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Assessment of the Socio-Ecological Context and Governance of the Tristao Islands Marine Protected Area

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Abstract

This study provides an integrated assessment of the socio-ecological and governance context of the Tristao Islands Marine Protected Area (Guinea), based on literature review and field surveys conducted among stakeholders, local communities, and institutional actors. The objective was to analyse biodiversity values, perceived threats, stakeholder involvement, and the legal and institutional framework governing the area. Results reveal that the Tristao MPA hosts a high ecological and socio-cultural value, characterized by diverse fishery resources, mangrove and forest ecosystems, and the presence of culturally significant sacred sites. The most frequently cited biological groups include fish, molluscs, crustaceans, mangroves, and forest species, highlighting the strong dependence of local communities on natural resources. However, the area is exposed to multiple anthropogenic pressures, including illegal fishing, nocturnal fishing, mangrove degradation, weak enforcement of regulations, and overexploitation of resources. These threats reflect the high socio-economic dependence of local populations on marine and coastal resources. Stakeholder analysis shows a multi-actor governance system involving local communities, state services, and technical and financial partners. Although community participation is significant, challenges remain in coordination, enforcement, and effective co-management implementation. The study also highlights the importance of traditional ecological knowledge, sacred sites, and customary practices in supporting conservation efforts. In addition, the legal framework, composed of national policies and international conventions, provides a strong basis for management, although its operational effec-

tiveness remains limited by local constraints. Overall, the findings emphasize the need for an integrated management approach combining ecological conservation, participatory governance, and socio-economic diversification to ensure the long-term sustainability of the Tristao Islands Marine Protected Area.

Keywords

Assessment, Socio-Ecology, Governance, Biodiversity, Natural Resources

1. Introduction

Marine protected areas are increasingly recognized as essential tools to achieve biodiversity conservation, food security, and climate mitigation objectives through the protection of critical marine ecosystems [1]. They are defined as geographically delineated marine spaces within which specific management measures are implemented to ensure the long-term protection of ecosystems and the services they provide [2].

In a context of increasing degradation of marine ecosystems, MPAs play a central role in habitat preservation, species protection, and the maintenance of ecological functions [3] [4]. Recent studies have highlighted that marine ecosystems retain considerable potential for recovery when major anthropogenic pressures are reduced and effective conservation measures are implemented [5]. However, their effectiveness largely depends on governance conditions, compliance with regulations, and stakeholder involvement. Numerous studies have therefore emphasized the need to assess not only the ecological outcomes of MPAs but also their socio-economic and institutional contexts [6]. Furthermore, global assessments of protected areas have emphasized that increasing the coverage of protected areas alone is insufficient, and that effective management, ecological representativeness, and long-term governance remain key challenges for conservation success [7].

Indeed, MPAs can generate a wide range of socio-economic impacts, both positive (e.g., diversification of livelihoods, ecotourism development, and income generation) and negative (e.g., restrictions on resource access and user conflicts). These effects largely depend on local dynamics, governance mechanisms, and the degree of stakeholder participation. Consequently, an integrated understanding of the socio-ecological context is essential for ensuring effective and sustainable MPA management.

The Tristao Islands Marine Protected Area, located in Guinea, constitutes an ecosystem of high ecological value, characterized by diverse habitats including mangroves, coastal environments, and marine ecosystems. It harbours significant biodiversity and provides essential natural resources for local communities. However, the area is subject to various anthropogenic pressures, particularly those associated with fishing activities and the exploitation of natural resources.

In this context, the present study aims to assess the socio-ecological and governance context of the Tristao Islands MPA through a combination of literature review and field surveys. Specifically, the study examines the values of the protected area, the main threats affecting it, the stakeholders involved in its management, and the institutional and policy framework governing its conservation.

2. Methods

This study was conducted to describe and evaluate the socio-ecological and governance context of the Tristao Islands Marine Protected Area.

2.1. Study Area

The study was carried out within the Tristao Islands Marine Protected Area in Guinea. The area encompasses several districts, including Katfoura, Kasmack, Kapkin, and Kadignet, where local communities are highly dependent on natural resources for their livelihoods.

2.2. Data Collection

Field surveys were conducted between 12 September and 20 December 2022. A total of 100 respondents participated in the study, comprising 80 local community members, 14 members of the MPA management committee, and 6 MPA staff. Respondents were selected using purposive sampling to ensure that participants had sufficient knowledge of the protected area, its governance, and the use of its natural resources.

