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OPINION

Will using artificial intelligence to review camera trap images reduce human connection to wildlife research?

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Abstract

Camera traps have been widely adopted in wildlife research and management; however, the manual review of the large volumes of images they produce is time-consuming and prone to errors. Artificial Intelligence (AI) platforms are becoming increasingly popular for automated image processing, as these tools can significantly reduce the time needed for reviewing images. Given the need for high-quality, rapidly accessible data for implementing conservation actions in a changing world, the use of AI holds great promise for conservation. Despite the potential of AI, we raise concerns regarding the loss of the human element in wildlife data review. We argue AI may miss unexpected discoveries in images and diminish the personal connection to wildlife and conservation landscapes which is fostered through manual image review. As human values are pivotal in soliciting investment in conservation, AI may pose a risk through the loss of human connection to ecological systems. Further, outsourcing image review to AI represents a loss of training opportunities for the next generation of scientists. Manual review of images also engages citizen scientists in scientific discoveries, fostering enthusiasm for conservation careers and community support for conservation actions. While acknowledging the benefits of AI in processing wildlife camera trap images, we call for meaningful conversation on how AI should be used in the advancement of wildlife research.

Given the recent challenges our field has faced with the advent of large language models (e.g., ChatGPT) in scientific training and research production, we should proactively begin conversations. We should prepare for discussion on alternative means of maintaining human connection to wildlife research, and alternative training opportunities for students and citizen scientists.

KEYWORDS

computer vision, data processing, ethical ecology, human-wildlife connection, image analysis, remote sensing, values, wildlife survey methodology

Camera traps are a leading tool in wildlife research and conservation (Steenweg et al. 2017), offering many benefits including long-term sampling, multi-species monitoring, and large-scale data collection (Burton et al. 2015). The rapid uptake of camera traps by many research groups facilitates collaborations, allowing ecological insights across study areas not otherwise possible (Fidino et al. 2021, Kays et al. 2022, Barnas et al. 2024, Burton et al. 2024). However, the benefit of abundant camera data provides an embarrassment of riches as large volumes of images require laborious manual review to convert to data. Manual review of camera-trap images is time consuming (Leorna and Brinkman 2022) and prone to human errors (Johansson et al. 2020, Zett et al. 2022). Wildlife researchers have therefore sought alternative means of processing large quantities of camera-trap images.

Artificial Intelligence (AI) platforms for automated processing of large image datasets hold tremendous promise for wildlife research. These tools use image training datasets with known values (e.g., camera images containing manually identified species), to classify images outside the training dataset. Artificial intelligence tools will eventually therefore be able to save researchers substantial time reviewing camera images. While there is some variability in AI platform performance, initial results show promise for detecting species presence/absence (Leorna and Brinkman 2022, Vélez et al. 2023). Improvements in AI technologies are inevitable and likely to occur rapidly in the era of ecological big-data (Farley et al. 2018). Therefore, wildlife researchers will soon have access to AI platforms that can rapidly review image datasets with high accuracy for individual species identification. Researchers will then have to choose between quick and efficient AI processing platforms or retaining costly and slow manual review of camera images. Given the financial and temporal stress for rapid access to high quality data (Hehmeyer 2024), it seems unlikely that many researchers would choose to manually review image datasets themselves when cost-effective AI options exist.

There are obvious benefits to the rapid processing of wildlife camera data, especially when conservation actions depend on the volume of recently collected high-quality data (Ahumada et al. 2020). However, will outsourcing review of camera trap images to AI platforms impact how researchers perceive and connect with their study systems? Leaving aside questions of AI performance and accuracy, under a perfectly tuned AI model that converts camera trap images to processed data, removing the human element from the review of wildlife data could present a loss of personal connection to wildlife and conservation landscapes.

Science proceeds by a mixture of induction and deduction, what Charles Pierce called abductive reasoning (Josephson and Josephson 1994). Underpinning discovery is observation of the unexpected, but since AI can only address questions or tasks it is asked to perform (Chowdhury and Sadek 2012, Braga and Logan 2017), human recognition of heretofore unknown processes is valuable for scientific insight. As one example, camera-image review of wolverine (*Gulo gulo*) images collected for species distribution modeling (Heim et al. 2017) showed distinct unexpected behavioral differences visible in camera images, leading to the discovery that wolverine

risk-avoidance behavior varied markedly inside and outside protected areas (Stewart et al. 2016). Images processed by AI would not have been able to discern similar nuanced patterns, as this required human intuition and creativity during laborious image review. A survey of the camera-trapping community will likely yield scores of more examples of human curiosity during image review, driving subsequent inquiry. Automating image analysis discards the kind of discovery of which only humans are capable, as this requires intuitive insight only acquired through diligent observation.

