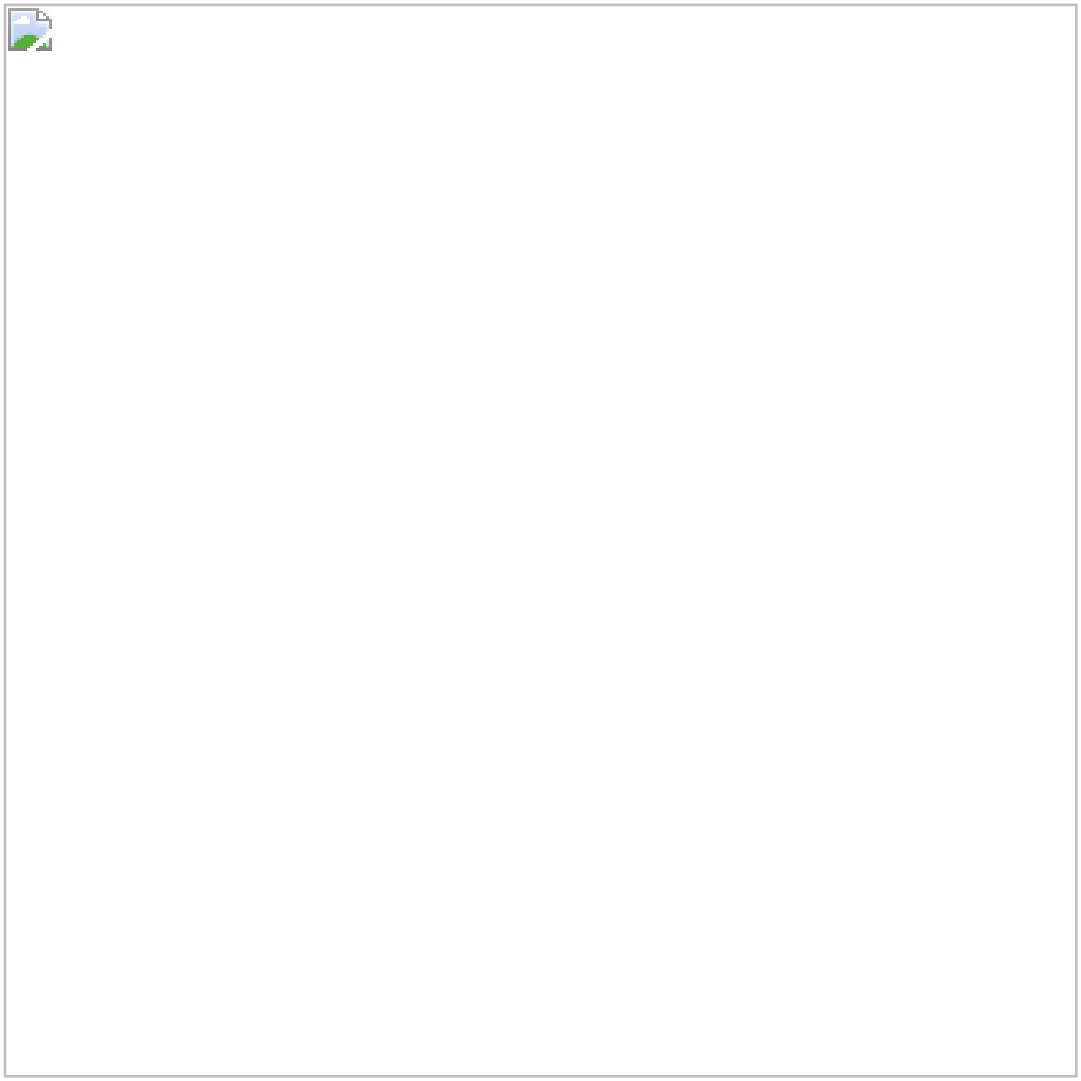

People in a Biodiverse Region Experienced Varying Types and Timing of Conflict With Multiple Wildlife Species

Author: Buchholtz, Erin

Source: Tropical Conservation Science, 17(1)

