frontiers | Frontiers in Conservation Science

TYPE Perspective
PUBLISHED 11 April 2025
DOI 10.3389/fcosc.2025.1578773

Check for updates

OPEN ACCESS

EDITED BY
Marta Luciane Fischer,
Pontifical Catholic University of Parana, Brazil

REVIEWED BY
Deepali Kalambhe,
Guru Angad Dev Veterinary and Animal Sciences University, India

*CORRESPONDENCE
Hongying Li
hli@climate.columbia.edu

RECEIVED 18 February 2025
ACCEPTED 24 March 2025
PUBLISHED 11 April 2025

CITATION
Li H (2025) Responsible biophilia for zoonosis prevention through a cultural lens.
*Front. Conserv. Sci.* 6:1578773.
doi: 10.3389/fcosc.2025.1578773

COPYRIGHT
© 2025 Li. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

# Responsible biophilia for zoonosis prevention through a cultural lens

Hongying Li*

Columbia Climate School, Columbia University, New York, NY, United States

Human affinity for nature ("biophilia") brings substantial health and ecological benefits and fosters environmental stewardship. However, close human-nature interactions can lead to conservation challenges and increase the risk of zoonoses. This paradox raises critical questions about how to balance public health, biodiversity conservation, and sustainable development, and understanding these dilemmas presents opportunities for integrated approaches seeking synergies rather than trade-offs. This perspective explores the complexities of these intricate challenges by examining cases that demonstrated the interconnections between biophilia and zoonotic risks and their implications for conservation, public health, and local livelihood. Acknowledging the role of social and cultural perspectives in shaping human-nature interactions, this perspective highlights the importance of integrating traditional knowledge and practices and tailored risk communications into community-centered initiatives for zoonotic risk mitigation. The discussion proposes a responsible biophilia approach that embraces biodiversity conservation as a primary strategy for zoonosis prevention. By fostering responsible biophilia through a transdisciplinary and culturally relevant approach, we can align conservation, public health, and sustainable local livelihood, transforming biophilia-based human-nature interaction into opportunities for community health and resilience.

KEYWORDS

**biodiversity conservation, biophilia, traditional knowledge and practices, integrated approach, zoonoses**

## 1 Introduction

The inherent affinity to nature in humans ("biophilia") is shown in diverse ways in which we seek to interact with various life forms in our shared environment (Kellert and Wilson, 1995). Through the course of evolution, humans have acquired knowledge and experience through interactions with nature, at the same time forming minds and behaviors that modify nature for the benefit of humans. The establishment of connections with nature offers substantial benefits to human health and fosters a sense of care and ethical obligation that generates environmental stewardship to maintain a

healthy ecosystem (Heerwagen, 2009). However, biophilic activities often bring humans and nature into close interactions, raising health concerns for animals, humans, and ecosystems (Spanjol and Zucca, 2023). The intricate relationship between biophilia and zoonoses unveils a multifaceted landscape, presenting both challenges and opportunities to nurture sustainable human-nature relationships. This perspective delineates the challenges of balancing zoonosis prevention, conservation, and local livelihoods in human-nature interactions and discusses the role of socio-cultural factors in shaping human-nature interactions, influencing conservation and zoonosis prevention. Drawing from community practices, the perspective introduces the concept of responsible biophilia, which emphasizes ethical, sustainable, and health-conscious engagement with nature to maintain a healthy ecosystem that is essential for zoonosis prevention, conservation, and sustainable development. Grounded in the principles of One Health, the perspective outlines pathways to transforming human-nature interactions into opportunities for zoonosis prevention by integrating biodiversity conservation, community-driven initiatives, and culturally sensitive approaches.

# 2 Challenges to biophilia and zoonosis prevention

## 2.1 The paradox between biophilia and health

Many nature-based activities, or biophilic activities, offer substantial mental and physical benefits to humans, but certain activities are also potential causes for zoonoses that are transmitted between humans and animals or via natural environments (e.g., water and soil). A number of zoonoses are known to be associated with biophilic activities. These include the recent B virus human case in Hong Kong where the patient was injured (e.g., scratches or bites) by monkeys in a park (Verma et al., 2024); Lyme disease that is transmitted through tick bites during outdoor activities in North America (St. Pierre et al., 2020); and different water-borne zoonotic parasite infections contracted from swimming in open water (Nithiuthai et al., 2004). While green spaces such as parks and gardens are critical for urban ecosystems and communities, inadequate health and environmental management may result in the emergence of tick- and rat-borne diseases in humans and animals (de Cock et al., 2023; Smith et al., 2015).

