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Analysing policy gaps in protecting avian species from electrocution and power-line collision in Kenya

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Summary

As countries transition from fossil fuels to renewable energy, impacts on wildlife, particularly avian species, have become a concern. In Kenya, the effects of human-made infrastructure such as power lines and wind turbines on birds have been overlooked. To prevent further loss of biodiversity, it is necessary for infrastructure development policies to consider these impacts on birds. We aim to identify gaps in current policies by analysing the intersection of wildlife conservation and power-line infrastructure development in Kenya. Through content analysis, we evaluate the effectiveness of existing wildlife protection and energy-related policies and identify strengths and weaknesses to highlight areas for improvement. Our analysis reveals that current policies neglect threats posed by power lines and other infrastructure to birds. This oversight points to challenges such as a lack of awareness among policymakers and stakeholders and a lack of legal obligation for energy institutions to implement mitigation measures; conservationists may also face conflicts with those responsible for electricity distribution. Addressing these policy gaps is essential for effective wildlife conservation and sustainable development. This paper underscores the need to integrate wildlife conservation considerations into energy infrastructure planning to mitigate adverse impacts on avian species.

Introduction

As many countries transition from fossil fuels to renewable energy sources to combat climate change (IPCC 2014), expansion of overhead power-line distribution is forecast to increase substantially, especially in developing countries. However, this anticipated growth poses pressing challenges for wildlife conservation efforts (see Dwyer et al. 2014, Smith & Dwyer 2016, Bernardino et al. 2018). As power-line networks expand, so too do the risks of electrocution and collision incidents for avian species (Biasotto et al. 2022, Guil & Pérez-García 2022). Integrating measures to address these threats into wildlife protection policies is imperative to ensure the conservation of avian populations (Antal 2010, Prinsen et al. 2012, Smeraldo et al. 2020, Therkildsen et al. 2021).

Overhead power lines significantly impact bird life, with the level of collision risk influenced by factors such as avian diversity, weather conditions, visibility and location of power-line sections relative to important bird habitats and migration routes (APLIC 2006). Furthermore, the specific design of power lines plays a crucial role, particularly in instances of electrocution (Bevanger 1998). Above-ground power lines pose three primary risks to birds. Birds perching on power poles or cables can be electrocuted if they cause short circuits, either between phases or to the ground. In flight, birds may collide with power-line cables, which are often difficult for them to perceive as obstacles; such collisions can result in immediate death or fatal injuries. Above-ground power lines cutting across open landscapes and vital bird habitats, such as wetlands and steppes, can also degrade habitat quality and fragment important feeding, breeding or hibernating areas, leading to avoidance by sensitive bird species (Northrup & Wittemyer 2013, Ngila et al. 2024).

Threats of electrocution and collision to avian species are increasingly pertinent in Kenya, as the species intersect with both infrastructural energy development and conservation initiatives aimed at preserving declining avian populations (Jon Smallie & Virani 2010). Placement of these power lines may coincide with areas suitable for avian species, resulting in fatalities due to electrocution, collision or habitat fragmentation (Bevanger 1994, Harness & Wilson 2001, Eccleston & Harness 2018, Dwyer et al. 2022). These incidents not only pose risks to avian populations but can also lead to power outages, resulting in significant financial losses for electricity provider and distributor companies (Biasotto et al. 2022). Particularly in avian species

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with slow reproductive rates such as raptors, these incidents have profound implications for population declines (Lehman 2001, Eccleston & Harness 2018).

