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DECLARATION OF INTERESTS

The authors declare no competing interests.

SUPPLEMENTAL INFORMATION

Supplemental information including two figures and experimental procedures can be found with this article online at https://doi.org/10.1016/j.cub.2026.09.086.

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Can protected area design and management mitigate human "super-predator" influence?

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Recent research by Liana Zanette and colleagues[1] in *Current Biology* from South Africa's Kruger National Park heightens awareness of wildlife's perception of humans as a 'super-predator'. It reveals that a wide range of savanna animals flee and avoid humans significantly more than other predators when hearing auditory cues. This creates disquiet amongst biologists and protected area managers, as it poses the question of whether the activity of conservation work has itself a negative effect on wildlife. Other research corroborates this effect across numerous biomes[2–4]. Neutral or mutualistic relationships between humans and wildlife may induce tolerance or even attraction[5], but where persecution or predation persist, the 'super-predator' label is emerging as a general rule. Protected areas should incorporate the outcomes of this research within their management frameworks. An ongoing attempt at this is described here.

Prioritizing biodiversity conservation in this context should ideally involve three strategies. First, researching the baseline measures of human-induced fear on wildlife[6]. Second, identify areas where the super-predator effect is less apparent, through minimal human presence, and build these into zonation systems that maintain and expand such zones within these protected areas. Third, to modify human behavior that invokes obvious adverse effects on wildlife. This is particularly significant where priority species are present, especially when human intervention plays a significant role in their protection. In South Africa's Hluhluwe-iMfolozi Park (HiP), these strategies are being woven into a newly developed Human Use and Behavior management framework (HUB), which draws from other protected area management frameworks[7,8], and includes a focus on determining and managing towards a desired condition of reduced human impact.

HiP has populations of white (*Ceratotherium simum*) and black rhino (*Diceros bicornis*), African wild dog (*Lycaon pictus*) and cheetah (*Acinonyx jubatus*), amongst other priority species[9], which illustrate strong human avoidance[1]. With anthropogenic impacts already being severe — especially rhino poaching and consequent management and law enforcement measures — the need to diminish additional stress should be prioritized. One-third of the park is designated as wilderness[9], thereby limiting human access to on-foot traffic. This may exacerbate human-induced fear because this type of contact emulates the long-evolved human–wildlife antagonism, and it crosses multiple senses and is not masked by vehicles, thus requiring supplementary measures to address previously unprioritized human impacts.

Rhinos occupy a central role in HiP's history and management[9] and also a median position in the study of Zanette and colleagues[1]. They thus are the obvious choice as an initial focus point for mitigating the super-predator effects of humans. The degree to which other animals would benefit from rhinos being used as the focus species requires ongoing research.

Within the HUB management framework, actions come in three categories: creating or engineering solutions; behavioral education of those accessing the protected area (including managers, law enforcement staff, researchers and visitors) to minimize anthropogenic impact; and lastly, enforcing regulations that achieve management goals[7]. Incorporating these actions, and their measured effectiveness, into the park management plan (and having it ratified by the relevant authority) provides regulatory rigor to withstand resistance from utilitarian user groups within the park and society. Such resistance may include the park management team itself. The innovations of the HUB management framework reduce human impact on wildlife through proactive zonation and human behavior change. In HiP, there is a negative correlation