Furthermore, the affection of animals has been driving the trade of various species for pets, facilitating the emergence and transmission of zoonoses during the translocation of live animals from their natural habitats to human-dense environments across regions and continents, regardless of the legality of these practices (Borsky et al., 2020; Pavlin et al., 2009). Meanwhile, pet ownership without proper veterinary care can lead to infections of different bacteria, fungi, parasites, and viruses in humans (Stull et al., 2015). Some pets (e.g., dogs) are also known as the intermediate host for disease transmission between humans and wild animals (Chomel, 2014). The health benefits of biophilic activities and the negative impacts of these activities on human and animal health, particularly in the context of zoonoses, raise questions about how to achieve the optimal health and well-being of humans, animals, and our shared environment in human-nature interactions.

## 2.2 The dilemmas of conservation, health, and local livelihood in zoonosis control and prevention

Many control measures for zoonoses involve culling or restricting wildlife movement, which often conflicts with conservation priorities and biophilic connection to nature. While these measures are intended to reduce disease transmission, they could cause unintended ecological, economic, and social consequences, which sometimes amply the risks they are designed to mitigate. For instance, mass culling of bats has been proposed as a response to outbreaks of rabies, Nipah virus, and Hendra virus in various countries. However, studies have shown that bat culling can disrupt colony structures and disperse infected individuals, potentially increasing the likelihood of disease spillover rather than preventing it (Anderson and Reaser, 2024; Miguel et al., 2020; Rocke et al., 2023; Viana et al., 2023). Additionally, bats play a vital role in pollination and insect control, and their population decline can lead to ecosystem destabilization and a decline in agricultural productivity (Kasso and Balakrishnan, 2013). In China, large-scale rodent control campaigns in the Inner Mongolia grasslands and Qinghai-Tibet Plateau for plague outbreak control and prevention have led to significant disruptions in the food chain. The extermination of Brandt's voles, considered a plague reservoir, has negatively impacted the populations of predators such as foxes, birds of prey, and weasels, leading to trophic cascades and further imbalances in rodent populations (Zhang et al., 2003). These interventions have not only been unsuccessful in eliminating disease risks but have resulted in broader ecological concerns.

Beyond the control of wildlife, zoonosis prevention measures by restricting human access to nature have the potential to impose hardship on local communities. The closure of wet markets and bans on wildlife trade, actions that have been implemented during the course of pandemics, resulted in economic losses and food insecurity for millions, particularly in developing regions, where local markets serve as primary sources of nutrition and livelihoods for local communities (Erokhin and Gao, 2020; Musa and Basir, 2021). In addition, the establishment of protected areas and conservation zones, aiming to minimize human-wildlife interactions, may unintentionally displace Indigenous and local communities, thereby restricting their access to critical resources such as food, medicinal plants, and culturally significant landscapes (Coad et al., 2008). Therefore, while implementing zoonosis control and prevention measures is imperative, their design and implementation must be equitable and just, considering the disproportionate impacts on vulnerable populations and socioeconomic factors, to not only protect nature and prevent diseases but also to promote the well-being of local communities.

# 3 Social and cultural dimensions of biophilia and zoonosis

## 3.1 Influence of social and cultural factors on human-nature interactions

Existing understanding of the various ways people interact with animals in local communities underscores the important role of social and cultural perspectives in shaping perceptions of disease risks and biophilia. Moreover, it reveals the significance of traditional and local knowledge in shaping views and perceptions about animals, thereby influencing human-nature relationships and interactions. For instance, communities and groups across diverse cultures and geographic regions describe animals as pets, pests, or food based on their knowledge and experience, resulting in varied patterns of human-animal interactions. In Asian and African countries, people from different cultures and ethnicities utilize various parts of pangolins for medicinal, food, and other religious and cultural purposes (Aisher, 2016; Boakye, 2018). Traditional medicine sourced from wild plants and animals remains an important healthcare resource for communities where access to conventional medicine is limited (Alves and Rosa, 2007). However, the belief in the medicinal function of some wildlife has been a driving force behind the sourcing and trade of animals and plants from the wild. These activities create opportunities for human-wildlife contact, which favors zoonosis emergence and transmission and results in the overexploitation of wild species.