In Africa, electrocution and collision incidents resulting from power lines and wind turbines increasingly impact avian species such as raptors, bustards, cranes and flamingos (Jenkins *et al.* 2010, Shaw *et al.* 2010, Smallie & Virani 2010, Prinsen *et al.* 2011, Smallie & Strugnell 2011, Angelov *et al.* 2013). While international policy debates have highlighted these issues (e.g., Prinsen *et al.* 2011, Loss *et al.* 2014, 2015, Bernardino *et al.* 2018), their incorporation into key policy documents related to energy and wildlife conservation in Africa remains limited. Kenya's rapid electrical infrastructure growth compared to other East African countries in the last decade makes it a critical case study for understanding the broader implications of infrastructure expansion on wildlife conservation. Its expansion through Kenya Power and Lighting Company (KPLC) has more than doubled electricity access from 26% in 2013 to 77% in 2018. In its 2023–2042 Master Plan, Kenya Electricity Transmission Company (KETRACO) underscores Kenya's commitment to sustainable energy but also highlights the need for integrated conservation strategies to mitigate biodiversity impacts (USAID 2016).

The present assessment aligns with global conservation goals such as those of the Global Biodiversity Framework (GBF) and the International Union for Conservation of Nature (IUCN). The GBF aims to address drivers of biodiversity loss and improve the status of ecosystems and species, emphasizing the need for development practices that reduce negative impacts on wildlife (SCBD 2014). Similarly, the IUCN's mission to conserve biodiversity and ensure that natural resources are used sustainably underscores the importance of mitigating risks to avian species from energy infrastructure. By examining Kenya's policy approaches to avian conservation in the context of expanding power-line networks, this study contributes to the broader objectives of these global frameworks, advocating for integrated conservation strategies that balance infrastructural development with biodiversity protection.

This study hypothesizes that current wildlife protection policies in Kenya lack specific provisions addressing the impacts of power lines on avian species, with three main predictions. First, existing policies probably emphasize general wildlife protection but inadequately address infrastructure-related risks such as electrocution and collision. Second, policy gaps may indicate a need for targeted regulations or amendments to integrate avian-specific concerns within infrastructure frameworks. Third, a comprehensive policy review will reveal opportunities to enhance collaboration between conservation and energy sectors to mitigate these risks. The present study will: (1) identify existing policies concerning wildlife protection in Kenya; (2) assess their effectiveness and highlight infrastructure-related deficiencies; and (3) examine how avian threats are addressed within current policy frameworks.

Methods

Source documents

Our analysis focuses on publicly available policy documents (Table 1) and does not encompass the policy formulation process itself. While recognizing that policies often extend beyond what is explicitly stated in written texts, we consider these documents as indicative of a governing body's stance on specific issues. To achieve a systematic review, we conducted a thorough search for

relevant documents across Google, Google Scholar and Scopus. We specifically targeted government-published reports and official documents pertaining to the issues mentioned. Our search strategy involved using a combination of specific search terms restricted to Kenya's jurisdiction. The key terms used were 'wildlife policy', 'energy policy', 'wildlife act', 'energy act', 'wildlife strategy', 'environment act' and 'climate change act'.

Policy analysis

We used content analysis (Crona & Rosendo 2011) to analyse 11 policy documents (Table 1). We recorded any prescriptive statements and provisions, along with guiding principles, related to the conservation of avian species. Specifically, we focused on the impact of infrastructural development, the importance of conservation areas and the protection of migratory birds. We then classified the statements and provisions addressing these themes in each analysed policy instrument according to their placement along a policy action gradient, ranging from the lowest category, where there is no explicit mention, to the highest category, where objectives, measures, details for implementation and monitoring and evaluation procedures are defined (Table 2).

Results

Integration of electrocution and collision threats into wildlife policy frameworks

Only four of the documents we analysed recognized the importance of protecting migratory species by preserving wildlife buffer zones, migratory routes, corridors, dispersal areas and habitats while also addressing human–wildlife conflict (HWC). The 2003 African Convention on the Conservation of Nature and Natural Resources (ACCNNR) emphasized monitoring species, including migratory species, and provided appropriate protection. However, the potential challenges posed by infrastructure development, such as power lines or wind turbines, were not adequately addressed in the avian and wildlife conservation documents.