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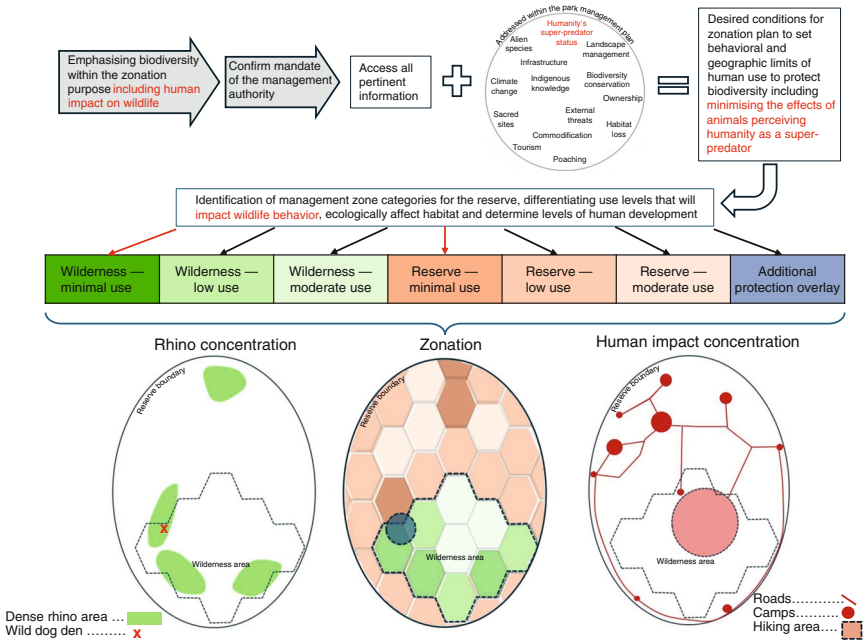


Figure 1. The initial steps of a human use and behavior management framework (HUB). Human super-predator impact is prioritized with red font or arrows. Resultant management zones are identified that reflect desired outcomes. Minimal use zones within and outside the wilderness identify existing or desired areas with minimal human impact. Additional protection overlays can supplement the existing protection measure within any of the zones. This zonation system is applied to a hypothetical reserve with a negative correlation between rhino concentration and human concentration. The inclusion of the HUB management framework captures the final zonation. The transition to a desired conditions framework includes the importance of regular monitoring; compulsory application of corrective interventions when monitored conditions exceed the standards; and the utilisation of delineated management areas (represented here as the hexagonal grid) to which zonation categories are applied.

between the presence of rhino (black and white) and high human activity[1,10]. Because spatial rhino data cannot be shared for security reasons, one application of the HUB framework is represented within a hypothetical protected area (Figure 1). Human activity has peak areas both within and outside the wilderness. Management areas are identified through a range of geographic criteria and demarcated throughout the park (hexagonal grid in Figure 1). The presence of low and high rhino concentration areas indicates respective and inversed areas of high and low human influence (Figure 1). The HUB framework may acknowledge existing patterns and can work towards desired conditions with the introduction of minimal use zones, and by concentrating and focusing human activity away from refugia. Additional, transitory or spatially flexible zonation needs — of priority species, habitats or vegetation types — can be accommodated within other zonation type overlays that depict a specific need, additional interventions or limitations. These could include denning cheetah or African wild dogs (Figure 1), vulnerable vulture nesting trees or threatened vegetation types.

Supplementing current zonation systems, HUB also addresses the human super-predator issue by identifying and altering impactful human behavior. These could include regulated minimum wildlife-impact courses for field leaders of management, law enforcement, research and tourist groups; limiting walking group sizes and types of permissible activity; limiting the number of vehicles in certain zones in the park and at points of interest; and implementing awareness programs with accompanying codes of conduct (Supplemental information). Strictly limited and regulated use of camera traps and drones is another form of behavior change, reducing the amount or frequency of human–wildlife encounters associated with law enforcement and biological monitoring. Such technologies may be used when, in balance, they reduce wildlife impact.

Park management, including zonation, could be determined by multiple criteria beyond human impact on wildlife. These could include other biodiversity issues, landowner and community benefit, sacred natural sites, environmental education, and tourism. Economically beneficial tourism, interactive environmental education and the inclusion of cultural practices are all activities that supplement the biodiversity value of protected areas. But with biodiversity protection being the primary purpose of HiP (acknowledged through proclamation, management priorities and stakeholder input), the mitigation of human super-predator effects must receive high priority within the ranking of zonation priorities and condoned behavioral practice.