Despite the conservation and health consequences associated with local practices, some culture-based practices can help reduce human-animal contact and potentially mitigate zoonotic risks. In many local and Indigenous communities, traditional knowledge is rooted in the profound connection to nature, characterized by beliefs in nature's offerings and the sanctity of the environment. This connection generates environmental stewardship, demonstrated by the reverence many cultures hold for specific species, considering them as totems or spiritual beings. This reverence plays a role in deterring interactions with these animals, contributing to conservation and zoonosis prevention (Landim et al., 2023). For instance, in Madagascar, Aye-Aye (a species of lemur) is regarded as sacred, and local communities adhere strictly to the taboo that helps limit hunting and consumption (Golden and Comaroff, 2015). While carnivores are often perceived as a threat to local livelihoods and agriculture, pastoral communities in South Asia and QinghaiTibetan Plateau China are found to be more tolerant of carnivores such as snow leopards and wolves, despite considerable livestock losses due to depredation. This can be attributed to the cultural perception of snow leopards as the guardian deity of the sacred mountains and the influence of Tibetan Buddhism (Kusi et al., 2020). These beliefs in sacred landscapes, groves, and animals in various cultural groups, often embedded in religions, represent the emotional, economic, and cultural attachment of human beings to nature (Kala, 2017). Similarly, Buddhist monasteries in Asia often function as sanctuaries for animals, protecting them from overexploitation (Dudley et al., 2009), which can potentially help mitigate zoonotic risks from hunting and consumption.

## 3.2 Leveraging local and traditional knowledge and practices in community initiatives

It is crucial to recognize and acknowledge the significance of local and traditional knowledge and practices in forming effective, ethical, and sustainable public health and conservation strategies that target human-wildlife interactions. The integration of traditional ecological knowledge into community-led conservation and sustainable resource management has yielded positive outcomes in some programs. For instance, in Ethiopia, the Oromo Gada system, an Indigenous institution, has managed natural resources and livestock in a way that prevents environmental degradation and reduces zoonosis transmission (Bedada, 2021). In Canada's Arctic, Inuit hunters have played a crucial role in tracking wildlife disease patterns, aiding in zoonosis monitoring and surveillance (Keatts et al., 2021). In West Africa, traditional healers incorporate plant-based treatments for zoonotic diseases like brucellosis and malaria in humans and parasites and infections in animals, reducing reliance on antibiotics and mitigating antimicrobial resistance (Gbenou et al., 2024; James et al., 2018). These examples underscore the potential of integrating and formalizing traditional knowledge and culture-based environmental stewardship to enhance zoonosis surveillance and prevention efforts and illustrate how such efforts can foster sustainable and culturally relevant practices in local communities through community participatory programs.

## 3.3 Developing culturally relevant communication strategies

Understanding and responding to local beliefs and cultures is vital for effective responses to disease outbreaks and zoonosis prevention, as well as fostering community trust to achieve further behavior change. In Bangladesh, despite the message from the health authority, the belief that the Nipah outbreak was caused by supernatural forces, instead of knowledge about bats as the source, hindered the protective measures taken by local communities to cease the consumption of contaminated palm sap by bats, causing Nipha virus transmission to humans (Parveen et al., 2016). During the Ebola epidemic in Sierra Leone, health officials collaborated with religious leaders to promote Ebola-safe burial practices that preserved cultural rituals while preventing disease spread. Religious leaders also served a critical role in community sensitization and communication of Ebola related information (Lee-Kwan et al., 2017). In Malaysia, scholars were integrating zoonotic risk awareness into the operation manual for halal slaughter to promote safe animal handling practices that can help prevent zoonoses (Min et al., 2018). Across the world, local religious leaders and groups have contributed to the preservation of ecosystems and the promotion of planetary health. These include

reducing wildlife trade and consumption and protecting forests through community engagement and policy advocacy (Mcleod and Palmer, 2015). In Vietnam, women play a primary role in poultry care and trade but were initially excluded from disease prevention efforts (e.g., avian influenza). Engaging women in training as peer educators is contributing to improved poultry management and zoonotic risk mitigation (Mitchell, 2019). Across these diverse settings, successful zoonotic risk communication efforts have depended on the use of culturally relevant messaging and culturally familiar narratives in a participatory manner to build community trust, sustain behavior change, and achieve more effective intervention.