Most policy and strategy documents (Table 3) consistently identified HWC as a prominent issue, often focusing on mitigation through community wildlife associations. These documents frequently criticized protected areas for their policy weaknesses, institutional challenges, financial limitations and struggles within the tourism sector. Calls to bridge biodiversity research gaps and involve local communities in wildlife management were common themes. The documents emphasized biodiversity conservation across diverse habitats and recognized the importance of national parks, reserves, wildlife sanctuaries and protected areas. Kenya's commitment to international agreements, such as the Convention on the Conservation of Migratory Species, was consistently mentioned.

While most documents acknowledged threats such as HWC, pollution, climate change, habitat degradation, overexploitation, poaching, illegal trade and invasive species, they rarely addressed the impacts of infrastructure on wildlife. Only the 2020 Wildlife Strategy discussed how unplanned infrastructure can destroy habitats, fragment landscapes and hinder wildlife movement, albeit without a specific focus on threats such as power lines or wind turbines. Discussions on electrocution or collision threats to wildlife are absent in documents such as the National Energy Policy, the Energy Act, the Climate Change Act and the Environmental Management and Coordination Act (Table 3).

Table 1. Source documents.

International agreements	Kenyan policy documents	Kenyan legal documents
African Convention on the Conservation of Nature and Natural Resources, Revised 2003	Wildlife Policy, 2020	Wildlife Conservation and Management Act, 2013
	Wetlands Policy, 2015	Climate Change Act, 2016
	National Environment Policy, 2013	Environmental Management and Coordination Act, 1999
	National Biodiversity Strategy and Action Plan, 2019–2030	Forest Conservation and Management Act, 2016
	National Energy Policy, 2018	Energy Act, 2019
	National Wildlife Strategy, 2030	

Table 2. Description of the categories used to classify provisions and statements in the surveyed policy documents.

Category	Description
0	No explicit mention
I	Mention of this aspect, without further statement
II	Mention broadly supportive of this aspect, but suggesting that further research is necessary
III	Objectives set for this aspect, but without further actions identified (including cases where objectives are specific targets (e.g., numeric targets), but where no further actions are detailed)
IV	Objectives and corresponding measures proposed for this aspect
V	Objectives and measures proposed for this aspect, with respective details for implementation provided, including entities responsible
VI	Objectives, measures and explicit details for implementation, with defined targets and associated monitoring and evaluation procedures

Wildlife conflict mitigation measures

The Wildlife Conservation and Management Act, the Wildlife Policy, the Wildlife Strategy, the Wetlands Policy, the Kenya Climate Change Act, the National Biodiversity Strategy and Action Plan (NBSAP) and the National Environmental Policy proposed diverse strategies, including reducing poaching, mitigating HWC, conserving priority species and adopting climate change measures. The Wildlife Strategy suggested developing an Endangered Species Act to mobilize public support and coordinate cross-sectoral conservation efforts for endangered species, aiming to create a legal framework for their protection.

The NBSAP emphasized using economic instruments to promote biodiversity conservation, including incentives to encourage conservation over habitat degradation. It outlined strategies for restoring degraded ecosystems, establishing protected areas for threatened ecosystems and increasing awareness among local communities and decision-makers. It also called for strengthening national capacities for technology transfer and promoting international collaboration to implement wildlife conservation policies. The ACCNRR highlighted the need for legislation to protect species, identifying and eliminating factors causing species depletion and establishing protected areas and forest reserves. It emphasized the responsibility of Parties to protect species unique to their jurisdictions.

Despite comprehensive strategies to mitigate threats such as habitat degradation, poaching and HWC, none of these documents explicitly addressed the significant threats posed by electrocution and collision incidents from power lines and wind turbines.

Discussion

The impacts of power lines on avian species were largely absent from Kenya’s policy documents, despite the potential to contribute to species conservation and reduce financial losses from bird-related power outages (Antal 2010). This invisibility may have stemmed from several factors. There may be a lack of awareness or understanding among policymakers about the issue’s severity. Competing priorities and resource constraints might have led to deprioritizing wildlife conservation, especially that related to infrastructure development. The complexity of addressing electrocution and collision threats may complicate policy interventions. Additionally, the absence of robust data on power lines’ impacts on avian species in developing countries may hinder evidence-based policy formulation (Martin et al. 2022). Vested interests or lobbying efforts from infrastructure industries may have also influenced policy agendas.