Cementing this prioritization involves the awareness of park managers, scientists, planners, law enforcement and tourism staff to the significance and impacts of humanity's super-predator status and translating that awareness into action. The HUB management framework provides an implementable and enforceable roadmap of how to implement a new way of perceiving humanity and wildlife interaction that was brought into stark relief by Zanette and colleagues[1].

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AUTHOR CONTRIBUTIONS

P.C. - conceptualization, writing and editing. S.P. - writing and editing. D.J.D. - writing and editing. D.K. - writing and editing. S.M. - writing and editing.

DECLARATION OF INTERESTS

The authors declare no competing interests.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE MANUSCRIPT PREPARATION PROCESS

During the preparation of this work, the authors used Copilot to refine the wording

of the Figure 1 heading. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

SUPPLEMENTAL INFORMATION

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Letter

Primer on human–wildlife conflict misses the full picture

Adrian Treves[1,*], Naomi X. Louchouarn[1,*], and Erik Joaquín Torres-Romero[2,3]

The *Current Biology* primer on *Human–wildlife conflict* by Kaitlyn Gaynor and Jennifer Green[1] has many strengths. We agree with much of the content but highlight omissions of some important alternative hypotheses and worldviews. We call attention to a worldview that individual non-humans deserve consideration neglected in the primer. Also, we call attention to omissions of alternative hypotheses and foregrounding a non-leading hypothesis about tolerance for wildlife. The improvements to the primer we suggest would enhance the inclusivity of work on human–wildlife conflicts and also recognize the plurality of the scientific community. Therefore, we offer this letter to advance public understanding of coexistence with wildlife and place research on such topics on a firmer scientific footing.

We understand the journal format for primers prohibits in-line citations. All findings are provisional. In-line citations make the provisional nature and uncertainty of claims clearer as said claims might be contested or yield to other data. Lack of in-line citations presents a mirage of settled fact for a fast-growing, contentious field like ours. Gaynor and Green[1] bear no responsibility for the journal policy. We select two examples below to illustrate the mirage of settled fact. In one example, we agree with the authors' inference[1] and in the other example we do not. Both illustrate the need to treat alternative hypotheses with fair summaries and acknowledge our uncertainties. Any review or primer should aim for a pluralistic presentation of alternatives.

Below we present two examples that give the appearance of fact by not mentioning alternative hypotheses. The primer[1] presents a summary of top down effects of wolves on herbivores, which describes the effects of eliminating wolves on Yellowstone elk "[wolf]… absence relaxed top-down control on elk, allowing elk populations to grow and browse heavily on young willow, aspen, and cottonwood. The resulting vegetation decline cascaded through the ecosystem, with evidence that it reduced hiding cover for small mammals, limited berry production for bears, and altered riparian geomorphology." (p. R242)[1]. In our opinion, had Gaynor and Green begun with a summary of the more general multi-authored, global review of trophic downgrading across predator taxa and ecosystems[2], and perhaps ended there, they would have been on firmer scientific footing. The top-down effect of wolves on Yellowstone ecosystems is hotly contested[3], so treating those effects as settled facts denies the ongoing debate and risks playing into a mistrust of scientists on both sides of the issue. In this case, we agree on the importance of wolves to ecosystem health and structure, but our view is based on the strength of three independent studies from Wisconsin[4]. Rather than attempting a fairer summary of that scientific debate here, we are concerned more with the consequences for public policy and information when one hypothesis is deemed settled fact. Debate may be cut off when we dismiss alternatives. Hence our second example represents one in which we disagree with the view articulated in[1]. This disagreement gives us a better perspective on what has been lost when alternative hypotheses are ignored.

Gaynor and Green assert "The exclusion of people from protected areas … lowers tolerance for wildlife, thereby exacerbating human–wildlife conflict." (p. R243)[1]. While we agree that said conflicts are felt more strongly by people living near wildlife, this statement appears inaccurate as written for several reasons. First, the phrase "lowers tolerance" implies measurement of changes in individual tolerance, if one wishes to generalize as the quotation does. A recent review of studies of changes in tolerance for wildlife does not seem to support the claim[5]. Second, the

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