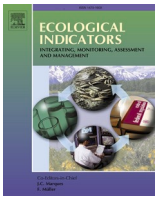
Ecological Indicators 120 (2021) 106887

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind



Letter to the Editor

Strawman arguments and flawed inferences: A response to Naha et al.

A B S T R A C T

Our study titled "The balancing act: Maintaining leopard-wild prey equilibrium could offer economic benefits to people in a shared forest landscape of central India" used an occupancy framework to provide baseline information on patterns and determinants of leopard occurrence and conflict in a human-dominated landscape. We also examined the role of wild prey in offsetting livestock depredation based on leopard diet. In their letter to the Editor, Naha et al. raise concerns about our study, claiming that our methods are inaccurate, and that our inferences are exaggerated. Here, we provide detailed responses to the issues raised by the authors, as we do not find any merits in their claims and reiterate the accurate interpretations of our findings.

A letter to the editor was recently published by Naha et al. (2020), in response to our paper titled "The balancing act: Maintaining leopard-wild prey equilibrium could offer economic benefits to people in a shared forest landscape of central India" (Puri et al., 2020). The authors have rightly recognized the difficulties in conducting surveys on elusive large carnivores at large spatial scales as well as the importance of accurate results for the conservation and management of these species. We agree with the authors that human-leopard conflict is an emerging serious conservation problem in India, and therefore, meaningful insights, relying on evidence-based research is critically needed.

We note that most of the points raised in the critique by the authors have been addressed in adequate detail in our paper, and other caveats have been freely acknowledged prior to acceptance and publication in this peer-reviewed journal. Despite this, our survey methodology has been misinterpreted and our results have been alleged to be erroneous. We stand by our robust study design, methodology, results and interpretation. We provide below detailed point-wise responses to claims made by Naha et al..

1. Claim: Naha et al. allege that "within such a multi-predator community it is not possible to distinguish between sympatric predator signs (pugmarks/tracks and scats) and hence there exists a high probability of false positive errors)". The authors further claim that we should have supplemented our field methods by deploying camera traps within a subset of the study sites and used species photographs to reduce false positive error rates.

Response: The human-dominated landscape of central India is a multi-predator system shared by sympatric carnivores including tiger, leopard, sloth bear, striped hyena and four canid species. To allege that distinguishing carnivore signs in a multi-predator system is not possible is tantamount to disregarding several other studies conducted in similar landscape-level scales across India, using indirect sign surveys as the primary survey methodology. The only other large-scale occupancy study from the Kanha–Pench landscape (Borah et al., 2016) uses identical methodology as ours (based on field methods and protocols developed by Karanth et al., 2011) and derive occupancy estimates of tigers from detection of indirect signs. In fact, the countrywide surveys of tigers, co-predators (including leopards) and prey conducted by the Indian government also relies on similar protocols to derive occupancy estimates. We agree that camera trapping is a better field methodology for unambiguous species identification and would provide accurate and precise estimates of carnivore occurrence. However, the scale at which our surveys were conducted (and the corresponding walk-effort required) did not make camera trapping logistically feasible. Molecular identification of species based on fecal DNA was beyond the scope of our study and resources available. Additionally, the indirect sign-based survey approach is a well-established and widely implemented methodology particularly when large spatial areas need to be surveyed with limited financial resources and trained field personnel are available.

2. Claim: The authors allege that our estimates of leopard occupancy are "highly unlikely" and that "leopard occupancy is several times lower in reality"

Response: We estimated the average occupancy of leopards to be 0.80 in the Kanha–Pench landscape. As scientists familiar with occupancy models would acknowledge, this is a probabilistic estimate, and the site-wise probabilities ranged from 0.20 to 0.95. While the focal species is different, Borah et al. (2016) estimate tiger occupancy to be 0.84 in the same landscape. It is common knowledge that leopards are highly adaptable and versatile carnivores, capable of persisting in disturbed or human-modified landscapes. Logic would dictate that a multi-use landscape that can support tigers at high occupancy levels could very well support leopard populations. We also emphasize that our approach combines best practices in field and analytical methods to arrive at quantitative estimates, which hold merit given the wide misuse and flawed implementation of spatial models (e.g., Naha et al. 2018). Our results are therefore of immense utility to conservationists and wildlife managers. Unless countered with different estimates from similar surveys in the focal landscape, this claim by Naha et al. is pure speculation and does not qualify as a critique.