The limited consideration of electrocution and collision impacts from power lines and wind turbines may have substantial implications for avian species conservation. It may undermine the ability of conservation biologists and land managers to effectively combat or accommodate future environmental changes. As developing countries, including Kenya, transition to renewable energy sources amidst climate change predictions (REN21 2014), the lack of mitigation measures for avian mortality poses a challenge. Kenya’s NBSAP submitted in 1999 lacks representation of electrocution and collision issues, indicating a need for revision. There is also no mention of the impact of such infrastructures on wildlife within the NBSAP. This oversight is concerning given the expanding power transmission network in Kenya and planned connections with Ethiopia, Uganda and Tanzania (Republic of Kenya 2018).

There is inadequate recognition and discussion of bird electrocution and collision in key policy documents not only in Kenya but also in other countries in Africa (e.g., Sudan and Ethiopia; Angelov et al. 2013, Bakari et al. 2020, BirdLife International 2021). Without a comprehensive study of the policy process, it is challenging to determine why electrocution and collision impacts on wildlife are absent from these policies and frameworks. Two factors may have contributed to this oversight. First, Kenya’s transition from a Least Developed Country to lower-middle-income status suggests a shift in development priorities. Electrocution and collision may not have been significant concerns for conservationists and decision-makers until recently, as evidenced by the limited number of studies on these issues in Kenya (Smallie & Virani 2010, Ngila et al. 2023, 2024). Second, a lack of awareness or understanding of the extent of these impacts on wildlife may have further contributed to their omission from policy discussions. Further research is needed to understand the

Table 3. Summary of provisions and statements in the surveyed policy documents.

Policy document	Provision/statement	Policy action score (0–VI)
African Convention on the Conservation of Nature and Natural Resources, Revised 2003	Recognizes the protection of migratory species and habitats through protected areas and conservation measures. Calls for regular reviews to monitor and protect species, including migratory species, but lacks mention of electrocution and collision threats	II
Wildlife Conservation and Management Act, 2013	Recognizes the importance of preserving wildlife buffers, migration corridors, dispersal areas and zones. Emphasizes conserving habitats and preventing harmful infrastructural activities. Addresses HWC, mandating mitigation mechanisms in collaboration with community wildlife associations	II
Forest Conservation and Management Act, 2016	Emphasizes the conservation of biodiversity, including threatened or endangered species, and the preservation of biological diversity in forests	I
Energy Act, 2019	Lacks provisions for wildlife conservation, migratory species and electrocution or collision issues	0
Wildlife Policy, 2020	Recognizes commitments to multi-sectoral environmental agreements such as the CMS and highlights the importance of regional and international cooperation in wildlife conservation as crucial for migratory species	II
Wildlife Strategy, 2030	Acknowledges threats to wildlife populations such as habitat loss, human population pressure and poaching	0
Wetlands Policy, 2014	Acknowledges the importance of wetlands as habitats for various plants and animals, including endemic, endangered and migratory species. Highlights wetlands' critical role in biodiversity conservation and their function as breeding and spawning areas for fish and water birds, acting as in situ genetic resource banks	I
Kenya Climate Change Act, 2016	Recognizes the importance of integrating climate change considerations into various sectors and aspects of governance	0
Environmental Management and Coordination Act, 1999	Recognizes the need to monitor the impacts of wildlife and to stop the introduction of alien invasive species	0
National Biodiversity Strategy and Action Plan, 2019–2030	Recognizes commitments to international treaties for conserving migratory bird species and stresses coordinated efforts at national and global levels. Recognizes national parks, reserves, wildlife sanctuaries, monuments, Biosphere Reserves, World Heritage Sites and Ramsar Sites as vital for wildlife conservation	II
National Energy Policy, 2018	No explicit mention of electrocution and collisions due to power lines	0
National Environment Policy, 2013	Recognizes wildlife conservation as essential for environmental protection and sustainable development. Emphasizes wildlife's economic contributions through employment, revenue generation and wealth creation. Underscores threats to wildlife, including HWC, pollution, climate change and habitat loss, stressing the urgency of conservation efforts	I

CMS = Convention on the Conservation of Migratory Species; HWC = human-wildlife conflict.

factors influencing this gap in conservation policymaking and decision-making processes.

