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Solution-Oriented Conservation Strategies to Mara Basin Biodiversity Extinction

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Abstract

Freshwater ecosystems are some of the most threatened on the planet. Efforts to conserve, restore, or otherwise manage riverine ecosystems and the services they provide are hampered by limited understanding of their functional dynamics. However, these ecosystems continue to face severe pressures, despite many benefits they provide to people and many conservation/restorations effort from recent efforts at local to national to global scales. Although there is no comprehensive assessment of the state of the world's remaining ecosystems, many are recognized as having deteriorated in status and to be currently degraded. This shortcoming is especially evident with regard to trophic structure and energy flow coupled with basic ecological research to alleviate the biodiversity extinction rate. Innovative conservation which is solutions-based not only focus on protecting endangered species and habitats but also emphasize the importance of integrating human needs with ecological sustainability. This holistic perspective recognizes that successful conservation efforts must engage local communities, leverage scientific advancements, and foster collaboration across various sectors. By embracing creativity and adaptability, conservationists can develop strategies that are not only effective but also resilient in the face of changing environmental conditions. This review highlights some of the solution-based conservation strategies that need to be employed in the larger Mara basin to curb the high rate of biodiversity extinction.

Keywords: Biodiversity; Conservation; Mara basin; Solution -based; Strategies

Introduction

The Mara Basin is a pivotal water catchment area extending across Kenya and Tanzania. Through its southernmost tip, the River Mara tumbles in a series of rapids down a height of approximately 2,000 meters, draining Lake Victoria (at 1,134m), one of the world's largest freshwater lakes [1]. It is of great ecological importance due to its wetlands and unique biodiversity. There are wooded and grassland savannas, as well as riverine, swamp, and montane forests, all of which are vital habitats for many species of invertebrates and vertebrates. These include many endemics, threatened, rare, and economically important species, some of which are found nowhere else on Earth (Malesse et al. 2008). It would be impossible to have the spectacle of the Mara/Serengeti migration without the River Mara and the wetlands it supports, as they are an important focal point for herbivores during the dry season and the breeding ground for several fish species [2].

The Mara Basin is endowed with rich biodiversity, a high potential for agricultural development, and a valuable natural resource base. The Mara Basin still possesses one of the last remaining wildernesses in Africa, with a great variety of wildlife. The UNESCO World Heritage site, the Serengeti-Maasai Mara ecosystem, located in the upper section of the basin, is internationally famous for the annual spectacular wildebeest migration [3]. The Mara Basin is a unique ecosystem rich in flora and fauna biodiversity, with its internationally known 'big five' and migrations of wildebeest, zebra, and crocodiles. The basin is also endowed with a diversity of large and small mammals, reptiles, birds, amphibians, and other endemic species. Additionally, there are six different forests and vegetation types, including montane, sub-montane, riparian, scrub, and savannahs.

The Basin as a Biodiversity Hotspot and Threats

At an international level, the basin is globally important because it is one of the fragile ecosystems in Lake Victoria, the Nile River, and Western Indian Ocean systems. It is also the source of permanent rivers and lakes in East Africa. At a regional level, the Mara Basin is important because it nourishes Lake Victoria, the largest tank of inland water fishery in Africa, the Nile River, and the restoration of the threatened ecosystems of Muhaka, Sabaki, and Kinbawani rivers in Kenya. At a local level, the Mara River

supports the drinking water needs of the inhabitants, irrigation for agricultural products, domestic animals, and horticultural products. It is also the source of fish, river sand, and clay. Finally, the Mara River is closely related to the livelihoods of the residents [4].