The community sample consisted primarily of fishers, community elders, and women because these groups possess extensive knowledge of local fisheries, natural resources, and traditional ecological practices.

a) Literature Review

The literature review was conducted using scientific articles, technical reports, institutional documents, and grey literature obtained from the Guinean Office of National Parks and Wildlife Reserves (OGPNRF), RAMPAO, IUCN, FAO, and Google Scholar. Searches included combinations of keywords such as "Marine Protected Area", "Tristao Islands", "Guinea", "marine biodiversity", "governance", and "marine conservation". Documents were included when they provided information on biodiversity, governance, socio-economic conditions, or conservation of the Tristao Islands MPA or comparable West African MPAs.

b) Institutional Interviews

Interviews were conducted with senior staff of the OGPNRF to collect information on the management of marine protected areas in Guinea, with a particular focus on the Tristao Islands MPA.

c) Field Surveys

Field surveys were carried out among local communities in the different districts of the MPA using structured questionnaires. Two categories of questionnaires were administered:

- A questionnaire targeting local community members;
- A questionnaire targeting members of the management committee and MPA staff.

In addition, focus group discussions and semi-structured interviews were conducted with key stakeholders, including:

- District leaders;
- The President of the Local Artisanal Fisheries Council;
- Fisheries services representatives;
- Women's groups;
- Local associations.

These interviews aimed to analyse the relationships between stakeholders and the MPA, assess local governance mechanisms, and examine community perceptions regarding the management and conservation of natural resources.

2.3. Data Analysis

The collected data were analysed using descriptive approaches. Quantitative data obtained from the questionnaires were processed as frequencies and percentages using RStudio software, while qualitative data from interviews were subjected to thematic analysis.

Quantitative data obtained from the questionnaires were analyzed using descriptive statistics (frequencies and percentages) in RStudio. Citation Frequency (CF) was calculated as the percentage of respondents mentioning a given species, ecosystem, cultural site, stakeholder, or threat according to the following equation:

$$\mathrm{CF}(\%) = \frac{n}{N} * 100$$

where n is the number of respondents who mentioned a given item and N is the total number of respondents in the corresponding survey group. Because respondents could provide multiple answers, the sum of citation frequencies may exceed 100%.

3. Results and Discussion

3.1. Values of the Tristao Islands Marine Protected Area (MPA)

3.1.1. Biodiversity Values

Surveys conducted among managers of the Tristao Islands Marine Protected Area identified the main biological groups constituting the local biodiversity.

According to MPA managers (N = 14), the most frequently cited biodiversity components were fish, molluscs, crustaceans, mangroves, and forest tree species (CF = 64.5%). Marine turtles (CF = 57.2%) and waterbirds (CF = 42.9%) were also commonly cited, whereas dolphins and crocodiles (CF = 38.3%) and whales (CF = 26.0%) were mentioned less frequently (**Figure 1**).

According to local community respondents (N = 80), fishery resources constitute the principal natural resources exploited by local communities. Fish were the

most frequently reported resource (55%), followed by molluscs (17.5%) and crustaceans (17.5%), whereas forest resources were mentioned much less frequently (10%) (Figure 2).

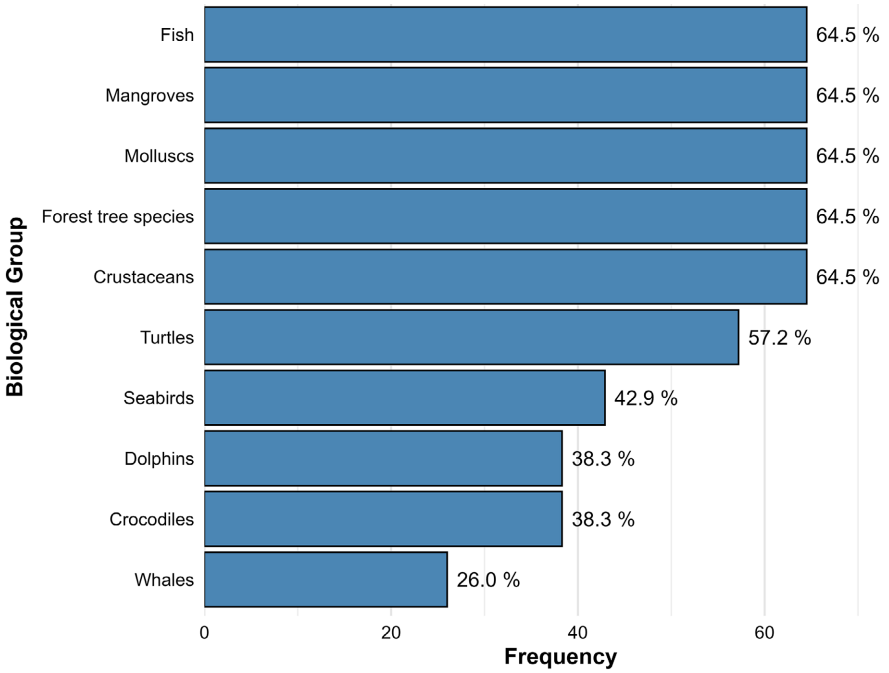

Figure 1. Biological diversity of the Tristao islands marine protected area according to managers.