# 4 Resolving the paradox and dilemma with a biophilia-based approach to zoonosis prevention

## 4.1 Fostering responsible biophilia for safe and sustainable human-nature connection

Despite the potential zoonotic risks from close human-animal contact, when guided by responsible principles centered on biodiversity conservation and ethical interactions with nature, biophilia can help mitigate these risks by maintaining healthy ecosystems and promoting safe and sustainable human-nature interactions. Biodiversity plays a critical role in regulating pathogen transmission and controlling host populations to limit disease spillover (Plowright et al., 2024). Responsible land use to protect intact ecosystems can serve as a natural defense against zoonotic threats while supporting local livelihoods (Dobson et al., 2020). Sustainable use of wild resources, such as regulated hunting, non-timber forest products, and agroforestry, can provide economic benefits while minimizing habitat destruction and human-wildlife conflict (Fromentin et al., 2023). Ethical and sustainable ecotourism exemplifies how human-wildlife interactions can be managed to minimize health risks while promoting conservation and economic benefits. In Liberia, ecotourism sites have been designed to allow safe bat watching without disturbing natural roosting habitats and reducing the likelihood of zoonotic transmission (IUCN and EcoHealth Alliance, 2022).

Human settlements and land-use practices should be designed in a manner that fosters both ecological integrity and public health. Urban planning that integrates green spaces without increasing vector habitats can improve human well-being and reduce disease risk at the same time (Fournet et al., 2024). In the United States, wildlife-friendly urban planning has considered bat-friendly dwelling designs, allowing people to coexist with bats in ways that reduce zoonotic risks while maintaining their ecological role in pest control and pollination (Pfeiffer, 2019). In addition, educational initiatives on responsible pet ownership have the potential to mitigate zoonotic risks associated with the exotic pet trade. These examples highlight the potential of a responsible approach to land, animals, and natural resources stewardship, which can foster a sustainable human-nature connection while contributing to human health and economic development. By cultivating a sense of responsible biophilia, we can transform human-nature interactions into opportunities for disease prevention, ensuring that conservation, economic development, and public health reinforce one another mutually rather than competing.

## 4.2 Promoting biodiversity conservation as a zoonotic risk mitigation strategy

Biodiversity conservation serves as a natural defense against zoonosis emergence by maintaining healthy ecosystems that regulate pathogen transmission (Plowright et al., 2008). Several community-led conservation programs have demonstrated the potential for synergies between conservation, public health, and local needs, pointing to the possibility of mutually beneficial outcomes (Brooks et al., 2012). Payments for Ecosystem Services (PES) programs compensate communities for biodiversity conservation efforts, reducing habitat destruction while lowering human-wildlife conflict and interactions and potential zoonotic spillovers (Salzman et al., 2018). In the agricultural sector, wildlife-friendly farming through reduced intensity of agricultural management and integrated conservation actions has been shown to increase the richness and abundance of plants, bees, and bird species (Pywell et al., 2012). Wildlife-friendly livestock management with non-lethal predator management and changes in grazing strategies have helped promote mammalian biodiversity recovery, thereby supporting healthy ecosystems for livestock and maintaining the co-existence of zoonotic pathogens and reservoirs to mitigate spillover risks (Schurch et al., 2021). Habitat preservation efforts, such as bat roost conservation, can help protect natural roosting sites and reduce stress-induced viral shedding and the likelihood of pathogen spillover (Ruiz-Aravena et al., 2022). Vaccination strategies, such as rabies control programs in dogs and wildlife, can help eliminate human rabies cases while preserving carnivore populations (Akinsulie et al., 2024). These examples demonstrate that preserving ecosystems is not only an environmental priority but a pivotal public health strategy, underscoring biodiversity as a fundamental element in zoonosis prevention.