3. Claim: Specifically with regard to our study design and scale of study for leopard occupancy and conflict, Naha et al. allege that "such results are contradicting since leopard occurrence was derived from field surveys conducted within forest patches and not multiple-use areas whereas questionnaires were conducted within 50% of the sub-sites (13 sq. km). Clumping and comparing results using data from two different study designs and spatial scale provide confusing results. Considering that leopards are adaptive and can occur in close proximity of

https://doi.org/10.1016/j.ecolind.2020.106887
Received 13 August 2020; Accepted 24 August 2020
Available online 4 September 2020

settlements, the authors should have surveyed all habitat types to generate reliable information on major drivers of occupancy and probability of human-leopard conflicts". Naha et al. also question that "if four settlements are selected within a sub-site with one interview from each settlement, the number of interviews should range from 1 to 16 and not 1–8 as mentioned by the authors."

Response: The indirect sign surveys were conducted in forest patches which are in fact multi-use areas, i.e., used by local people for collecting fuelwood, non-timber forest products, and for grazing cattle. There is no difference between what is defined as a forest or multi-use area in this landscape, as all forested areas outside of Kanha and Pench National Parks are used by people. For the questionnaire surveys (for estimating probabilities of depredation), our 52 sq. km grids were divided into four sub-cells of 13 sq. km each and every alternate sub-grid was surveyed for logistical feasibility and to ensure spatial coverage. Data from 13 sq. km sub-grids were pooled to the corresponding 52 sq. km grids so that inferences for the two surveys (indirect sign surveys and questionnaire surveys) could be made at the same spatial scale. Accordingly, there is no mismatch between our scales of inference as claimed by the authors. With reference to the number of respondents surveyed per grid, we have made it abundantly clear in our paper that every alternate sub-grid was sampled in a checkerboard pattern (the same has been explained in a figure as well). Given that 50% of the sub-grids were sampled, with four households sampled in each alternate sub-grid, the numbers add up to a maximum of 8 and not 16.

4. Claim: Regarding our methodology to elucidate responses pertaining to livestock attacks by leopards, Naha et al. state that "attacks on livestock, humans could have occurred outside the surveyed grids (13 sq. km) but are assumed to have happened within the grid. If the attacks occurred within the settlement, the authors should have mentioned the condition of livestock shelters and specific animal husbandry practices". They add that "[we] don't provide any quantitative or qualitative assessment of such drivers (apart from just the number of cattle holdings) within the settlement. It is important to generate reliable information on all sociological factors which increases the likelihood of predator attacks and not just in parts". They further state that "[we] provide recommendations on improving animal enclosures, increasing compensation amount to predator attacks and veterinary services for livestock without any evidence for such suggestions. Such recommendations are in general important for improving human-carnivore relations globally but were not derived from the outcomes of the current study".

Response: We reiterate that during the questionnaire surveys, respondents were specifically asked to report incidents within the village or in close proximity (in less than 3 km distance such that it would be within the sampling sub-grid). While we have not elaborated on the condition of livestock shelters, they are almost non-existent in the landscape, with rudimentary structures to secure livestock at night, or often just tied to a pole. Most studies of human-felid conflict from India are conducted at much smaller spatial resolutions allowing for social and ecological variables to be collected at the location of livestock/human attacks. A large proportion of these studies are based on forest department records. Given that there is documented evidence of under-reporting of conflict incidents across India (Karanth et al., 2012; 2013), we relied on self-reported incidents by local people. In addition, to allow for a comparative analysis of leopard occurrence and conflict, the scale of our grid cells did not allow for very specific predictor variables. We used variables at a coarse scale that helped us simultaneously identify hotspots of leopard occurrence and conflict. Our recommendations arise from a combination of results from this study, field-based knowledge gained while conducting surveys, and a heuristic understanding of human–wildlife–management relationships in the landscape. Our suggestions are therefore pertinent and important for reducing livestock attacks by leopards or other carnivores.