Published By: SAGE Publishing

URL: https://doi.org/10.1177/19400829241233479

Short Communication

Tropical Conservation Science
Volume 17: 1–6

DOI: 10.1177/19400829241233479
journals.sagepub.com/home/trc
Sage

People in a Biodiverse Region Experienced Varying Types and Timing of Conflict With Multiple Wildlife Species

Erin Buchholtz[1,2]

Abstract

Background & Research Aims: Understanding how people and wildlife coexist is crucial to informing conservation and management of biodiverse areas, supporting both wildlife conservation and human well-being. Yet, most studies of human-wildlife conflict and coexistence focus on a limited number of wildlife species. **Methods:** This study characterizes patterns of reported human-wildlife conflict in the Okavango region of Botswana based on records for all species from the Botswana Department of Wildlife and National Parks (2008 – 2016). **Results:** The reported incidents implicated a diverse range of wildlife species in conflict. The patterns indicated that for conflicts like crop and property damage, only a few main species were implicated, while livestock damage reports had more diversity of conflict species. Additionally, people in this region faced wildlife challenges throughout the year. **Conclusion & Implications for Conservation:** Having such variable types and timing of conflict, and from diverse species, may make it particularly difficult for people to mitigate costs and prevent further conflicts.

Keywords

biodiversity, Botswana, coexistence, crop raiding, human-wildlife conflict, human-wildlife interactions, livestock predation, Okavango

Introduction

In biodiverse areas where people and wildlife species coexist, there are associated costs and benefits for both (Kremen & Merenlender, 2018). The costs and conflicts that occur when there are negative interactions between people and wild animals is a key challenge for human livelihoods and wildlife conservation (Nyhus, 2016). Studies of human-wildlife conflict often focus on a single species or species guild, and while this may lead to targeted interventions, it overlooks the complexity of the challenges for people sharing the landscape with multiple wildlife species (Pozo et al., 2021). Gaining a more comprehensive view of the varied threats or costs associated with wildlife diversity may improve conservation and management strategies that can benefit both people and wildlife.

Human-wildlife conflict comes in a variety of forms, and it stands to reason that in biodiverse areas, people may experience different types of threats from different species or species guilds. Herbivorous wildlife may cause economic losses by foraging on growing crops or stored grains in agricultural areas, while carnivores are often implicated in livestock predation in rangelands. A range of species can be physically dangerous to people, as well as increase stress and opportunity costs associated with experiencing and

[1]U.S. Geological Survey South Carolina Cooperative Fish and Wildlife Research Unit, Clemson University, Clemson, SC, USA
[2]Department of Wildlife and Fisheries Sciences, Texas A&M University, Texas, TX, USA

Received: 10 September 2023; accepted: 2 February 2024

Corresponding Author:
Erin Buchholtz, U.S. Geological Survey, South Carolina Cooperative Fish and Wildlife Research Unit, Clemson University, Lehotsky Hall, Clemson, SC 29634, USA.
Email: ekbuchh@clemson.edu

Data Availability Statement included at the end of the article

responding to negative interactions with wildlife (Barua et al., 2013). The aim of this paper is to characterize the diversity of species, conflict types, and conflict timing that people experience in a biodiverse region. The study focuses on the Western Okavango Panhandle in Botswana, where studies have often focused on charismatic species such as elephants (*Loxodonta africana*) and lions (*Panthera leo*), but rarely consider the full scope of potential sources of wildlife conflict. Previous studies have analysed patterns of multispecies human-wildlife conflict in the Eastern Okavango Panhandle in more depth (LeFlore et al., 2019; Pozo et al., 2021); the goal of this short communication is to complement these studies by examining the neighbouring Western Okavango Panhandle with a focus on the species diversity within reported human-wildlife conflict.

