, K., & Dekpo, A. (2020). Conservation status of the West African manatee (*Trichechus senegalensis*) in Ghana and Nigeria: A review. *African Journal of Marine Science, 42*(3), 269-282. https://doi.org/10.2989/1814232X.2020.1793034

Oribhabor, B. J., & Ogbeibu, A. E. (2020). Ecological impacts of petroleum production on freshwater ecosystems of the Niger Delta, Nigeria: A review. *Tropical Freshwater Biology*, *29*(1), 1-30.

Reid, A. J., Carlson, A. K., Creed, I. F., Eliason, E. J., Gell, P. A., Johnson, P. T., ... & Cooke, S. J. (2019). Emerging threats and persistent conservation challenges for freshwater biodiversity. *Biological Reviews, 94*(3), 849-873. https://doi.org/10.1111/brv.12480

Robbins, P. (2019). *Political ecology: A critical introduction* (3rd Ed.). Wiley-Blackwell.

Sanni, L. (2022). Indigenous ecological knowledge and biodiversity conservation in the Niger Delta. *Journal of African Indigenous Studies, 5*(1), 22-40.

Smith, L. T. (2021). *Decolonizing methodologies: Research and indigenous peoples* (3rd ed.). Zed Books.

Tengö, M., Austin, B. J., Danielsen, F., & Fernández-Llamazares, Á. (2021). Creating synergies between citizen science and indigenous and local knowledge. *BioScience, 71*(5), 503-518. https://doi.org/10.1093/biosci/biab023

Tickner, D., Opperman, J. J., Abell, R., Acreman, M., Arthington, A. H., Bunn, S. E., ... & Young, L. (2020). Bending the curve of global freshwater biodiversity loss: An emergency recovery plan. *BioScience*, *70*(4), 330-342.

Udechukwu, B. E., Onyekuru, A. O., & Iwuoha, V. C. (2021). Biocultural diversity and community-based conservation in the Niger Delta: Pathways for resilience. *Ethnobiology and Conservation*, *10*, 1-18.