Of these, the Mara River Basin is home to a remarkably-varied fauna that includes 40 fish species, 50 invertebrate species, 4 mammals, 88 waterbirds, 126 birds connected with freshwater, 4 reptiles, 20 amphibians, and 141 vascular plants. It is noteworthy that a large number of species in this thriving ecosystem are yet unknown or poorly documented, especially in the case of fish and invertebrates, which opens the door to the possibility of discovering hundreds more. There is a serious danger of going extinct because of a dangerous confluence of factors. These threats include habitat loss brought on by development and human activity, water pollution from a variety of sources, excessive water resource extraction, the effects of droughts made worse by climate change, the presence of invasive non-native species upsetting the ecosystem, and unsustainable resource over-exploitation [4]. The future of these aquatic ecosystems is, however, clouded by the uncertainties [5]. This calls for an innovative, technology and data-driven conservation strategies to help protect this rich biodiversity hotspot.

Climate change is currently pausing a major risk to the basin and its associated habitats important to biodiversity and people's livelihoods. Wetlands within the basin are vital for the local communities as they provide water, fish, fuel wood, grazing land, and agricultural land. Wetlands are also a crucial resource for many local communities who rely on rivers for fish, game, access to freshwater, and watering points for livestock. Knowledge about the region's stresses, impacts, and risks to water, food, energy, and ecosystems linked to climate change are limited [5]. Driven by population growth and economic development, urban and industrial growth, as well as the expansion of agriculture, there is high competition for water.

The basic structure of the hydro-logical cycle in the basin is breaking down as temperatures soar to previously unheard-of heights. Rising mercury levels add a new layer of complexity to the delicate-equilibrium that has developed over generations, while also making it more difficult for essential water supplies to evaporate [6]. The implications go well beyond simple thermometric measurements, permeating the core of water security that keeps the Mara Basin alive [7].

In an era marked by rapid environmental degradation and climate change, innovative conservation solutions have emerged as critical tools for preserving biodiversity and promoting sustainable practices. These solutions encompass a wide range of strategies, from advanced technological applications to community-driven initiatives, all aimed at addressing the pressing challenges facing our planet. As the urgency for effective conservation intensifies, it becomes essential for stakeholders, including NGOs, governments, and local communities, to explore and implement these innovative approaches [8].

Innovative conservation solutions not only focus on protecting endangered species and habitats but also emphasize the importance of integrating human needs with ecological sustainability. This holistic perspective recognizes that successful conservation efforts must engage local communities, leverage scientific advancements, and foster collaboration across various sectors. By embracing creativity and adaptability, conservationists can develop strategies that are not only effective but also resilient in the face of changing environmental conditions [9]. This review highlights some of the solution-based conservation strategies that need to be employed in the larger Mara basin to curb the high rate of biodiversity extinction. Some of the strategies include:

i) Innovative research funding

While threats to biodiversity conservation are increasing due to climate change and the exploitation of land and natural resources, traditional sources for financing biodiversity protection mostly supported by public spending and private donations are becoming increasingly inadequate. Innovative financing mechanisms, such as payments for ecosystem/environmental services (PES), mechanisms for biodiversity offsetting (e.g., habitat banking), integration of biodiversity into existing fiscal instruments and different mechanisms for leveraging private funding, provide an opportunity to help to bridge the widening gap between financing needs and capacities to address these needs in the larger Mara region [10]. The existing literature at the European union level on the effectiveness of PES and offsetting schemes shows a range of aspects affecting the conservation outputs and cost-effectiveness of innovative schemes including, for instance, methodologies used to determine the payment levels, measure and monitor biodiversity losses and gains [11]. The instruments are also known to have socio-economic impacts and legitimacy issues, with payments resulting in the redistribution of benefits and/or access to ecosystems which in turn can have implications on how the payment schemes are received by stakeholders [12]. Many land owners have benefitted more so from Europe from the PES innovative program where they get financial incentives for conservation and sustainable development in the forested areas. The program has successfully mobilized private landowners to participate in conservation efforts. The program underscores the importance of aligning economic incentives with ecological goals fostering the culture of stewardship among landowners and providing that conservation can be economically viable [12]

ii) Drone technology

Numerous innovative conservation solutions have emerged globally, showcasing the potential for creativity in addressing environmental challenges. One notable example is the use of drone technology for wildlife monitoring and anti-poaching efforts [8]. Drones equipped with high-resolution cameras and thermal