Methods

Botswana is a biodiverse country with over 1,015 vertebrate species (Botswana DEA, 2016). The Western Okavango Panhandle (study area, Figure 1) is the region to the west of the Okavango River and Delta and does not include any formal protected areas. The Okavango serves as the only permanent water source in the region and supports local wildlife diversity. Habitat diversity in the study area includes riverine woodlands and floodplains, mopane woodlands, *Acacia-Baikiaea* savannas, and sparsely vegetated, sandy Kalahari savannas. Rainfall is strongly seasonal, with most rainfall occurring between November and April (average 500mm annual rainfall as measured at Shakawe Station, Statistics Botswana 2015). Most of the human population and agricultural lands are located relatively close to the Okavango floodplain (Buchholtz et al., 2019) with cattle posts outside of the settlements to manage livestock. The Western Okavango Panhandle is more populous than the region to the east of the Okavango (Statistics Botswana, 2015) and has more developed transportation infrastructure.

Data for this study came from existing government records from two regional offices of the Botswana Department of Wildlife and National Parks (DWNP). Wildlife is the property of the government in Botswana, and the DWNP Problem Animal Control (PAC) program seeks to manage and mitigate wildlife-related issues. In the study region, people are encouraged to report negative incidents involving wildlife to the DWNP PAC office. Only damages due to elephants (*Loxodonta africana*) and livestock loss (when livestock are actively being herded or protected in enclosures) due to predator species such as lion (*Panthera leo*), wild dog (*Lycaon pictus*), leopard (*Panthera pardus*), and cheetah (*Acinonyx jubatus*) are eligible for government compensation. DWNP inspection of reported conflicts and subsequent dispersal of compensation is largely variable and/or delayed due to limited time and resources. A limitation of this data is therefore that people have variable incentives for reporting wildlife conflict to the DWNP. I worked with regional DWNP offices in Shakawe and Gumare to collate records from 2008 to 2016 to characterize the wildlife-related conflict types that people experienced. These data represent the reported conflict for the Western Okavango Panhandle region during this time period and do not overlap with the records analysed by Pozo et al. (2021) or with the spatial extent of the eastern region. All data calculations were carried out in R v. 4.2.1 (R Core Team, 2018).

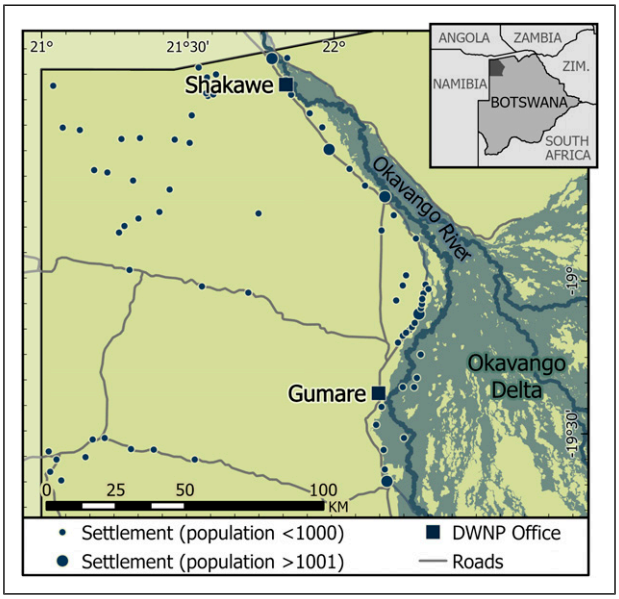

Figure 1. The study region of the Western Okavango Panhandle in north-western Botswana. The Okavango River and Delta represent the main water source for this region. This study includes data collated from the two indicated regional offices of the Botswana Department of Wildlife and National Parks.

Results

From 2008 to 2016 there were 7271 complete DWNP incident reports. Not all incidents resulted in a single type of damage; about 10% of reports included multiple types (such as property and crop damage occurring in the same incident). Noteworthy examples of property damage included broken fences (n = 1063) and damage to equipment for pumping and storing water (n = 151).