# 5 Conclusion

These paradoxes and dilemmas are not insurmountable conflicts but complex interconnected challenges requiring collaborative and systematic solutions.

## 5.1 An integrated approach to transform biophilia into opportunities for zoonosis prevention

Promoting responsible biophilia and biodiversity has the potential to reconcile the paradox between fostering human-nature connections and mitigating zoonotic risks, informing

ethical decision-making that benefits human, animal, and ecosystem health. Integrating conservation efforts with sustainable natural resources management, ethical nature-based activities, and community-centered disease prevention strategies can help reduce the trade-offs between protecting biodiversity, safeguarding public health, and supporting local livelihoods. Instead of perceiving conservation and zoonosis prevention as disparate goals, an integrated approach emphasizes biodiversity as a primary mechanism for mitigating zoonotic risk while providing economic opportunities. Many existing cases have offered a feasible framework for people to coexist with nature safely and sustainably.

### 5.2 An equitable and just approach to build community-driven and culturally inclusive strategies for zoonosis prevention

Furthermore, the incorporation of cultural and social perspectives into conservation and zoonosis prevention strategies has been demonstrated to promote sustainable and community-driven solutions. Integrating local and traditional knowledge into local surveillance systems and resource management can promote ecological stewardship in ways that align with local cultural practices. Meanwhile, the implementation of culturally relevant risk communication strategies has demonstrated efficacy in fostering engagement and compliance by leveraging trusted local leaders, traditional storytelling, and community-led activities. These approaches ensure that solutions are not only scientifically sound but also acceptable, equitable, and sustainable to be capable of driving changes in the long term.

### 5.3 One Health principles as a guide for policymaking

These solutions will result from a paradigm shift in the development and implementation of zoonotic risk mitigation, transitioning from a siloed, discipline-specific, and academic process to a transdisciplinary, community-centered, and cross-sectoral collaboration. A One Health approach that recognizes the interconnections between people, animals, and ecosystems has the potential to encourage policies that balance human-nature connection and zoonotic risk management. These policies can guide various sectors, including urban planning, tourism, biosecurity measures, and other ethical and sustainable regulations in conservation and public health, acknowledging the value of biophilia. This approach is poised to foster collaborative efforts to break down the barriers between disciplines and sectors and transform the perceived paradoxes and dilemmas into synergies, resulting in solutions from short-term fixes to long-term resilience.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author/s.

## Author contributions

HL: Writing – original draft, Writing – review & editing.

## Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

## Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## References

Aisher, A. (2016). Scarcity, alterity and value: decline of the pangolin, the world's most trafficked mammal. *Conserv. Soc.* 14, 317–329. doi: 10.4103/0972-4923.197610

Akinsulie, O. C., Adebowale, O. O., Adesola, R. O., Banwo, O. G., Idris, I., Ogunleye, S. C., et al. (2024). Holistic application of the one health approach in the prevention and control of rabies: plausible steps towards achieving the 2030 vision in Africa. *One Health Outlook* 6 (1), 22. doi: 10.1186/s42522-024-00108-6

Alves, R. R., and Rosa, I. M. (2007). Biodiversity, traditional medicine and public health: where do they meet? *J. Ethnobiol. Ethnomed* 3, 14. doi: 10.1186/1746-4269-3-14

Anderson, C. J., and Reaser, J. K. (2024). Wildlife culling as a biophobic response to zoonotic disease risk: why we need a one health approach to risk communication. *Front. Conserv. Sci.* 5, 1488981. doi: 10.3389/fcosc.2024.1488981

Bedada, A. B. (2021). The role of traditional institution in managing natural resources; the case of Oromo "Gada" system in Ethiopia: A review. *J. Agric. Res. Pesticides Biofertil.* 2 (3), 1–10. doi: 07.2021/1.1036

Boakye, M. K. (2018). Influence of ethnicity on cultural use of pangolins in Ghana and its implications on their conservation. *Ethnobiol. Conserv.* 7.