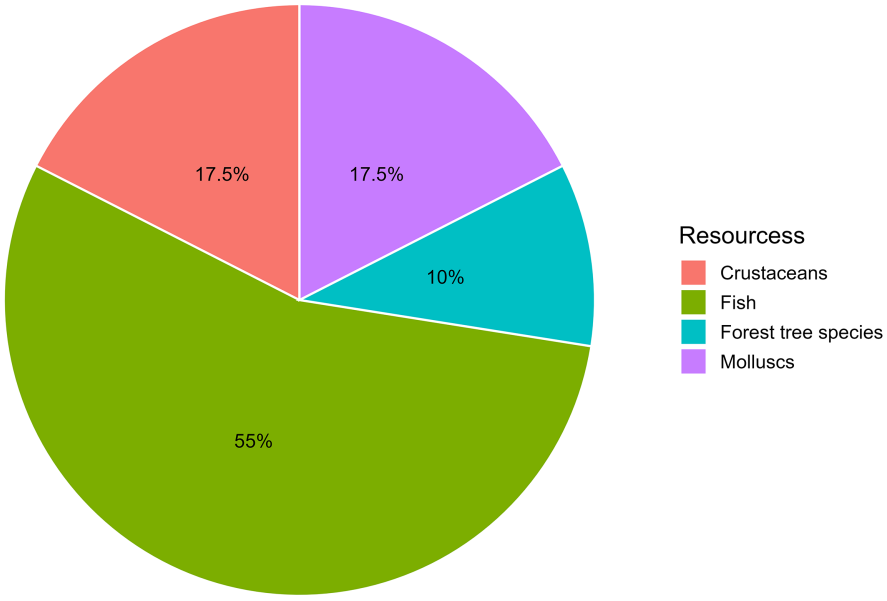

Figure 2. Distribution of natural resource exploitation by local communities in the Tristao islands marine protected area.

Historical fishery diversity was reconstructed from local ecological knowledge obtained through interviews with 80 local community members, comprising 54

fishers, 18 community elders, and 8 women (Table 1).

The results indicate a species richness of 44 species, including 33 fish species, predominantly belonging to the families Carangidae and Sciaenidae, as well as 3 mollusc species, 6 crustacean species, and 2 cetacean species.

Several species, including *Sphyraena barracuda*, *Arius heudelotii*, *Pentanemus quinquareus*, *Sardinella maderensis*, *Ethmalosa fimbriata*, *Dasyatis margarita*, and *Pristis pristis*, exhibited citation frequencies greater than or equal to 50%. Similar patterns were observed for certain mollusks (cuttlefish) and crustaceans (shrimps, particularly spiny lobster).

These findings suggest that these species played an important role in historical catches and were likely among the most abundant species in the study area.

This dominance may reflect both the historical abundance of these species and their importance in artisanal fisheries. However, it may also be influenced by a perception bias, whereby respondents are more likely to recall species that were heavily targeted or of greater commercial value.

Table 1. Historical species diversity of fishery resources prior to the establishment of the Tristao islands marine protected area (MPA).

No.	Local or Common Name	Scientific Name	Family	Taxonomic Group
1	Whale	*Balaenoptera physalus*	**Balaenopteridae**	Cetacean
2	Oyster	*Crassostrea gasar*	**Ostreidae**	Mollusk
3	Octopus	*Octopus vulgaris*	**Octopodidae**	Mollusk
4	Cuttlefish	*Sepia officinalis*	**Sepiidae**	Mollusk
5	Barracuda	*sphyraena barracuda*	**Sphyraenidae**	Fish
6	Carp	*Cyprinus sp.*	**Cyprinidae**	Fish
7	Royal Threadfin	*Pentanemus quinquarius*	**Polynemidae**	Fish
8	Sardinella	*Sardinella maderensis*	**Clupeidae**	Fish
9	Bonga Shad	*Ethmalosa fimbriata*	**Clupeidae**	Fish
10	Daisy Stingray	*Dasyatis margarita*	**Dasyatidae**	Fish
11	Marine Catfish	***Carlarius heudelotii***	**Ariidae**	Fish
12	Sole	*Cynoglossus senegalensis*	**Cynoglossidae**	Fish
13	Longneck	*Pseudotolithus typus*	**Sciaenidae**	Fish
14	Seabream	*Sparus aurata*	**Sparidae**	Fish
15	Round Scad	*Decapterus punctatus*	**Carangidae**	Fish
16	Bobo	*Pseudotolithus elongatus*	**Sciaenidae**	Fish
17	Guinea tongue sole	*Cynoglossus monodi*	**Cynoglossidae**	Fish
18	Bottlenose dolphin	*Tursiops truncatus*		Fish

