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RESEARCH HIGHLIGHTS

Species interactions in the Anthropocene

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Abstract

Research Highlight: Van Scoyoc, A., Smith, J. A., Gaynor, K. M., Barker, K., & Brashares, J. S. (2023) The influence of human activity on predator–prey spatiotemporal overlap. *Journal of Animal Ecology*, https://doi.org/10.1111/1365-2656.13892. Few corners of the globe remain untouched by humans, and thus nearly all wildlife communities are influenced by human activity. Van Scoyoc et al. (2023) present a framework that places predator–prey interactions explicitly within an anthropogenic context, revealing that predator–prey dyads fall into one of four categories depending on whether predators and prey are attracted to or avoid human activity. These responses can either increase or decrease overlap among species via divergent pathways, which can help to make sense of seemingly conflicting patterns from prior studies. Their framework facilitates hypothesis testing, which they demonstrate with a meta-analysis of 178 predator–prey dyads from 19 camera trap studies. With evidence for each of the four pathways, yet some unexpected outcomes for temporal overlap among dyads, this review generates exciting questions and lays out a productive path forward to improve our understanding of species interactions in the Anthropocene.

KEYWORDS
anthropogenic effects, camera traps, human impacts, overlap, predator–prey interactions, trophic cascades

Human activity has reshaped ecosystems worldwide, with recent estimates indicating that a mere 3% of faunal communities remain unaltered by people (Plumptre et al., 2021). This biodiversity crisis has sparked a virtual firehose of studies aiming to understand how human activities such as habitat conversion, harvest, pollution and recreation are affecting terrestrial wildlife species. Technological advances such as remote cameras facilitate whole-community investigations at spatial and temporal scales that were previously not feasible (Palmer et al., 2022; Suraci et al., 2021), opening new possibilities to rapidly advance our understanding of species' responses to human impacts (Chen et al., 2022). Van Scoyoc et al. (2023) take a much-needed step back and propose an elegant framework with which to organize this flood of information, with a focus on understanding how human activities shape interactions among predators and prey. Their framework is firmly grounded in ecological theory regarding trophic interactions, organized explicitly within the context of human impacts. By developing this framework and applying it to data from published camera trap studies, Van Scoyoc et al. (2023) have contributed a valuable resource for interpreting prior studies and guiding future work.

Van Scoyoc et al. (2023) first review the varied ways that human activities can alter the behaviour of predators and prey. These behavioural effects can either reduce or increase overlap among predator–prey dyads, with subsequent implications for predation rates and cascading ecosystem-wide effects. They go on to propose that the continuum of behavioural responses to humans can be categorized into one of four pathways: (1) predator attraction, in which predators are attracted to human activity and prey avoid it, (2) prey refuge, in which predators avoid human activity and prey are attracted to it, (3) mutual attraction, in which both predators and prey are attracted to human activity, and (4) mutual avoidance, in which both predators and prey avoid human activity (Figure 1). Pathways