Borsky, S., Hennighausen, H., Leiter, A., and Willieges, K. (2020). CITES and the zoonotic disease content in international wildlife trade. *Environ. Res. Econ.* 76, 1001–1017. doi: 10.1007/s10640-020-00456-7

Brooks, J. S., Waylen, K. A., and Borgerhoff Mulder, M. (2012). How national context, project design, and local community characteristics influence success in community-based conservation projects. *Proc. Natl. Acad. Sci. U.S.A.* 109, 21265–21270. doi: 10.1073/pnas.1207141110

Chomel, B. B. (2014). Emerging and re-emerging zoonoses of dogs and cats. *Animals* 4, 434–445. doi: 10.3390/ani4030434

Coad, L., Campbell, A., Miles, L., and Humphries, K. (2008). *The costs and benefits of protected areas for local livelihoods: a review of the current literature* (Cambridge, UK: UNEP World Conservation Monitoring Centre).

de Cock, M. P., de Vries, A., Fonville, M., Esser, H. J., Mehl, C., Ulrich, R. G., et al. (2023). Increased rat-borne zoonotic disease hazard in greener urban areas. *Sci. Total Environ.* 896, 165069. doi: 10.1016/j.scitotenv.2023.165069

Dobson, A. P., Pimm, S. L., Hannah, L., Kaufman, L., Ahumada, J. A., Ando, A. W., et al. (2020). Ecology and economics for pandemic prevention. *Science* 369, 379–381. doi: 10.1126/science.abc3189

Dudley, N., Higgins-Zogib, L., and Mansourian, S. (2009). The links between protected areas, faiths, and sacred natural sites. *Conserv. Biol.* 23, 568–577. doi: 10.1111/j.1523-1739.2009.01201.x

Erokhin, V., and Gao, T. (2020). Impacts of COVID-19 on trade and economic aspects of food security: Evidence from 45 developing countries. *Int. J. Environ. Res. Public Health* 17, 5775. doi: 10.3390/ijerph17165775

Fournet, F., Simard, F., and Fontenille, D. (2024). Green cities and vector-borne diseases: emerging concerns and opportunities. *Eurosurveillance* 29, 2300548. doi: 10.2807/1560-7917.ES.2024.29.10.2300548

Fromentin, J.-M., Emery, M. R., Donaldson, J., Balachander, G., Barron, E. S., Chaudhary, R. P., et al. (2023). Status, challenges and pathways to the sustainable use of wild species. *Global Environ. Change* 81, 102692. doi: 10.1016/j.gloenvcha.2023.102692

Gbenou, J. D., Toklo, P. M., Assogba, M. F., Ahomadegbe, M. A., Ahoton, D., Davo, A., et al. (2024). Traditional medicinal plants used in the treatment of viral diseases. *Adv. Tradition. Med.* 24, 99–131. doi: 10.1007/s13596-023-00687-1

Golden, C. D., and Comaroff, J. (2015). The human health and conservation relevance of food taboos in northeastern Madagascar. *Ecol. Soc.* 20 (2), 42. doi: 10.5751/ES-07590-200242

Heerwagen, J. (2009). Biophilia, health, and well-being. Restorative commons: Creating health and well-being through urban landscapes. 39–57. Available online at: https://www.nrs.fs.usda.gov/pubs/gtr/gtr-nrs-p-39papers/04-heerwagen-p-39.pdf.

IUCN and EcoHealth Alliance (2022). *One Health principles for sustainable tourism in protected and conserved areas: Accompanying principles to the guidelines for prevention, detection, response and recovery from disease risks in and around protected and conserved areas* (Gland, Switzerland: IUCN, and New York, USA: EcoHealth Alliance). Available online at: https://portals.iucn.org/library/node/50683.