Continued

19	Largetooth sawfish	*Pristis pristis*	**Pristidae**	Fish
20	Spotted puffer	*Ephippion guttifer*	**Tetraodontidae**	Fish
21	Atlantic bonito	*Sarda sarda*	**Scombridae**	Fish
22	Guinean croaker	*Pseudotolithus epipercus*	**Sciaenidae**	Fish
23	False scad	*Decapterus rhonchus*	**Carangidae**	Fish
24	African pompano	*Alectis alexandrinus*	**Carangidae**	Fish
25	Blue runner	*Caranx crysos*	**Carangidae**	Fish
26	Guinean amberjack	*Seriola carpenteri*	**Carangidae**	Fish
27	African moonfish	*Selene dorsalis*	**Carangidae**	Fish
28	Atlantic bumper	*Chloroscombrus chrysurus*	**Carangidae**	Fish
29	Round sardinella	*Sardinella aurita*	**Clupeidae**	Fish
30	Madeiran sardinella	*Sardinella maderensis*	**Clupeidae**	Fish
31	Largehead hairtail	*Trichiurus lepturus*	**Trichiuridae**	Fish
32	Royal threadfin	*Pentanemus quinquarius*	**Polynemidae**	Fish
33	Lesser African threadfin	*Galeoides decadactylus*	**Polynemidae**	Fish
34	Giant African threadfin	*Polydactylus quadrifilis*	**Polynemidae**	Fish
35	Cameroon meagre	*Pseudotolithus senegallus*	**Sciaenidae**	Fish
36	Gabonese meagre	*Pseudotolithus brachygnathus*	**Sciaenidae**	Fish
37	Sompat grunt	*Pomadasys jubelini*	**Haemulidae**	Fish
38	Atlantic emperor	*Lethrinus atlanticus*	**Lethrinidae**	Fish
39	Guinea shrimp	*Parapenaeopsis atlantica*	**Penaeidae**	Crustacean
40	Southern pink shrimp	*Penaeus notialis*	**Penaeidae**	Crustacean
41	Caramote prawn	*Penaeus kerathurus*	**Penaeidae**	Crustacean
42	Red slipper lobster	*Scyllarides herklotsii*	**Scyllaridae**	Crustacean
43	Royal spiny lobster	*Palinurus regius*	**Palinuridae**	Crustacean
44	Smooth swimming crab	*Portunus validus*	**Portunidae**	Crustacé

3.1.2. Sociocultural Values

According to survey respondents (N = 100), the Tristao Islands Marine Protected Area (MPA) hosts numerous sacred sites where traditional practices contribute to the protection of natural spaces and their associated ecosystems. These sites also present significant potential for the development of ecotourism and cultural heritage-based tourism initiatives (**Figure 3**).

The results indicate that several cultural and social practices continue to be

widely maintained by local communities, particularly at the sites of Kamounkoulouminèkatè and Kantankafonck (citation frequency [CF] = 60.0%), followed by Kafoutcha (45.2%), Koumbom (33.4%), Kamkéléwou (23.1%), Kamanbouh (16.3%), Kamkolon Nakan Groumanck (15.2%), and N'bélékéte (10.8%). These sites serve similar cultural, spiritual, and social functions, reflecting the values, beliefs, and needs of local communities. The N'bélékéte site, located in Katfoura, is specifically dedicated to ancestral practices performed by women.

Furthermore, traditional symbolic and spiritual elements are reported to be present in most of these sacred sites. In particular, the Koumbom site (Katfoura) is regarded by local populations as an ancestral heritage inherited from the Nalou people, and access to this site is strictly regulated according to customary rules. Other sacred sites, including Kamkaboum (8.33%), Kampkankatôblouck, Kam Kan, and Tôb (7.5%), as well as Kabôlekatounah (5.0%), also contribute to the cultural and spiritual landscape of the protected area.

These traditional practices play an important role in the informal conservation of natural resources by regulating access to specific areas and limiting certain forms of resource exploitation. As a result, they contribute to the preservation of habitats, species, and ecosystem functions, while reinforcing cultural identity and social cohesion within local communities.