Twenty-five unique species were implicated in reported conflicts between 2008 and 2016 (Table 1). Elephants were by far the most commonly reported species for conflict related to crop damage, property damage, and life-threatening incidents, while lions and wild dogs were most commonly reported for livestock predation (Table 1). Of the twenty-five species, eleven species were reported only rarely, with only one or two conflict incidents (Table 1, caption). For specific types of conflict, the diversity of implicated species varied (Table 1). The most diverse group of species reported was for conflict related to livestock. Seventeen different species were

Table 1. Summary of species reported for different types of conflict incidents to the Botswana Department of Wildlife and National Parks in the study region (2008 – 2016). An additional 5 incidents of livestock loss due to 'predator' (unspecified species) were reported. Species reported for less than three incidents were not included in the table, but are as follows: Crops: aardvark (*Orycteropus afer*), chacma baboon (*Papio ursinus*), eland (*Taurotragu oryx*), sitatunga (*Tragelaphus spekei*), spring hare (*Pedetes capensis*); Livestock: buffalo (*Syncerus caffer*), caracal (*Caracal caracal*), chacma baboon (*Papio ursinus*), eagle (unspecified), mongoose (unspecified), pied crow (*Corvus albus*); Life threatened: snake (unspecified species); Property: plains zebra (*Equus quagga*).

			Conflict type				Incidents per species
		Species reported for incident	Crops	Livestock	Life threat	Property	
Primary conflict type: crop/property	Mammals	elephant (*Loxodonta africana*)	3369	84	11	1621	5085
		hippopotamus (*Hippopotamus amphibius*)	214	5	5	60	284
		porcupine (*Hystrix africaeaustralis*)	8	-	-	-	8
		vervet monkey (*Chlorocebus pygerythrus*)	4	-	-	-	4
		bush duiker (*Sylvicapra grimmia*)	3	-	-	-	3
Primary conflict type: livestock	Mammals	lion (*Panthera leo*)	-	1096	1	-	1097
		wild dogs (*Lycaon pictus*)	-	836	-	-	836
		leopard (*Panthera pardus*)	-	334	1	-	335
		hyena (*Hyaenidae*)	-	40	-	-	40
		cheetah (*Acinonyx jubatus*)	-	14	-	-	14
		honey badger (*Mellivora capensis*)	-	7	-	-	7
		black-backed jackal (*Canis mesomelas*)	2	1	-	-	3
	Reptiles	Nile crocodile (*Crocodylus niloticus*)	7	412	1	-	420
		African rock python (*Python sebae*)	-	8	-	-	8
		Total incidents per conflict type	3612	2849	21	1683	
		Species per conflict type	12	17	6	3	

reported for livestock conflict in this region, with lions and wild dogs as the primary species implicated. Crop damage was reported for twelve different species, although dominated by elephant and hippopotamus. Relatively few life-threatening incidents were included in the DWNP records for Problem Animal Control, of which, elephants were most reported.

People experienced varying conflict throughout the year (Figure 2). Reported incidents peaked from February to April (average 129 incidents/month across years) with the highest peak in March (147 incidents/month) (Figure 2A). From June through January, conflict reports averaged about 43 incidents per month. There was species diversity in reported conflict (Figure 2B-D), with incidents from at least 8 unique species reported per month across all years, and higher diversity of species conflicts reported in February, March, April, September, and October (12+ unique species in each month, Figure 2B). These data reflect over 300 reports per year between 2008 and 2016, with an average of 935 reports per year between 2010 and 2016.

Discussion

A multispecies approach toward conflict illustrated that people in the Western Okavango Panhandle of Botswana did not face conflicts with only a single species, a single type of conflict, or at a single point in the year. Conflicts were reported for over a dozen unique species during certain times of the year, and these conflicts impacted physical safety, livelihoods, and property. Having variable types and timing of conflict, and from diverse species, exemplifies the complexity of experiences and costs people face from negative interactions with wildlife.

The Okavango is a defining characteristic of the social-ecological system in this region. The habitat gradient from bushveld to wetland supports diverse wildlife species and therefore diverse risks. While crop foraging and livestock predation by terrestrial species are commonly recognized conflicts, people in the Panhandle must also deal with semi-aquatic species such as crocodiles preying on livestock, hippos foraging on floodplain crops, and both crocodiles and hippos pose a significant physical threat to human lives. Additionally, people engaging in activities such as fishing, collecting water, or gathering reeds in the wetland may be more exposed to wildlife risks from these semi-aquatic species (Dunham et al., 2010). Furthermore, animals rely on the Okavango as the primary water source in the region, and as the majority of the human population lives and makes their livelihoods close to the river, animals traveling to and from the water are likely to encounter human settlements and fields (Buchholtz et al., 2019). This could in part be responsible for persistence of reported elephant conflicts during the dry season, as even though there are not crops growing during that time of year (and therefore limited crop-related