Conclusion

The absence of robust policies and legal frameworks addressing avian mortality from electrocution and collision with power lines reveals an oversight in conservation policy. This gap not only limits the accountability of energy institutions but also leaves conservationists without the necessary legal backing to advocate for effective mitigation measures. As biodiversity continues to decline due to threats such as climate change and habitat loss, the conservation and energy sectors need to work together to address these challenges. Conservation scientists must also play an active role in translating their research into actionable policy recommendations. The urgency of the current biodiversity crisis demands that scientists move beyond mere documentation of species declines and actively engage with policymakers to influence conservation legislation. By integrating data-driven decision-making and adaptive management strategies, conservation policies can be strengthened to address infrastructure-related risks more effectively.

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References

- Angelov I, Hashim I, Opper S (2013) Persistent electrocution mortality of Egyptian vultures *Neophron percnopterus* over 28 years in East Africa. *Bird Conservation International* 23: 1–6.
- Antal M (2010) Policy measures to address bird interactions with power lines—a comparative case study of four countries. *Ostrich* 81: 217–223.
- APLIC (2006) *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006*. Washington, DC and Sacramento, CA, USA: Avian Power Line Interaction Committee.
- Bakari S, Mengistu S, Tesfaye M, Ruffo AD, Opper S, Arkumarev V, Nikolov SC (2020) *Technical Report under Action A3 of the 'Egyptian Vulture New LIFE project': Bird Mortality Due to Hazardous Powerlines in East Oromia and Afar Regions, Ethiopia, 2019*. Nairobi, Kenya: BirdLife Africa.
- Bernardino J, Bevanger K, Barrientos R, Dwyer JF, Marques AT, Martins RC, et al. (2018) Bird collisions with power lines: state of the art and priority areas for research. *Biological Conservation* 222: 1–13.
- Bevanger K (1994) Bird interactions with utility structures: collision and electrocution, causes and mitigating measures. *IBIS* 3: 412–425.
- Bevanger K (1998) Biological and conservation aspects of bird mortality caused by electricity power lines: a review. *Biological Conservation* 86: 67–76.
- Biasotto LD, Moreira F, Bencke GA, D'Amico M, Kindel A, Ascensão F (2022) Risk of bird electrocution in power lines: a framework for prioritizing species and areas for conservation and impact mitigation. *Animal Conservation* 25: 285–296.