5. Claim: Naha et al. have dismissed our results due to potential misidentification of carnivore signs. They describe differences in carnivore signs and claim that we do not "adhere to a standard measurement/protocol for differentiating between sympatric predator scats while conducting fieldwork".

Response: We fully understand the challenges and issues with misidentification of scats and pugmarks. We exercised extreme caution when attributing species ID. In the field, species identification was confirmed by recording the presence of secondary signs (scrape marks and pugmarks). Signs that were ambiguous or could not be confirmed were not recorded during field surveys. The study presented here was conducted as a part of a larger project that examined the distribution patterns of 8 carnivores occurring in the landscape (see Srivathsa et al., 2019). We ensured that we were able to distinguish between scats of leopards with that of tiger, other canids or feral dogs. Scats were identified through a combination of (a) secondary signs such as scrapes and tracks where available, (b) size and shape of scats, and, (c) location of scats deposited. We are well aware of identification protocols for carnivore signs and did not deem it necessary to include elaborate details in our paper because these are established methods that have been in practice for more than a decade. We cannot emphasize enough the rigorous field protocols we followed during our surveys. As authors of the original study, we possess cumulative field and analytical experience of three decades working in wildlife-rich as well as degraded human-altered habitats, making quantitative assessments of animal populations at multiple spatial scales. Both the field and statistical methods employed in our study stem from extensive involvement in conducting empirical studies. Blatant dismissal of our results by Naha et al. based on threadbare counter arguments is outright disrespectful, besides unduly casting aspersions on our integrity as scientists and discounting the insights we have gained from years of experience.

6. Claim: Naha et al. allege that "[we] conclude that wild prey availability could be a reason for such high proportion [of leopard prey biomass consumed]" and that we "don't provide any reference for wild prey abundance neither do [we] estimate the same for the study site." They go on to state that "the conclusions derived from the present study which states that wild prey abundance is crucial to minimize human-carnivore conflicts and common leopards provide economic benefits to local communities in Central India is exaggerated, inaccurate and not based on science based evidence".

Response: Based on the results of our leopard diet analysis, we found that wild prey contributed nearly 90% of the biomass consumed. We compared our results to other studies conducted in human-dominated landscapes outside protected areas (Athreya et al., 2016; Kshettry et al., 2018). These studies found that leopards mostly consumed non-wild prey. In our discussion, we attribute these differences to higher prey availability in the Kanha–Pench landscape. Among the basic tenets of scientific exploration is the generation of new hypotheses which need to be validated by future studies. This is fundamental to the progress of science. The possible differences in prey availability across landscapes is one such potential hypothesis that our results provide. Estimation of prey abundance by direct methods at the spatial scale envisaged in our study was not practical and the application of indirect methods was beyond the scope of this study.

7. Claim: According to Naha et al., we state that "leopards reduce competition between wild and domestic prey" and that "this statement is somewhat contradictory". Naha et al. further add that "though large carnivores have been documented to have cascading effects of ecosystems, yet their presence provide economic benefits to local communities primarily through wildlife tourism related initiatives."

Response: We show that wild prey plays a major role in leopard diet in the focal landscape. Under hypothetical scenarios whereby wild prey abundance decreases, we show that leopards may shift their diet to domestic livestock to sustain their current population. This would consequently lead to higher conflict in the region as well as increased economic costs to people. Nowhere do we make claims about competition between wild and domestic prey. Moreover, the authors have made some conclusions about carnivores providing economic benefits to

people through wildlife tourism – this connection is completely unfounded and irrelevant to results presented in our paper.

As Naha et al. themselves assert, reliable evidence-based research can provide meaningful insights into conservation problems and their solutions. We also firmly believe that intellectual debates over published articles are integral for scientific advancement, and should lead to deliberations over philosophy, methodological approaches and insights gained from research studies. But the cavalier nature of their comments, inadequate attention to detail, and gross misinterpretations of our results leads us to question if the authors even read with requisite rigor, the final version of our paper published in this journal. Besides exemplifying unethical practices in academia, the letter by Naha et al. is a sub-standard critique that rests on conjectures and oblique comments, and is a serious impediment for furthering scientific discourse in conservation research.