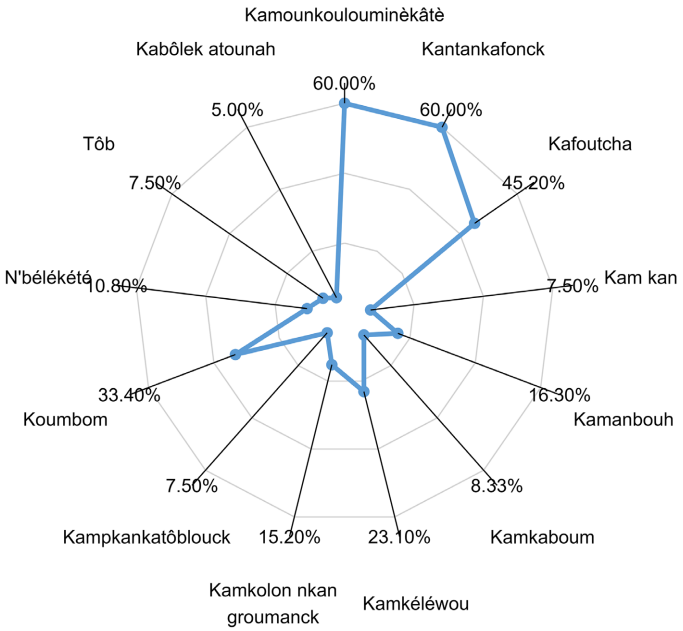

Figure 3. Sacred Sites of the Tristao islands marine protected area (MPA).

3.1.3. Ecotourism Values

According to members of the MPA management committee (N = 14) and local community respondents (N = 80), tourism in the Tristao Islands Marine Protected Area (MPA) remains at an early stage of development. In contrast, tourism is recognized as one of the main economic sectors in several other marine protected areas in the West African sub-region, where it often ranks second only to fisheries

in terms of its contribution to local livelihoods and economic development.

This limited development is mainly explained by a lack of infrastructure and organizational capacity, particularly the absence of basic visitor facilities such as hotels, campsites, restaurants, and adequate accommodation services.

Nevertheless, the area presents significant tourism potential. The scenic beauty of the landscape, combined with the presence of a relatively calm sea, represents a strong asset for the development of beach tourism. In addition, the cultural richness and ecosystem diversity offer opportunities for ecotourism and integrated rural tourism that could promote both local knowledge and natural and cultural heritage.

Furthermore, the current absence of structured ecotourism circuits within the MPA limits the full valorization of these assets. The establishment of such circuits could help promote the destination while generating income-generating activities (IGAs) based on non-extractive use of natural resources.

However, tourism development must be carefully regulated to avoid negative impacts on ecosystems and local socio-cultural dynamics. An integrated planning approach involving local communities and management institutions is therefore essential to ensure sustainable tourism development within the Tristao Islands Marine Protected Area.

3.1.4. Educational Values

The socio-cultural and economic importance of the Tristao Islands Marine Protected Area (MPA), together with its rich biodiversity, has promoted the implementation of numerous research projects since its establishment. These studies have addressed a wide range of topics and have been conducted by both university students and international organizations. Table 2 summarizes the main scientific studies carried out in Guinea that include the Tristao area, highlighting the diversity of research themes related to biodiversity conservation, protected area management, and sustainable natural resource use. These research activities demonstrate the scientific importance of the Tristao Islands MPA as a valuable site for ecological, socio-economic, and conservation research.

Table 2. Scientific research conducted in guinea including the Tristao area.

No.	Year	Author(s)/Organization	Theme
1	2019	Oumar Sadio	Threats to marine protected areas in West Africa: from uncontrolled fishing to climate change
2	2010	International Union for Conservation of Nature (IUCN)	Analysis of management approaches in a sample of 10 protected areas in Guinea: contribution to conservation
3	2008	UICN	Evaluation of the management effectiveness of protected areas

3.2. Threats

Based on interviews with MPA mangers (N = 6), the main perceived threats af-

fecting natural resources, particularly fishery resources, were identified in the Tristao Islands Marine Protected Area (Figure 4).

The results indicate that these resources are perceived as highly vulnerable to multiple anthropogenic pressures.

The most significant threats include nocturnal fishing (76.0%), followed by mangrove cutting (66.4%) and weak enforcement of sanctions (62.6%). Other important pressures include the use of motorized boats, illegal fishing activities, non-compliance with fishing restrictions within the MPA, and the use of unauthorized fishing gear (54.2%).

In addition, population growth, non-compliance with mesh size regulations, and overexploitation of resources are also considered important driving factors of pressure (48.6%). Finally, forest tree cutting and non-compliance with harvesting seasons are perceived as relatively less frequent but still significant threats (37.9%).

Percentages represent the proportion of respondents who cited each threat (multiple responses were allowed).