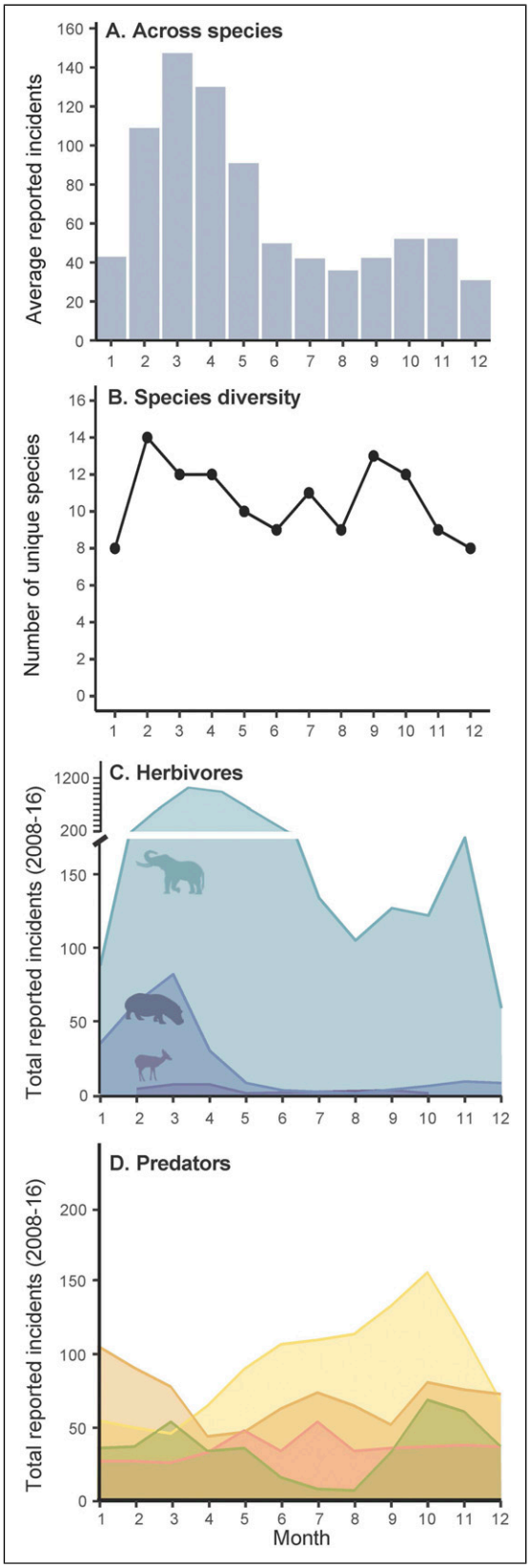

Figure 2. Reported conflict incidents caused by different wildlife species in the Western Okavango Panhandle, Botswana based on Botswana Department of Wildlife and National Parks records (2008 – 2016). A. Average number of incidents reported per month across all years and all species. B. Number of unique species reported in conflict incidents for each month. C. Monthly patterns of conflict reported for herbivores summed over all years, including elephants (teal), hippopotamus (blue), and other species such as duiker (purple). Note change in y axis at y = 200 to accommodate high numbers of elephant incidents. D. Monthly patterns of conflict reported with predators and omnivores associated with livestock loss, including lions (yellow), wild dogs (orange), other predators such as leopards and hyenas (red), and crocodiles (green).

foraging) these large-bodied mammals rely on the Okavango for water and must travel through human settlements to reach it (Buchholtz et al., 2019, 2020). In contrast, crop foraging by hippos, which would not be expected to change relative to seasonal water availability, did not show this dry-season persistence and was concentrated in the peak growing months for floodplain crops.