James, P. B., Wardle, J., Steel, A., and Adams, J. (2018). Traditional, complementary and alternative medicine use in Sub-Saharan Africa: a systematic review. *BMJ Glob Health* 3, e000895. doi: 10.1136/bmjgh-2018-000895

Kala, C. P. (2017). Conservation of nature and natural resources through spirituality. *Appl. Ecol. Environ. Sci.* 5 (2), 24–34. doi: 10.12691/aees-5-2-1

Kasso, M., and Balakrishnan, M. (2013). Ecological and economic importance of bats (Order Chiroptera). *Int. Scholar. Res. Notices* 2013, 187415. doi: 10.1155/2013/187415

Keatts, L. O., Robards, M., Olson, S. H., Hueffer, K., Insley, S. J., Joly, D. O., et al. (2021). Implications of zoonoses from hunting and use of wildlife in North American arctic and boreal biomes: Pandemic potential, monitoring, and mitigation. *Front. Public Health* 9, 627654. doi: 10.3389/fpubh.2021.627654

Kellert, S. R., and Wilson, E. O. (1995). The biophilia hypothesis. Available online at: https://philpapers.org/rec/KELTBH?utm_source=nationaltribune&utm_medium=nationaltribune&utm_campaign=news.

Kusi, N., Sillero-Zubiri, C., Macdonald, D. W., Johnson, P. J., and Werhahn, G. (2020). Perspectives of traditional Himalayan communities on fostering coexistence with Himalayan wolf and snow leopard. *Conserv. Sci. Pract.* 2, e165. doi: 10.1111/csp2.165

Landim, A. S., de Menezes Souza, J., dos Santos, L. B., de-Freitas-Lins-Neto, E. M., da Silva, D. T., and Ferreira, F. S. (2023). Food taboos and animal conservation: a systematic review on how cultural expressions influence interaction with wildlife species. *J. ethnobiol. ethnomed.* 19, 31. doi: 10.1186/s13002-023-00600-9

Lee-Kwan, S. H., DeLuca, N., Bunnell, R., Clayton, H. B., Turay, A. S., and Mansaray, Y. (2017). Facilitators and barriers to community acceptance of safe, dignified medical burials in the context of an Ebola epidemic, Sierra Leone 2014. *J. Health Commun.* 22, 24–30. doi: 10.1080/10810730.2016.1209601

Mcleod, E., and Palmer, M. (2015). Why conservation needs religion. *Coast. Manage.* 43, 238–252. doi: 10.1080/08920753.2015.1030297

Miguel, E., Grosbois, V., Caron, A., Pople, D., Roche, B., and Donnelly, C. A. (2020). A systemic approach to assess the potential and risks of wildlife culling for infectious disease control. *Commun. Biol.* 3, 353. doi: 10.1038/s42003-020-1032-z

Min, M., Omar, M., Hashi, A. A., Wahab, R. A., Shahdan, I. A., bin Mohd Amin, M. H., and Shamsuddin, N. B. (2018). A preliminary study for developing operator manual for ruminant abattoirs on prevention of foodborne diseases and halal-compliance. *Int. J. Allied Health Sci.* 2 (3), 528-536

Mitchell, M. E. (2019). *A review of the literature: Gender, food safety and the pork value chain in Vietnam*. Australia, Sydney: University of Sydney.

Musa, S. F. P. D., and Basir, K. H. (2021). Covid-19 and food security in Southeast Asia. *Int. J. Sustain. Agric. Manage. Inf.* 7, 90–110. doi: 10.1504/ijsami.2021.116071

Nithiuthai, S., Anantaphruti, M. T., Waikagul, J., and Gajadhar, A. (2004). Waterborne zoonotic helminthiases. *Vet. Parasitol.* 126, 167–193. doi: 10.1016/j.vetpar.2004.09.018

Parveen, S., Islam, M. S., Begum, M., Alam, M.-U., Sazzad, H. M., Sultana, R., et al. (2016). It's not only what you say, it's also how you say it: communicating nipah virus prevention messages during an outbreak in Bangladesh. *BMC Public Health* 16, 1–11. doi: 10.1186/s12889-016-3416-z

Pavlin, B. I., Schloegel, L. M., and Daszak, P. (2009). Risk of importing zoonotic diseases through wildlife trade, United States. *Emerg. Infect. Dis.* 15, 1721. doi: 10.3201/eid1511.090467

Pfeiffer, M. J. (2019). *Bats, people, and buildings: issues and opportunities. Gen. Tech. Rep. FPL-GTR-265*. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 9 p. Available online at: https://research.fs.usda.gov/treesearch/57707.