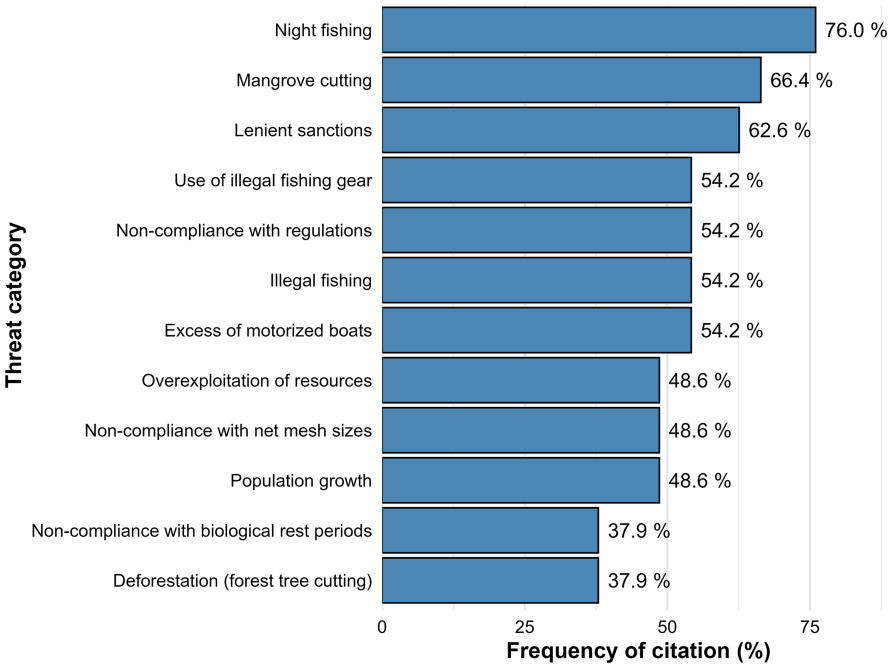

Figure 4. Main threats affecting fishery resources.

Surveys conducted among MPA managers (N = 14) revealed threat patterns broadly consistent with those identified by local communities, with particular emphasis on non-compliance with fishing restrictions (75.3%) and mangrove cutting (45.2%). Mangrove degradation was identified as a major concern due to its potential impacts on fish habitat, particularly spawning and nursery areas for several fishery species (Figure 5).

These results suggest that this coastal area has major ecological and socio-cultural importance, justifying its status as a Marine Protected Area. As in other MPAs within the RAMPAO network, the Tristao Islands MPA hosts several spe-

cies locally perceived as rare, threatened, or vulnerable, reflecting their ecological significance and cultural value within local knowledge systems.

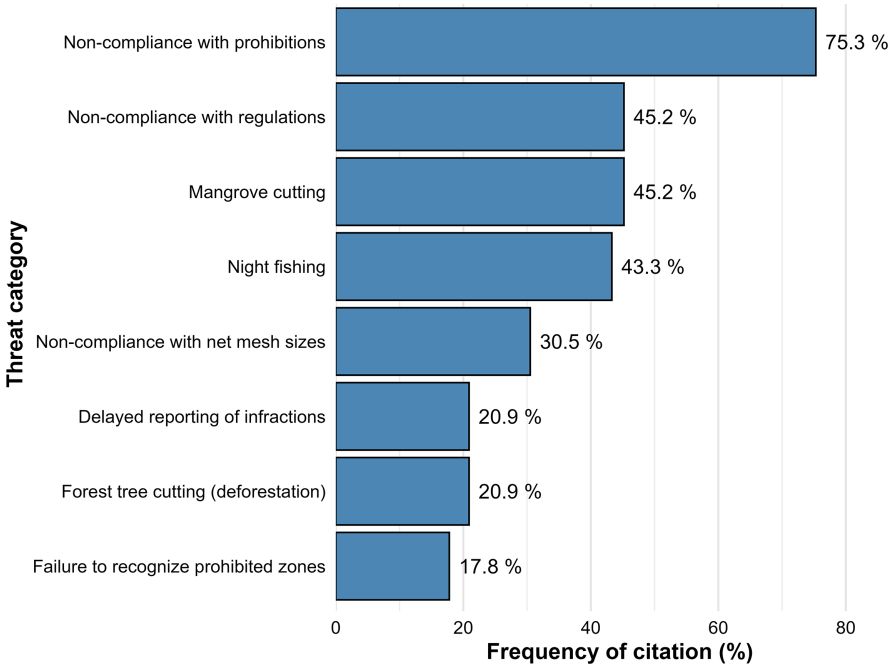

Figure 5. Threats to resources in the Tristao islands MPA according to managers.

The Tristao Islands Marine Protected Area is characterized by mangrove ecosystems dominated by species such as *Rhizophora mangle*, *Avicennia germinans*, and *Laguncularia racemosa*. These ecosystems play a crucial ecological role, particularly in coastal protection, serving as nursery habitats for fishery species, and supporting overall biodiversity. However, they are subject to strong anthropogenic pressures, mainly related to mangrove wood harvesting for fish processing and salt production.

In addition, the terrestrial part of the protected area contains several forest tree species, including *Picnanthus angolensis*, *Piptadenia africana*, *Alstonia congensis*, *Khaya grandifoliola*, *Afzelia africana*, and *Sterculia tragacantha*. These species are increasingly exploited due to logging activities and cross-border trade, particularly toward neighboring countries such as Guinea-Bissau. This situation highlights both the high socio-economic value of forest resources and their vulnerability to human pressure.