Rangelands and agricultural fields are common types of 'working lands' that occur in biodiverse areas (Kremen & Merenlender, 2018), and people in the Panhandle reported considerable wildlife conflicts associated with farming and livestock-based livelihoods. These impacts on agricultural livelihoods echo findings from other studies in Botswana (Pozo et al., 2021) and Namibia (Tavolaro et al., 2022). The primary species reported for crop and property damage was elephants, occurring during the crop-growing months (Buchholtz et al., 2019) and at an order of magnitude greater than other species. Elephant-related incidents therefore represent a significant and well-recognized threat to human livelihoods through direct economic costs. They also threaten human personal safety, as well as the hidden costs to health and wellbeing associated with experiencing and responding to conflict (Barua et al., 2013; Mayberry et al., 2017). The number of elephant-related conflicts reported monthly highlights that the challenges people face with elephants are chronic (Buchholtz et al., 2023), and the constant exposure and potential for negative experiences likely affect people's attitudes and tolerance for the species (Kansky & Knight, 2014). Overall, the extent of elephant-related incidents reported to DWNP emphasizes that elephants are a key focal species for mitigating wildlife conflict effects on agricultural livelihoods in this region.

In the case of livestock loss, though, a species-specific focus could overlook certain species related to conflict and therefore lead to incomplete information for conservation and management (Gusset et al., 2009; LeFlore et al., 2019). People also reported conflicts with large predators including lions, wild dogs, crocodiles, leopards, hyenas, and cheetahs. This is in line with other studies of predator conflict in the region (Kgathi et al., 2012; LeFlore et al., 2019; Mbaiwa, 2018). In addition to the expected predators, the reports highlighted the variety of threats people faced from all manner of species, ranging from pythons,

monkeys, and jackals that preyed on smaller domesticated animals kept close to the home to large mammals such as elephants and hippos that could trample or otherwise injure livestock. Moreover, people faced these threats across the year. In contrast to crop foraging conflict, which is constrained to months when the crops are growing and ripening, different seasonal trends likely drive livestock threats. For example, people reported a peak in lion conflicts at the end of the dry season, and this could be related to seasonal availability of wild prey species in the region (Valeix et al., 2012). However, reported livestock loss to other non-lion predators varied highly across months, which could correlate with other ecological or anthropogenic variables (Kgathi et al., 2012; LeFlore et al., 2019). This constant exposure to predation threat could negatively influence people's tolerance for predator species (Kansky & Knight, 2014). Further investigation could aim to draw out ecological drivers and potential mitigation strategies, and more in-depth analyses of DWNP human-wildlife data from the neighbouring eastern region are explored by Pozo et al. (2021) and LeFlore et al. (2020). Together, these studies highlight the variable and diverse set of wildlife conflicts that people face throughout the year.

While these reported conflicts do reflect a diverse range of species and general types and patterns of conflict, it is important that the findings are interpreted in the context of the data source. As previously noted, the availability of time and resources for the DWNP to first investigate and then compensate each report is often limited and highly variable (Kgathi et al., 2012; LeFlore et al., 2020; Mbaiwa, 2018), and this influences which conflicts are reported. Losses to elephants and large predators are eligible for government compensation, and these are the most-reported species; this pattern aligns with their compensation status but also with our expectation that they are present in the ecosystem. If compensation is good enough to incentivize people to falsely attribute losses to these species, as is evident for lions in the neighbouring region (LeFlore et al., 2019, 2020), the numbers reflected in DWNP records could be inflated. In contrast, the limited nature of the compensation program and unreliable benefit for reporting effort leads to frustration and under-reporting (Noga et al., 2018), which was a sentiment reflected by farmers in this region who experienced elephant crop raiding (Buchholtz et al., 2023). The contrasting drivers of reporting compensation-eligible incidents should be considered when interpreting exact levels of conflict due to elephants and lions. Additionally, the lack of compensation for other species suggests that these incidents would be underreported. Hyenas are not uncommon in this region, and are likely underreported due to limited compensation or attributed to a compensable species like lions. This is also true for species that contribute to crop loss, such as vervet monkeys and foraging birds. The patterns in reported conflicts, therefore, likely represent a very conservative estimate of the true species diversity associated with conflicts.

