

## Conservation behavior in action: a comment on Harding et al

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### Behavioral Ecology

DOI:  
[10.1093/beheco/arz136](https://doi.org/10.1093/beheco/arz136)

Published: 01/12/2019

Peer reviewed version

[Cyswllt i'r cyhoeddiad / Link to publication](#)

*Dyfyniad o'r fersiwn a gyhoeddwyd / Citation for published version (APA):*  
Shannon, G. (2019). Conservation behavior in action: a comment on Harding et al. *Behavioral Ecology*, 30(6), 1513-1514. <https://doi.org/10.1093/beheco/arz136>

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## **Conservation behaviour in action**

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Word count: 975

The surge in research interest focussing on the effects of anthropogenic noise on wildlife over the past two decades has greatly increased awareness of the pervasive nature of this global pollutant across aquatic and terrestrial habitats (Barber et al. 2010; Shannon et al. 2016). Harding et al. (2019) now provide a timely review on this research topic, outlining the need to consider intraspecific variation in the response of animals exposed to anthropogenic noise. The variation in behavioural response between individual animals is not just a measurement of 'error' around the population mean, but it gives us crucial insights into how differences in sex, age, size, condition and personality can shape the reaction of an animal to an environmental stressor. Ultimately, these differences have the potential to affect the fitness of the individual and the wider population. Indeed, research on woodland caribou demonstrated that adult females exhibited marked variation in their strategies for selecting habitats affected by human disturbance, which significantly influenced their reproductive success (Leclerc et al. 2014).

The value of considering intraspecific variation in response to noise is well argued from a behavioural perspective in this review paper– an issue that is also highly relevant for research on other sources of environmental disturbance (e.g. artificial light at night). However, given the global extent of these pollutants, it is also important that the findings from individual behavioural-based studies can be readily used to inform conservation management and policy, so that the magnitude of the impact(s) can be determined and mitigation approaches implemented. Indeed, research on the effects of anthropogenic noise on wildlife provides an excellent example of a conservation issue that can be further evidenced by an improved understanding of animal behaviour. This is a topic that has been well debated in the literature over recent years (Caro and Sherman 2013; Greggor et al. 2016). The challenge in achieving greater integration between these two disciplines broadly centres around reconciling the longer-term population-level focus of conservation management with the shorter-term individual-level responses that are commonly documented by researchers studying the effects of anthropogenic disturbance (e.g. noise and light) on behaviour.

Firstly, it is important to emphasize that documenting shifts in behaviour provides crucial evidence regarding the potential impacts of acoustic disturbance across species, particularly

as the mediation of critical behaviours such as foraging, communication moving and vigilance are typically the first responses available to an animal facing environmental change. However, as Harding et al. (2019) note, longer-term measures of the fitness costs associated with noise exposure are also needed for gaining a detailed understanding of the population and ecosystem-level effects of noise. To date, there have been very few long-term sound exposure experiments that explore how animal behaviour or physiology changes over time and how this affects metrics of individual and population-level fitness – not least because these are challenging experiments to design and implement. Secondly, with a rapidly expanding evidence base on the effects of noise across a range of taxa and biological responses (i.e. individual animal behaviour to community-level structure), there is the opportunity to synthesise and analyse the results from multiple studies using meta-analyses to determine the weight of evidence regarding the specific impacts of different noise sources. However, as Harding et al. (2019) discuss, this requires accurate and consistent reporting of sound level metrics. This is especially relevant given the complex and diverse nature of anthropogenic noise, which varies in duration, amplitude and frequency (see Mckenna et al. 2016). Encouraging more rigorous characterisation of the acoustic environment offers an excellent avenue for improving our understanding of the impacts of noise exposure across species.

Behavioural research has the potential to help address a number of conservation challenges, particularly in light of the rapid environmental change that is the hallmark of the past century. However, the adoption of behavioural methods by conservation biologists has been relatively modest to date (Greggor et al. 2016). Anthropogenic noise research provides scientists and conservation practitioners with an excellent opportunity to highlight how the use of well-designed behavioural studies can greatly benefit our understanding of the diverse effects of this global pollutant. While great strides have been made over the past two decades in this field of research, there is a need for greater accuracy and consistency in the measurement and reporting of both the sound source and the biological response, so that evidence can be readily extracted and compared across multiple studies. As such, the review by Harding et al. (2019) outlining the importance of accounting for intraspecific variation, provides a valuable perspective on the future direction of behavioural-based research in addressing conservation challenges such as noise pollution.

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