3.3. Stakeholders

Stakeholder analysis identified three main categories of actors involved in the governance of the Tristao Islands Marine Protected Area: local communities, government institutions, and non-governmental organizations/technical partners (**Figure 6**). The relative contribution of each category was calculated from the number of actors identified within each group. These findings highlight a diversity of actors participating in the governance of the protected area.

Management is ensured by a management committee composed of the main socio-professional, cultural, and religious organizations in the area. Identified stakeholders are structured into three main categories: state services, local communities, and non-governmental organizations as well as technical and financial partners.

State services represent 20.6% of stakeholders, primarily involving technicians from the Guinean Office of National Parks and Wildlife Reserves (OGPNRF) (17.2%) and the fisheries service (3.4%). These actors provide technical support and expertise, contributing to monitoring and guiding conservation activities within the MPA.

Local communities constitute the largest group of stakeholders, representing 62.1% of actors involved. They participate mainly through the management committee and eco-guards. Under the current participatory management policy, their involvement is considered essential due to their strong dependence on natural resources and their role in surveillance, reforestation, and community-based conservation activities.

Finally, non-governmental organizations and technical and financial partners support MPA management through ecosystem restoration initiatives and capacity-building activities. These actors include Guinée Écologie, sea turtle conservation associations, and the RAMPAO network.

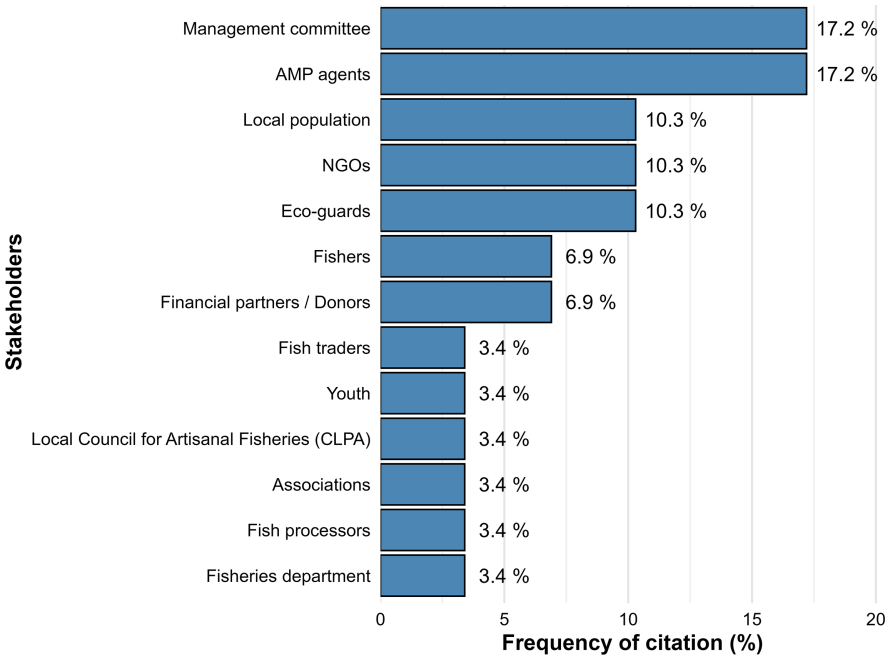

Figure 6. Stakeholders of the Tristao islands marine protected area (MPA).

3.4. Policy Context

The management of the Tristao Islands Marine Protected Area is governed by a set of national and international legal and regulatory instruments. At the national level, it is guided by the environmental sector policy as well as several sectoral legal

frameworks, including the Water Code, Fisheries Code, Hunting Code, Environmental Protection Code, Forest Code, and Urban Planning Code. In addition, the MPA is regulated by its specific internal management rules, which define its operational functioning.

At the international level, the management of the MPA is aligned with major conventions such as the Ramsar Convention on Wetlands and the Convention on Biological Diversity (CBD), which provide strategic guidance for ecosystem conservation and sustainable management.

Furthermore, the national policy for sustainable natural resource management emphasizes a participatory approach aimed at involving local communities in the governance of protected areas as well as in the equitable sharing of benefits derived from their use. This orientation is reinforced by the National Biodiversity Strategy and the National Wetlands Conservation Policy, which serve as key frameworks for implementing conservation actions.

4. Discussion

The results show that fishery resources, particularly fish (CF = 55%), constitute the most exploited natural resources by local communities. This predominance can be explained by their strong economic and social importance, as well as the fact that local livelihoods are primarily oriented toward fishing activities. In West African coastal areas, fishery resources represent a major source of income, food security, and employment for riparian communities, playing a fundamental role in sustaining rural livelihoods and national economies [6] [8] [9]. These findings are consistent with those reported by RAMPAO [10], which highlights fishing as the dominant activity in most Marine Protected Areas (MPAs) in the region, largely due to the high availability of fishery resources.