Despite limitations on the species being eligible for compensation and the actual functionality of the compensation program, DWNP records indicated a high level of species diversity in conflicts people experienced throughout the year. During crop growing season and the end of the dry season, people reported conflicts with over a dozen different species. To protect personal safety, crops, livestock, and property against such diverse threats is challenging and costly in terms of time, energy, and resources; although beyond the scope of this note, it is likely that the persistence and diversity of wildlife costs are cumulative or interact in some way to influence people's attitudes, tolerance, and well-being. Further research could employ more detailed conflict reporting and/or surveys to gain a more representative understanding of the diversity of conflicts borne by people who live in biodiverse regions. This, in turn, could inform conflict prevention and mitigation strategies that are able to reduce risk from diverse species.

Conservation Implications

Biodiversity is often touted as an important conservation goal, but social-ecological systems with diverse wildlife species can present challenges for the people in those systems. While recognizing that some wildlife species such as elephants and lions made up a large portion of conflict incidents in the study region, the occurrence of unexpected or overlooked species may add to the cumulative costs people bear, with potential consequences for their wellbeing and for wildlife tolerance. Recognizing that people face a variety of wildlife species and conflicts, and that conflict occurs throughout the year, can help us understand the experiences that drive patterns of conflict and coexistence. In turn, research on these patterns can inform conservation strategies that aim to reduce conflict, support healthy wildlife populations, and improve the lives and livelihoods of people in biodiverse areas.

Acknowledgements

I am thankful to the Botswana government and Department of Wildlife & National Parks regional offices for granting access to and use of the data presented in this study. In particular, thank you to A. Sejamitlwa (DWNP). I am also thankful to the Ecoexist Project for guidance and support during my PhD research. Thank you to phylopic.org for hosting animal silhouettes used in Figure 2. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government. Thank you to the anonymous reviewers who provided thoughtful feedback on this paper through the peer review process.

Author's Contributions

Study design, data collation and analysis, writing: EB.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: While at Texas A&M University, E.B. was funded by the National Science Foundation Integrative Graduate Research Traineeship through the Applied Biodiversity Science Program.

ORCID iD

Erin Buchholtz https://orcid.org/0000-0002-1985-9531

Data Availability Statement

Data is property of the Botswana Department of Wildlife & National Parks and is available from them by reasonable request.

References

Barua, M., Bhagwat, S. A., & Jadhav, S. (2013). The hidden dimensions of human–wildlife conflict: Health impacts, opportunity and transaction costs. *Biological Conservation*, *157*, 309–316. https://doi.org/10.1016/j.biocon.2012.07.014

Botswana DEA. (Department of Environmental Affairs). (2016). *National Biodiversity Strategy and Action Plan*. Republic of Botswana. https://www.cbd.int/doc/world/bw/bw-nbsap-v3-en.pdf

Buchholtz, E. K., Fitzgerald, L., Songhurst, A., McCulloch, G., & Stronza, A. (2019). Overlapping landscape utilization by elephants and people in the Western Okavango Panhandle: Implications for conflict and conservation. *Landscape Ecology*, *34*(6), 1411–1423. https://doi.org/10.1007/s10980-019-00856-1

Buchholtz, E. K., McDaniels, M., McCulloch, G., Songhurst, A., & Stronza, A. (2023). A mixed-methods assessment of human-elephant conflict in the Western Okavango Panhandle, Botswana. *People and Nature*, *5*(2), 557–571. https://doi.org/10.1002/pan3.10443

Buchholtz, E. K., Stronza, A., Songhurst, A., McCulloch, G., & Fitzgerald, L. A. (2020). Using landscape connectivity to predict human-wildlife conflict. *Biological Conservation*, *248*, 108677. https://doi.org/10.1016/j.biocon.2020.108677

Dunham, K. M., Ghiurghi, A., Cumbi, R., & Urbano, F. (2010). Human–wildlife conflict in Mozambique: A national perspective, with emphasis on wildlife attacks on humans. *Oryx*, *44*(2), 185–193. https://doi.org/10.1017/S003060530999086X