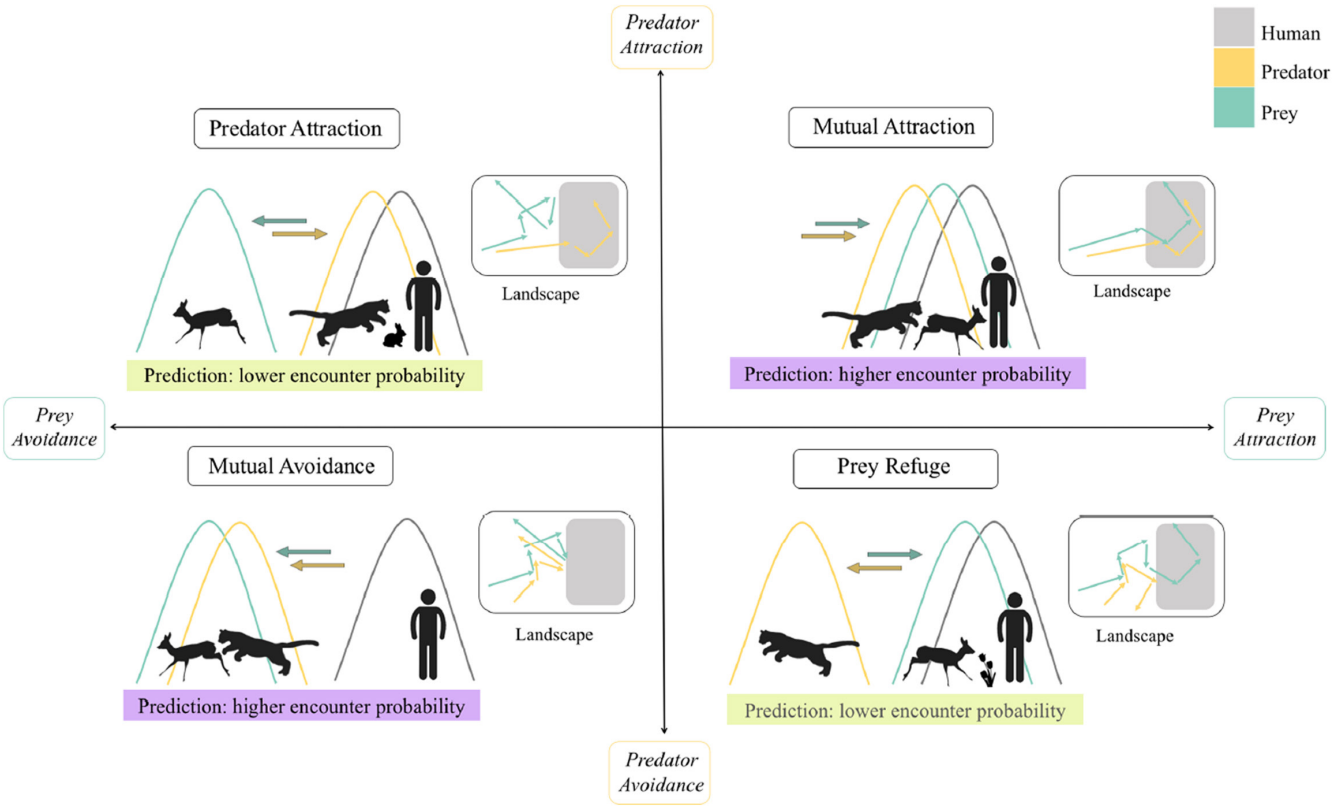

FIGURE 1 Conceptual framework for understanding the four ways that human activity can either increase or decrease overlap between predators and their prey, depending on the behavioural responses of each species to humans. "Predator attraction" occurs when predators are attracted to human activity but prey avoid it, which should reduce predator–prey overlap (and thus encounter probability). Conversely, "prey refuge" occurs when prey are attracted to human activity and predators avoid it, which should likewise reduce predator–prey overlap. "Mutual attraction" occurs when both predator and prey are attracted to human activity, and "mutual avoidance" occurs when both species avoid humans; both of these responses should increase predator–prey overlap and encounter rates (reproduced with permission from Van Scoyoc et al., 2023).

1 and 2 should reduce overlap (and thus encounters) between predators and prey, whereas Pathways 3 and 4 should increase overlap. They evaluated this prediction by conducting a meta-analysis of published camera trap studies, examining the effect of human activity on temporal overlap among 178 predator–prey dyads. They found evidence for all four pathways, with most dyads falling into mutual avoidance ($n = 70$) and prey refuge ($n = 60$) categories, and fewer dyads falling into the predator attraction ($n = 23$) and mutual attraction ($n = 19$) categories. Interestingly, temporal overlap between dyads did not consistently increase or decrease among dyads as expected based on these behavioural responses to human activity, and patterns appeared unrelated to functional traits of species such as hunting mode or body size. The authors use these surprising results to propose testable explanations and recommendations for future work.

Van Scoyoc et al. (2023) acknowledge several limitations and simplifying assumptions of their approach. First, they define "human activity" as encompassing both human presence and infrastructure, which species can respond to in divergent ways (Nickel et al., 2020). Second, their meta-analysis was limited to evaluating temporal overlap, because studies seldom reported both temporal and spatial responses. Third, they acknowledge that spatiotemporal overlap is a requisite for encounters that may lead to predation events, but other factors such as densities, ambient light levels and habitat structure can also strongly affect predation rates (e.g. Ditmer et al., 2021; Holling, 1966; Hopcraft et al., 2005). Finally, an implicit assumption of temporal overlap analyses in the context of predator–prey interactions is that prey are at greater risk of being detected by predators during times they are most active. While intuitive and likely valid for many species, this assumption remains untested. Given that predation rates are highest for the most sessile ontogenetic phases (e.g. neonates) for many species, this assumption needs evaluating. Rather than detracting from the value of their work, however, clarifying these knowledge gaps and current limitations is in fact one of the most valuable contributions of this review.

The framework proposed by Van Scoyoc et al. (2023) shows how dichotomous behavioural responses can lead to similar outcomes for predator–prey overlap, which helps to make sense of seemingly incongruous findings from past studies and to generate testable hypotheses rooted in general theory. Their work is also notable for placing species interactions front and center, as they argue that "understanding species interactions remains key to the coexistence and persistence of wildlife, and ecosystem function, in settings with high human activity." Indeed, species are embedded within communities

that can present seemingly intractable levels of complexity and contingencies (Lawton, 1999). However, interactions such as predation, competition, and facilitation are central processes in ecological communities, human altered or not. Integrating human impacts and species interactions into a unified framework, as Van Scoyoc et al. (2023) have done, is essential to advancing wildlife conservation in the Anthropocene.

AUTHOR CONTRIBUTION

LRP wrote the paper.

CONFLICT OF INTEREST STATEMENT

The author declares no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data have not been archived because this article does not use data.

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