However, this strong dependence on fishery resources may increase pressure on fish stocks, particularly in the absence of effective regulatory mechanisms or livelihood diversification strategies. This raises important sustainability and governance challenges, especially regarding compliance with management measures, control of fishing effort, and the involvement of local communities in co-management processes. Community participation has been widely recognized as a key component of successful fisheries governance and the long-term effectiveness of protected areas [9] [11].

The results also highlight the central role of sacred sites in the conservation of natural resources within the Tristao Islands Marine Protected Area. Customary practices associated with these sites contribute to species protection through cultural prohibitions and belief systems, such as totems, which restrict resource exploitation. In addition, sacred forests and ponds, considered strictly no-take areas, act as effective informal conservation mechanisms. These areas function as ecological refuges, supporting biodiversity conservation and natural resource regeneration [12] [13]. These observations are consistent with RAMPAO [10], which reports that most MPAs in the region contain sites of religious or spiritual signif-

icance that contribute to biodiversity conservation.

However, the effectiveness of these traditional conservation systems may be influenced by socio-economic change, population pressure, and evolving cultural values. It is therefore essential to integrate these local practices into formal management strategies in order to strengthen co-management approaches and ensure sustainable conservation outcomes.

These studies are also important as they allow the MPA to self-assess its management effectiveness while incorporating external scientific perspectives. They further provide opportunities for students to strengthen theoretical knowledge through field experience, supporting the idea that protected areas function as "natural open-air laboratories offering significant opportunities for knowledge development" [14]. Nevertheless, it was observed that many research outputs conducted in the area are not systematically archived by the management authority. This lack of documentation limits knowledge accessibility for managers and future research, highlighting the need for a structured data management and knowledge-sharing system. Effective conservation increasingly relies on systematic monitoring, data sharing, and adaptive management to support evidence-based decision-making [7].

These findings are consistent with Cvetković *et al*. [15], who emphasize that the primary objective of protected areas is to ensure the protection and restoration of biodiversity within representative ecosystems. The results therefore confirm the central role of the Tristao Islands MPA in biodiversity conservation while highlighting the importance of local perceptions in identifying ecologically and culturally significant species.

Finally, these results are in agreement with RAMPAO [10], which notes that most MPAs in the region host ecosystems under significant pressure, particularly mangroves and palm groves, which are among the most vulnerable habitats. Mangrove ecosystems provide essential ecosystem services, including shoreline protection, nursery habitats for fish, carbon sequestration, and biodiversity conservation. Nevertheless, they continue to experience rapid degradation due to anthropogenic pressures and climate change, reinforcing the need for integrated conservation and sustainable management strategies [16].

5. Conclusions

This study provided an integrated analysis of the socio-ecological and governance context of the Tristao Islands Marine Protected Area, based on a combination of literature review and field surveys. The results highlight a high level of biological and socio-cultural richness, characterized by diverse fishery resources, mangrove and forest ecosystems, and the presence of sacred sites that play an important role in local conservation dynamics.

However, this richness is under pressure from multiple anthropogenic threats, including illegal fishing, mangrove cutting, weak enforcement of regulations, and overexploitation of natural resources. These pressures reflect a strong dependence

of local populations on natural resources and highlight major challenges for sustainable management.

Stakeholder analysis reveals a multi-actor governance system dominated by local communities, in interaction with state services and technical and financial partners. This configuration underscores the importance of co-management approaches while highlighting the need to strengthen institutional coordination and management capacity.

Furthermore, the legal and policy framework governing the MPA is relatively comprehensive, combining national instruments and international conventions such as the Ramsar Convention and the Convention on Biological Diversity. However, the effective implementation of these frameworks remains constrained by local realities and operational limitations.

Finally, the study emphasizes the potential role of traditional ecological knowledge and socio-cultural values in resource conservation, as well as opportunities for economic diversification through sustainable tourism development.

Overall, this study highlights the need for an integrated management approach combining ecological conservation, participatory governance, and socio-cultural valorisation to ensure the long-term sustainability of the Tristao Islands Marine Protected Area.

6. Limitations

This study has several limitations. First, most results are based on respondents' perceptions rather than direct ecological observations. Second, the historical species list relies on local ecological knowledge and may therefore be affected by recall bias. Third, no direct ecological surveys or biodiversity sampling were conducted to validate respondents' perceptions. Nevertheless, combining documentary evidence with interviews from multiple stakeholder groups provided a comprehensive understanding of the socio-ecological and governance context of the Tristao Islands MPA.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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