Gusset, M., Swarner, M. J., Mponwane, L., Keletile, K., & McNutt, J. W. (2009). Human–wildlife conflict in northern Botswana: Livestock predation by Endangered African wild dog Lycaon pictus and other carnivores. *Oryx*, *43*(1), 67–72. https://doi.org/10.1017/S0030605308990475

Kansky, R., & Knight, A. T. (2014). Key factors driving attitudes towards large mammals in conflict with humans. *Biological Conservation*, *179*, 93–105. https://doi.org/10.1016/j.biocon.2014.09.008

Kgathi, D. L., Mmopelwa, G., Mashabe, B., & Mosepele, K. (2012). Livestock predation, household adaptation and compensation policy: A case study of Shorobe Village in northern Botswana. *Agrekon*, *51*(2), 22–37. https://doi.org/10.1080/03031853.2012.695148

Kremen, C., & Merenlender, A. M. (2018). Landscapes that work for biodiversity and people. *Science*, *362*(6412), eaau6020. https://doi.org/10.1126/science.aau6020

LeFlore, E. G., Fuller, T. K., Tomeletso, M., Dimbindo, T. C., & Stein, A. B. (2020). Human dimensions of human–lion conflict: A pre- and post-assessment of a lion conservation programme in the Okavango Delta, Botswana. *Environmental Conservation*, *47*(3), 182–189. https://doi.org/10.1017/S0376892920000120

LeFlore, E. G., Fuller, T. K., Tomeletso, M., & Stein, A. B. (2019). Livestock depredation by large carnivores in northern Botswana. *Global Ecology and Conservation*, *18*, e00592. https://doi.org/10.1016/j.gecco.2019.e00592

Mayberry, A. L., Hovorka, A. J., & Evans, K. E. (2017). Well-Being Impacts of Human-Elephant Conflict in Khumaga, Botswana: Exploring Visible and Hidden Dimensions. *Conservation and Society*, *15*(3), 280–291.

Mbaiwa, J. E. (2018). Human-wildlife conflicts in the Okavango Delta, Botswana: What are sustainable management options? *Pula: Botswana Journal of African Studies*, *32*(1). https://journals.ub.bw/index.php/pula/article/view/1524

Noga, S. R., Kolawole, O. D., Thakadu, O. T., & Masunga, G. S. (2018). 'Wildlife officials only care about animals': Farmers' perceptions of a Ministry-based extension delivery system in mitigating human-wildlife conflicts in the Okavango Delta, Botswana. *Journal of Rural Studies*, *61*, 216–226. https://doi.org/10.1016/j.jrurstud.2018.06.003

Nyhus, P. J. (2016). Human–Wildlife Conflict and Coexistence. *Annual Review of Environment and Resources*, *41*(1), 143–171. https://doi.org/10.1146/annurev-environ-110615-085634

Pozo, R. A., LeFlore, E. G., Duthie, A. B., Bunnefeld, N., Jones, I. L., Minderman, J., Rakotonarivo, O. S., & Cusack, J. J. (2021). A multispecies assessment of wildlife impacts on local community livelihoods. *Conservation Biology*, *35*(1), 297–306. https://doi.org/10.1111/cobi.13565

R Core Team. (2018). *R: A language and environment for statistical computing (3.5.1) [Computer software]*. R Foundation for Statistical Computing. https://www.R-project.org/

Statistics Botswana. (2015). *Population and Housing Census 2011: National Statistical Tables*. Botswana Census Office. https://www.statsbots.org.bw/sites/default/files/publications/national_statisticsreport.pdf

Tavolaro, F. M., Woodgate, Z., Brown, C., Redpath, S. M., & O'Riain, M. J. (2022). Multispecies study of patterns and drivers of wildlife impacts on human livelihoods in communal conservancies. *Conservation Science and Practice*, *4*(9), e12773. https://doi.org/10.1111/csp2.12773

Valeix, M., Hemson, G., Loveridge, A. J., Mills, G., & Macdonald, D. W. (2012). Behavioural adjustments of a large carnivore to access secondary prey in a human-dominated landscape. *Journal of Applied Ecology*, *49*(1), 73–81. https://doi.org/10.1111/j.1365-2664.2011.02099.x