Collaboration for Environmental Evidence

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Plain Language Summary
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Systematic Review
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There is no behavioural test or predator cue that is most effective for quantifying anti-predator responses in mammals, but accounting for variation in behaviour between males and females, and using appropriate control treatments is critical

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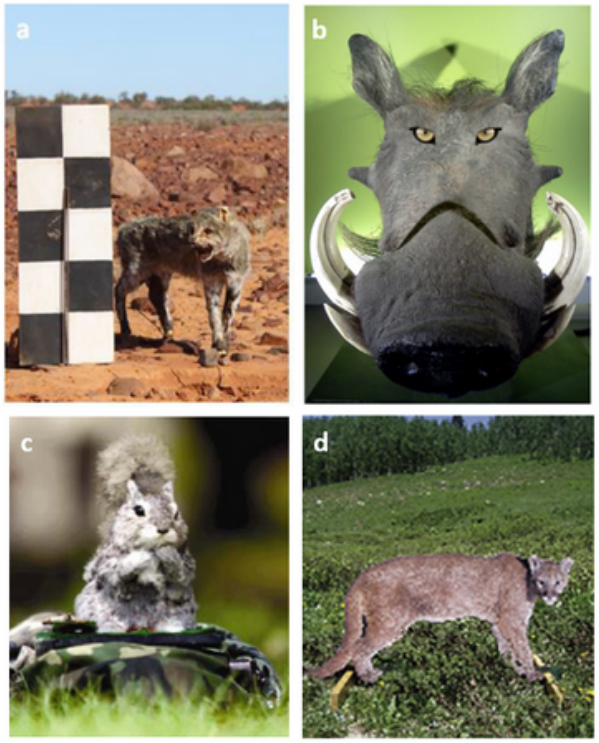


Examples of visual predator cues used to quantify anti-predator responses in mammals; taxidermied cat (a), warthog modified to include predator eyes (b), mechanical gray squirrel robot (c), and life sized photograph of mountain lion (d).

We compared six types of behavioural assay (evaluation of response) that quantified seven different behaviours. No single assay or predator cue was most effective. Studies that separated male and female responses found greater effects, demonstrating that it is important to account for sexual dimorphisms in behaviour. We make suggestions for the experimental design of studies of this nature, and highlight existing work, making it accessible for researchers and conservation managers alike.

Why is this Evidence Synthesis Needed?

Understanding anti-predator responses in mammals is essential for informing effective population management and conservation. To quantify such behavioural responses, robust behavioural assays and representative predator stimuli are required. This review evaluates the efficacy of six behavioural assay types (behavioural focal, capture probability, feeding station, flight initiation distance, giving-up-densities and stimulus presentation) and of various properties of predator cues by comparing the difference in behavioural response between the treatment and control groups in each study (effect sizes).

This Collaboration for Environmental Evidence Systematic Review synthesizes evidence to identify the most effective behavioural tests for quantifying anti-predator responses in mammals, comparing evidence from over 1000 studies.

Main Findings

What studies are included?

The review includes studies that measure how mammals respond to predators or a predator stimulus. There were over 1000 studies suitable to examine, from over 200 articles, most of which were conducted in Australia, Europe, or North America. The majority of studies were conducted on species that are not currently threatened with extinction.

Were there any behavioural assays that were best?

We examined six assay types (please see below) that measured five behaviours (activity, escape, exploration, foraging, vigilance). There was no one assay type or behaviour measured that proved most effective.

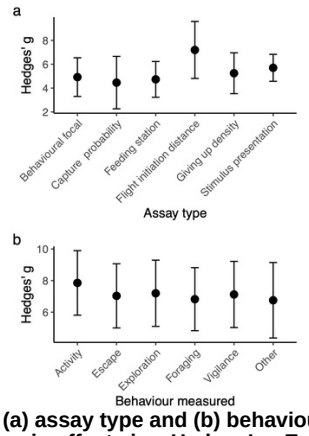
Assay type	Description
Behavioural focal	Ad libitum observations of unprovoked behaviours, without the presentation of a stimulus
Capture probability	The probability of an animal entering a trap. Traps may be treated with predator cues
Feeding station	Monitoring of behaviour around a food source. May include a stimulus
Flight initiation distance	The distance at which the animal flees from an approaching predator stimulus
Giving-up-densities	The food density at which the animal chooses to leave the foraging patch. May include a stimulus
Stimulus presentation	Behavioural observations of an animal following the presentation of a predator or other stimulus

What about predator cues?

Similarly, there was no predator cue type that was most effective, though we do reveal some important aspects regarding experimental design. When the absence of a stimulus was used as the control treatment, studies had higher effect sizes. This may indicate artificially inflated results, whereby the differences observed are merely animals investigating a novel stimulus, rather than displaying anti-predator behaviour, and hence appropriate control stimuli are important. Studies that compared males and females individually had better results than those that pooled them highlighting the importance of accounting for sexual dimorphisms in behaviour.

What are the Implications of the Review Findings?

Collating the variety of assay types that have been implemented can be useful for researchers and practitioners to scope out existing work, making it more accessible. Our review also highlights important implications for future research – we recommend that studies of this nature control for differences in responses between males and females, use appropriate control treatments (absence of stimulus does not serve as an effective control), use organic predator cues rather than synthetic ones, and calculate the repeatability of behavioural assays where possible.



Effect of (a) assay type and (b) behaviour measured on differences in effect size, Hedges' g. Error bars indicate mean +/− standard errors of the mean, and the larger the Hedge's g, the more effective the assay is.

Woylie_cagetrap: a picture of a small Australian mammal, the woylie (*Bettongia penicillata*), next to a cage trap. Capture probability (the willingness of an animal to go into a trap) can be used as a measure of anti-predator responses.

Synthesis Time Frame

The review includes studies published before April 2022, and the review findings were published in April 2023.

Full Citation

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