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# Editorial: Can technology save biodiversity?

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Editorial on the Research Topic
Can technology save biodiversity?

The question of whether technology can save biodiversity is central to contemporary conservation debates. With the rapid advancement of digital tools, remote sensing, and artificial intelligence, technological innovation is often presented as a necessary step to better monitor biodiversity decline or recovery (Besson et al., 2022). From biologgers to passive acoustic monitoring, technology-driven biodiversity monitoring tools have indeed significantly improved data collection, enabling researchers to monitor elusive species and track environmental changes with unprecedented precision. However, technological interventions alone are insufficient to address the biodiversity crisis. Biodiversity, understood as the variability of life on Earth in all its complexity, cannot be "saved" through a single act of technological heroism.

Conservation efforts are fundamentally political, shaped by interactions between ecosystems, human societies, and economic structures (Valiente-Banuet et al., 2015). While digital technologies can support conservation science, they are not neutral tools; they reflect the priorities, biases, and limitations of the societies that produce them. As techno-utopian narratives continue to dominate mainstream discourse, they risk masking the environmental costs of digital infrastructures themselves—ranging from resource extraction and energy consumption to electronic waste (Mullaney et al., 2021). In the worst-case scenario, the environmental costs associated with the production and operation of biodiversity monitoring equipment, as well as the analysis and storage of massive datasets, could outweigh the benefits for conservation and restoration programs. More studies are needed to assess the detailed environmental footprint of each technology-driven conservation initiative (Stephenson, 2020). Beyond carbon footprint assessments, new tools to evaluate the direct biodiversity footprint of environmental sensors, data analysis, and storage will likely help conservationists understand the potential impact of their monitoring choices (Marques et al., 2017).

The articles in this Research Topic of *Frontiers in Conservation Science* contribute to this discussion by examining both the possibilities and limitations of technology in conservation. For instance, passive acoustic monitoring has proved particularly valuable for detecting vocalizations of aquatic species living in turbid waters, such as the critically endangered manatee (*Trichechus manatus manatus*). By training a convolutional neural network to classify manatee calls and using unsupervised clustering techniques to estimate population sizes, researchers have expanded the scope of non-invasive wildlife monitoring (Schneider et al., 2024).

Similarly, advancements in remote sensing have transformed large-scale ecosystem assessments, allowing for more efficient and safer wildlife surveys compared to traditional observer-based aerial methods (Converse et al., 2024).

Furthermore, open-source hardware has emerged as a promising approach in ecological research. By reducing costs, increasing adaptability, and improving replicability, open-source devices such as SnapperGPS, OpenFlexure, and OpenCTD have democratized access to conservation tools. Hsing et al. (2024) argue that open-source technologies enable broader participation in scientific research, fostering knowledge-sharing and innovation while mitigating the financial and proprietary constraints of commercial equipment. These developments illustrate how technology can enhance conservation efforts and make scientific inquiry more inclusive and sustainable.

The poet Richard Brautigan famously envisioned "a cybernetic forest/filled with pines and electronics/where deer stroll peacefully/past computers/as if they were flowers/with spinning blossoms" (Brautigan, 1967). Yet, more than fifty years later, we are neither "free of our labors and joined back to nature," nor "all watched over by machines of loving grace." Instead, the expansion of digital technologies has often reinforced anthropocentric biases rather than addressing the deeper cultural and economic drivers of biodiversity loss. As Courtier-Orgogozo (2024) suggests, one explanation for the biodiversity crisis is that human perception is inherently limited by our senses. Conservation science must therefore seek to overcome these limitations, embracing a broader, non-anthropocentric approach to ecological understanding (Dominoni et al., 2020).

This challenge is particularly evident in the design of sensory interactions between animals and machines. The development of remote sensing and biologging technologies has allowed scientists to extend their perceptual reach, capturing data beyond human sensory capacities (Laine et al., 2024). For example, ultrasonic bat vocalizations, which are inaudible to human ears, can be visualized through time-frequency analysis, offering new insights into bat behavior and ecology. New technologies are also enabling us to better study wild animal cognition directly *in natura* Cauchoix et al., 2017. Such technologies do not "save" biodiversity per se, but they can play a transformative role in scientific research and public outreach by revealing hidden dimensions of the natural world (Ridgway, 2023).

A clear example of how technology can help "save" biodiversity is the replacement of traditional destructive biodiversity monitoring methods (such as those used in entomology) with non-lethal approaches (Lövei et al., 2023).

Finally, increasing reliance on technology to mediate our relationship with nature reveals a deeper paradox in the human condition—what environmental psychologist Peter Kahn has termed the dilemma of "technological nature ". In their 2009 article, Peter Kahn et al. argue that while such technologies may offer partial psychological benefits, they ultimately fall short of replicating the multisensory, relational richness of direct experience with the natural world (Kahn et al., 2009). The authors warn that increasing reliance on technological nature may lead to a "shifting baseline," whereby diminished ecological encounters become normalized, potentially weakening both human well-being and environmental concern. In this light, the technological tools designed to conserve biodiversity may, paradoxically, contribute to the erosion of our capacity to relate meaningfully to the living world—a contradiction that conservation science must carefully address.

Thus, the role of technology in biodiversity conservation must be approached critically. While technological tools can enhance our ability to monitor and study ecosystems, they should not be seen as a substitute for addressing the root causes of biodiversity decline—such as habitat destruction, overexploitation, and socio-economic inequalities. A balanced approach requires integrating technological advancements with broader political, cultural, and ethical considerations. Ultimately, the question is not only whether technology can save biodiversity, but whether biodiversity can challenge and reshape our technological paradigms toward a more sustainable, equitable and desirable future.

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## Conflict of interest

The authors declare 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 Generative AI was used in the creation of this manuscript. Some portions of the English text were revised with the assistance of ChatGPT, an AI language model developed by OpenAI, to improve clarity and grammar. The authors take full responsibility for the final content.

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