Author contributions

For the original study, MP and AS conceived the ideas; MP, AS, KKK and NSK designed the survey methodology; MP and IP collected the data; MP and AS analysed the data; MP and AS led the writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We thank the Madhya Pradesh State Forest Department for providing research permits and supporting the study. DeFries-Bajpai Foundation, Rufford Foundation (UK), Ravi Sankaran Inlaks Fellowship and IDEA-Wild (USA) funded the study. The funding agencies had no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. M.P. and A.S. were supported by the University of Florida. A.S. was supported by Wildlife Conservation Society's Christensen Conservation Leaders Scholarship and Wildlife Conservation Network's Sidney Byers Fellowship. K.K. was supported by Oracle. Centre for Wildlife Studies and Wildlife Conservation Society-India program provided institutional and logistical support.

References

Athreya, V., Odden, M., Linnell, J.D., Krishnaswamy, J., Karanth, K.U., 2016. A cat among the dogs: leopard Panthera pardus diet in a human-dominated landscape in western Maharashtra, India. Oryx 50 (1), 156–162.

Borah, J., Jena, J., Yumnam, B., Puia, L., 2016. Carnivores in corridors: estimating tiger occupancy in Kanha-Pench corridor, Madhya Pradesh, India. Reg. Environ. Change 16 (1), 43–52.

Karanth, K.K., Gopalaswamy, A.M., DeFries, R., Ballal, N., 2012. Assessing patterns of human-wildlife conflicts and compensation around a central Indian protected area. PLoS ONE 7 (12), e50433.

Karanth, K.K., Gopalaswamy, A.M., Prasad, P.K., Dasgupta, S., 2013. Patterns of human–wildlife conflicts and compensation: Insights from Western Ghats protected areas. Biol. Conserv. 166, 175–185.

Karanth, K.U., Gopalaswamy, A.M., Kumar, N.S., Vaidyanathan, S., Nichols, J.D., MacKenzie, D.I., 2011. Monitoring carnivore populations at the landscape scale: occupancy modelling of tigers from sign surveys. J. Appl. Ecol. 48 (4), 1048–1056.

Kshettry, A., Vaidyanathan, S., Athreya, V., 2018. Diet selection of Leopards (Panthera pardus) in a human-use landscape in North-Eastern India. Trop. Conserv. Sci. 11.

Naha, D., Sathyakumar, S., Rawat, G.S., 2018. Understanding drivers of human-leopard conflicts in the Indian Himalayan region: Spatio-temporal patterns of conflicts and perception of local communities towards conserving large carnivores. PLoS ONE 13 (10), e0204528.

Naha, D., Dash, S.K. and Sathyakumar, S., 2020. Inaccurate methods and erroneous conclusions drawn on human-leopard coexistence in India–Response to Puri et al., 2020 "The balancing act: Maintaining leopard–wild prey equilibrium could offer economic benefits to people in a shared forest landscape of central India". Ecological Indicators, 117, p.106632.

Puri, M., Srivathsa, A., Karanth, K.K., Patel, I., Kumar, N.S., 2020. The balancing act: Maintaining leopard-wild prey equilibrium could offer economic benefits to people in a shared forest landscape of central India. Ecol. Ind. 110, 105931.

Srivathsa, A., Puri, M., Karanth, K.K., Patel, I., Kumar, N.S., 2019. Examining human–carnivore interactions using a socio-ecological framework: sympatric wild canids in India as a case study. R. Soc. Open Sci. 6 (5), 182008.

Mahi Puri[a,b,*], Arjun Srivathsa[a,c,d], Krithi K. Karanth[b,e], Imran Patel[b], N. Samba Kumar[b]

[a] *Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL, USA*

[b] *Centre for Wildlife Studies, Bengaluru, India*

[c] *Wildlife Conservation Society-India, Bengaluru, India*

[d] *School of Natural Resources and Environment, University of Florida, Gainesville, FL, USA*

[e] *Environmental Science and Policy, Nicholas School of the Environment, Duke University, Durham, NC, USA*

[*] Corresponding author.
E-mail address: mpuri@ufl.edu (M. Puri).