Fundamentally, conservation biology is a unique mix of science and human values (Bennett et al. 2017), values being critical for fostering investment in conservation actions (Kleespies and Dierkes 2023). Reviewing camera-trap images can better allow humans to observe and immerse themselves in study systems, a key component of conservation motivation, forming a deeper connection than would otherwise be possible due to time constraints on fieldwork (Whitburn et al. 2020). While AI will undeniably increase the efficiency of obtaining data for statistical analyses of wildlife populations, there is unique value in directly observing wildlife phenomena (habitat use, behavior, etc.) that has the potential to be lost due to automation. In-depth manual review of images provides an invested connection with the study site that allows nuanced insights from human intuition based on subtle cues and context, which would likely be overlooked by AI in the pursuit of simple classification unless otherwise directed.

Although technological advances in wildlife research techniques allow us to address new questions, these tools are being used by researchers who are already motivated and connected to wildlife. For example, developments in environmental DNA, stable isotopes, or drone technology allow researchers to explore wildlife in unprecedented ways, arguably deepening our connection to nature. Therefore, advancements in technology do not inherently result in reduced human-nature connection, but on the contrary can actually enhance it. However, we argue that camera-trap images differ from other sampling methods in offering a discrete and direct observational experience that allows researchers to view wildlife in both an informative and emotional manner. From our own anecdotal experiences, reviewing images and discovering, for example, sequences of bear cubs play fighting or a moose curiously investigating the camera, provides poignant reminders for why we research wildlife in the first place. Such moments reinforce our purpose and remind us of why we care about wildlife, serving as important motivation for continuing conservation research. We simply caution that losing those emotional moments of discovery during image review is a trade-off to be considered when using AI.

Related to the loss of personal connection to wildlife when using AI platforms, there is also a potential opportunity loss for training the next generation of scientists. Recognizing that many students cannot spend extended time in the field (Anderson 2017), manual review of camera-trap data provides training opportunities for undergraduate and graduate students, allowing direct observations of wildlife in their natural habitats that are otherwise impossible (Karlin and De La Paz 2015, Lasky et al. 2021). The use of AI for identifying wildlife in images will be contingent on well-researched, *a priori* questions; otherwise why would a study be conducted in the first place? However, ecological inferences from that processed data will depend on a solid understanding of natural history and species biology. As Anderson (2017:295) writes on the value of natural history, "I doubt Darwin would have made the breakthroughs that still drive much of biology had he not first been exposed to a wide range of organisms…it was his actual observations of plants and animals in the field that led him to his linking behavior with morphology in a real evolutionary synthesis." We contend the observational experience students gain from reviewing camera images as a supplement to time spent in the field, *sensu* Tosa et al. (2021), is an important aspect of training experience that should not be overlooked.

The opportunity for an exciting moment of discovery from cameras is very real and can foster early enthusiasm for science that is critically important for investment in conservation careers. Similarly, many research programs have used citizen scientists for reviewing images via online platforms (e.g., Zooniverse; Rivera et al. 2024), allowing their participation in scientific discovery. Given the increasing desire to involve community members and other non-scientists in wildlife research, removing this form of outreach may have negative consequences for promoting effective conservation actions which require community support. The argument may be made that AI could rapidly filter camera-trap data and extract these exciting images of rare species or events for easy viewing, but the pursuit

of discovery of these events for the first time by students or citizen scientists provides a much deeper level of investment and incentive to care about conservation.

We do not oppose development and use of AI in the review of wildlife camera images. Increasingly large camera datasets and the need for rapidly available high-quality data in conservation necessitate technological advancements in data processing (Ahumada et al. 2020), and the benefits of AI in wildlife camera-trap research for this purpose are many. The problems we propose are likely many years away, but there are many dedicated wildlife professionals working with AI to continuously test these new tools. The progress on AI development for use in conservation is only possible because of dedicated, enthusiastic individuals with a passion for wildlife science. However, given the inevitable progress of AI technology, we should prepare to think meaningfully about how we should use AI once more advanced models are available and no longer require diligent testing. It stands to reason that anyone who is using AI for wildlife image review is likely already enthusiastic about wildlife research, but we simply wish to generate discussion on what will change from the perspective of scientific creativity and personal connections through these tools. One requirement of integrating AI platforms into wildlife research could be developing alternative means of human connection with wildlife and conservation problems, or perhaps a simple emphasis on the importance of maintaining a connection with nature as wildlife researchers. It is also possible that AI will allow a flourishing of wildlife research by reducing the technical burden on researchers, therefore contesting the decline in disruptive science (Park et al. 2023). Initial experience with AI in the wildlife research field has shown we are not prepared for these difficult conversations, as demonstrated by novel large language models (i.e. ChatGPT) and their use in research and manuscript preparation (Conroy 2023, Stokel-Walker 2023). While we do not offer any specific solutions in this opinion piece, we believe this is a topic that deserves further open discussion, and users of camera traps should consider how they will approach their use of AI in the future.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

ETHICS STATEMENT

This opinion piece did not involve human or animal subjects.

DATA AVAILABILITY STATEMENT

No data was used for the production of this manuscript.

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