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imaging capabilities allow conservationists to survey vast areas of land quickly and efficiently. This technology has proven invaluable in regions plagued by poaching, enabling real-time data collection and rapid response to illegal activities [13]. Reforestation drones are also an excellent example of using technology as an innovative solution. One of the main causes of biodiversity loss is habitat loss and fragmentation caused by deforestation, so a simple solution would be to plant more trees, however, tree planting by hand can be slow and labour intensive [9].

iii) Community-based conservation

Another compelling example is the implementation of community-based conservation initiatives that empower local populations to take an active role in protecting their natural resources [14]. In Namibia for instance, the communal conservancy model has successfully integrated wildlife conservation with community development. By granting local communities rights over wildlife management, this approach has led to increased wildlife populations and improved livelihoods for residents. Such initiatives demonstrate that when communities are engaged and incentivized, they can become powerful stewards of their environment [15]. Community conservation has been hailed worldwide as the plausible approach to meeting the needs of local people while ensuring conservation and sustainable utilisation of biological resources. Several experts have advocated for integrating local communities into protected area planning and management [16]. It has been acknowledged that protected areas cannot co-exist with communities which are hostile to them and that when placed in proper context, PAs can make significant contributions to the welfare of the people living next to them [2].

iv) Collaborations and Partnerships in Conservation

Collaboration is a cornerstone of successful conservation efforts, as it brings together diverse stakeholders with varying expertise and resources. Partnerships between NGOs, government agencies, academic institutions, and private sector entities can amplify the impact of conservation initiatives [17]. For instance, the collaboration between the World Wildlife Fund (WWF) and various corporations has led to innovative sustainability practices in supply chains, reducing deforestation and promoting responsible sourcing.

Moreover, cross-sector partnerships can facilitate knowledge sharing and capacity building among organizations working towards similar goals. The Global Environment Facility (GEF) exemplifies this approach by funding projects that involve multiple stakeholders in addressing environmental challenges. By fostering collaboration, GEF has enabled countries to implement integrated solutions that address biodiversity loss while promoting sustainable development [18].

v) Strong governance approach

To promote biodiversity conservation in Mara region, strong institutions are needed both at the national and county levels**.** The principle that biodiversity should be managed at the lowest appropriate level has led to decentralization in many parts of the world [19]. However, all levels of government need to be involved, with laws and policies developed by central governments in order to support the authority at the lower levels of government enabling them to provide incentives for sustainable resource management. Neither complete centralization nor complete decentralization of authority always results in better management [20].

In the region local norms and traditions regarding property rights and ecosystems are much stronger than the law on paper. In that case, local knowledge, integrated with other scientific knowledge, becomes critical in managing local ecosystems. International cooperation is required with increased commitments to conserve biodiversity and promote sustainable use of biological resources [21]. Indeed, to be most effective, multilateral environmental agreements should include incentives, plus sanctions in case of violations or noncompliance [22]. Moreover, synergies should be sought between different agreements. Paradoxically, international agreements that deal with economic and political issues and not directly with environmental issues often have the greatest impact on biodiversity. Such agreements need to be closely linked with other agreements in order to take into account trade-offs and impacts on biodiversity [19]. Although biodiversity loss is a recognized global problem, most direct actions to halt or reduce loss need to be taken locally or nationally [23-25].

Conclusion

In conclusion, innovative conservation solutions represent a vital pathway towards achieving sustainable environmental outcomes. By leveraging technology, fostering collaboration, and engaging local communities, NGOs can enhance their effectiveness in addressing biodiversity loss and promoting ecological resilience. As we navigate the complexities of conservation in a rapidly changing world, embracing innovation will be essential for ensuring a thriving planet for future generations.

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