Plowright, R. K., Ahmed, A. N., Coulson, T., Crowther, T. W., Ejotre, I., Faust, C. L., et al. (2024). Ecological countermeasures to prevent pathogen spillover and subsequent pandemics. *Nat. Commun.* 15, 2577. doi: 10.1038/s41467-024-46151-9

Plowright, R. K., Sokolow, S. H., Gorman, M. E., Daszak, P., and Foley, J. E. (2008). Causal inference in disease ecology: investigating ecological drivers of disease emergence. *Front. Ecol. Environ.* 6, 420–429. doi: 10.1890/070086

Pywell, R. F., Heard, M. S., Bradbury, R. B., Hinsley, S., Nowakowski, M., Walker, K. J., et al. (2012). Wildlife-friendly farming benefits rare birds, bees and plants. *Biol. Lett.* 8, 772–775. doi: 10.1098/rsbl.2012.0367

Rocke, T., Streicker, D., and Leon, A. (2023). "Management of Vampire Bats and Rabies: Past, Present, and Future," in *History of Rabies in the Americas: From the Pre-Columbian to the Present, Volume I: Insights to Specific Cross-Cutting Aspects of the Disease in the Americas*. Ed. C. E. Rupprecht (Springer International Publishing), 199–222. doi: 10.1007/978-3-031-25052-1_8

Ruiz-Aravena, M., McKee, C., Gamble, A., Lunn, T., Morris, A., Snedden, C. E., et al. (2022). Ecology, evolution and spillover of coronaviruses from bats. *Nat. Rev. Microbiol.* 20, 299–314. doi: 10.1038/s41579-021-00652-2

Salzman, J., Bennett, G., Carroll, N., Goldstein, A., and Jenkins, M. (2018). The global status and trends of Payments for Ecosystem Services. *Nat. Sustainabil.* 1, 136–144. doi: 10.1038/s41893-018-0033-0

Schurch, M. P., McManus, J., Goets, S., Pardo, L. E., Gaynor, D., Samuels, I., et al. (2021). Wildlife-friendly livestock management promotes mammalian biodiversity recovery on a semi-arid Karoo farm in South Africa. *Front. Conserv. Sci.* 2, 652415. doi: 10.3389/fcosc.2021.652415

Smith, A., Rock, M., Neumann, N., and Massolo, A. (2015). Urban park-related risks for Giardia spp. infection in dogs. *Epidemiol. Infect.* 143, 3277–3291. doi: 10.1017/S0950268815000400

Spanjol, K., and Zucca, P. (2023). 7 Biophilia, one health, and humane education: Mitigating global risk through embracing humanity's interconnection with the natural world. *SocioPolit. Risk Manage.: Assess. Manag. Global Insecurity* 4, 109. doi: 10.1515/9783110731217

St. Pierre, S. E., Gould, O. N., and Lloyd, V. (2020). Knowledge and Knowledge Needs about Lyme Disease among Occupational and Recreational Users of the Outdoors. *Int. J. Environ. Res. Public Health* 17, 355. doi: 10.3390/ijerph17010355

Stull, J. W., Brophy, J., and Weese, J. (2015). Reducing the risk of pet-associated zoonotic infections. *CMAJ: Can. Med. Assoc. J. = J. l'Assoc. medic. Can.* 187, 736–743. doi: 10.1503/cmaj.141020

Verma, A., Zaheer, A., Bisht, K., Gaidhane, A. M., Khatib, M. N., Sah, S., et al. (2024). Hong Kong's first human case of B virus: Feeding monkeys, a risky practice! *New Microbes New Infect.* 62, 101456. doi: 10.1016/j.nmni.2024.101456

Viana, M., Benavides, J. A., Broos, A., Ibañez Loayza, D., Niño, R., Bone, J., et al. (2023). Effects of culling vampire bats on the spatial spread and spillover of rabies virus. *Sci. Adv.* 9, eadd7437. doi: 10.1126/sciadv.add7437

Zhang, Z., Pech, R., Davis, S., Shi, D., Wan, X., and Zhong, W. (2003). Extrinsic and intrinsic factors determine the eruptive dynamics of Brandt's voles Microtus brandti in Inner Mongolia, China. *Oikos* 100, 299–310. doi: 10.1034/j.16000706.2003.11810.x