- BirdLife International (2021) *Death by Collision: Counting the Cost of Power Lines on Birds in Kenya*. Cambridge, UK: BirdLife International.
- Crona B, Rosendo S (2011) Outside the law? Analyzing policy gaps in addressing fishers' migration in East Africa. *Marine Policy* 35: 379–388.
- Dwyer JF, Harness RE, Donohue K (2014) Predictive model of avian electrocution risk on overhead power lines. *Conservation Biology* 28: 159–168.
- Dwyer JF, Karyakin IV, López JRG, Nikolenko EG (2022) Avian electrocutions on power lines in Kazakhstan and Russia. *Ardeola* 70: 3–27.
- Eccleston DT, Harness RE (2018) Raptor electrocutions and power line collisions. In: JH Sarasola, JM Grande, JJ Negro (eds), *Birds of Prey: Biology and Conservation in the XXI Century* (pp. 273–302). New York, NY, USA: Springer International Publishing.
- Guil F, Pérez-García JM (2022) Bird electrocution on power lines: spatial gaps and identification of driving factors at global scales. *Journal of Environmental Management* 301: 113890.
- Harness RE, Wilson KR (2001) Electric-utility structures associated with raptor electrocutions in rural areas. *Wildlife Society Bulletin* 29: 612–623.
- IPCC (2014) *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- Jenkins AR, Smallie JJ, Diamond M (2010) Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. *Bird Conservation International* 20: 263–278.
- Lehman RN (2001) Raptor electrocution on power lines: current issues and outlook. *Wildlife Society Bulletin* 29: 804–813.
- Loss SR, Will T, Marra PP (2014) Refining estimates of bird collision and electrocution mortality at power lines in the United States. *PLoS ONE* 9: e101565.
- Loss SR, Will T, Marra PP (2015) Direct mortality of birds from anthropogenic causes. *Annual Review of Ecology, Evolution, and Systematics* 46: 99–120.
- Martín JM, Rafael J, López G, Sousa HC, Barrios V (2022) *Wildlife and Power Lines: Guidelines for Preventing and Mitigating Wildlife Mortality Associated with Electricity Distribution Networks*. Gland, Switzerland: International Union for Conservation of Nature.
- Ngila PM, Chiawo D, Owuor MA, Wasonga VO, Ellwood E, Mugo D (2024) Assessing the susceptibility of raptor species to electrocution: a framework for Kenya. *Environmental and Sustainability Indicators* 22: 100400.
- Ngila PM, Chiawo D, Owuor MA, Wasonga VO, Ellwood E, Mugo J, et al. (2023) Developing bird friendly transmission power lines in Kenya. *F1000Research* 12: 414.
- Northrup JM, Wittemyer G (2013) Characterising the impacts of emerging energy development on wildlife, with an eye towards mitigation. *Ecology Letters* 16: 112–125.
- Prinsen HAM, Boere G, Pires N, Smallie J (2011) *Review of the Conflict between Migratory Birds and Electricity Power Grids in the African–Eurasian Region*. Bonn, Germany: AEWa.
- Prinsen HAM, Smallie JJ, Boere GC, Pires N (2012) *Guidelines on How to Avoid or Mitigate Impact of Electricity Power Grids on Migratory Birds in the African–Eurasian Region*. Bonn, Germany: AEWa.
- REN21 (2014) *Renewables 2014 Global Status Report*. Paris, France: REN21.
- Republic of Kenya (2018) *National Energy Policy*. Nairobi, Kenya: Ministry of Energy.
- SCBD (2014) Secretariat of the Convention on Biological Diversity [www document]. URL <http://www.cbd.int>
- Shaw JM, Jenkins AR, Ryan PG, Smallie JJ (2010) A preliminary survey of avian mortality on power lines in the Overberg. *Ostrich* 81: 109–113.
- Smallie J, Strugnell L (2011) *Use of Camera Traps to Investigate Cape Vulture Roosting Behavior on Power Lines in South Africa*. Unpublished Report to Eskom.
- Smallie J, Virani MZ (2010) A preliminary assessment of the potential risks from electrical infrastructure to large birds in Kenya. *Scopus* 30: 32–39.
- Smeraldo S, Bosso L, Fraissinet M, Bordignon L, Brunelli M, Ancillotto L, Russo D (2020) Modelling risks posed by wind turbines and power lines to soaring birds: the black stork (*Ciconia nigra*) in Italy as a case study. *Biodiversity and Conservation* 29: 1959–1976.
- Smith JA, Dwyer JF (2016) Avian interactions with renewable energy infrastructure: an update. *The Condor* 118: 411–423.
- Therkildsen OR, Balsby TJS, Kjeldsen JP, Nielsen RD, Bladt J, Fox AD (2021) Changes in flight paths of large-bodied birds after construction of large terrestrial wind turbines. *Journal of Environmental Management* 290: 112647.
- USAID (2016) Development of Kenya's power sector 2015–2020 [www document]. URL www.usaid.gov/powerafrica