Human wildlife conflict in India: Do we need to debunk popular “ecological” theories implicit in conservation management?

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Abstract:

Conservation management in India appears to be based on a set of implicit oversimplified ecological beliefs. Using a thought experiment, I demonstrate here how management based on these beliefs is bound to lead to escalating human wildlife conflict (HWC). Mitigation measures such as capture-relocation are largely being used in spite of their demonstrated ineffectiveness or even counterproductive outcomes. It is time for ecologists to actively debunk the simplistic assumptions driving conservation management practices so that more realistic, scientific and data-based management can take the place of sentiment and ideology driven management.

Human wildlife conflict (HWC) has been on the rise quantitatively in terms of increased crop damage, livestalk kills and human attacks; as well as qualitatively in the form of increasing types of conflict issues. Although the problem is increasingly acknowledged the true causes are underexplored. It is routinely and rhetorically stated in almost every published paper or report from India that increasing human population, encroachment, deforestation, habitat fragmentation and pressure from developmental activities is responsible for the conflict (Baishya et al 2025, Mishra et al 2025, Chettry et al 2025, Bharti et al 2025, Routray et al 2025, Tiwari et al 2025, Akhila et al 2025). Although human population pressure and habitat loss are serious problems, whether they are necessary and sufficient causes of HWC remains an unaddressed question. A hypothesis driven approach and scientific methods of causal analysis (Prabhulkar and Watve 2025) have not yet been applied to the problem. Until then, the above-mentioned cause should be treated only as an unsupported belief or untested hypothesis. Although globally human population has been increasing and land use pattern changing rapidly, there are many examples of local reversal of this pattern. In many villages close to wilderness areas people have given up agriculture and migrated to cities in large numbers. Wildlife reserves have expanded their areas with good habitat management including restoration. HWC in these areas should have reduced if the often-stated cause was true. But conflict in the neighbourhood of such areas has increased considerably instead of being under control. Forest cover has a positive rather than negative correlation with crop damage (Dandekar et al 2025). The experience in and around Tadoba Andhari Tiger Reserve (TATR) is that as the area under the reserve and the intensity of habitat management intensified (Habib et al 2019) the frequency of human attacks increased by orders of magnitude (Menon 2024). There is no evidence at present that habitat restoration arrests HWC. An approach involving a collection of plausible alternative causal hypotheses for HWC and ways to test them differentially is only recent (Prabhulkar and Watve 2025) and not yet backed by sufficient empirical work in that direction.

The philosophy behind conservation management in India is based on a set of implicit assumptions that are taken from popular ecological perceptions. Concepts such as ecological balance, carrying capacity, natural mechanisms of population control, predator control of prey populations have been implicit in wildlife management. Animals are often assumed to have wilderness as their “preferred” habitats which are distinct and different

from human landscapes. This “two habitat theory” has no support from empirical studies and capture-relocation measures based on this theory have been ineffective (Ram et al 2024) and even counterproductive (Athreya 2011) but still continue to be the predominant measure of attempted mitigation. The increasing use of human habitation by wild animals are assumed to be because there is inadequate food resources left in their natural habitat. Everything natural is assumed to be good and everything man-made is bad in the popular perspective implicit in conservation management. However, in contrast, many human values and “good” versus “bad” perceptions predominate conservation policies. Seasonal food and water scarcity, malnutrition, early deaths, diseases and parasites are considered “bad”, although they are quite natural. Wildlife management tries to eliminate or at least minimize such “bad” elements. The concepts of animal rights, compassion and welfare is another dimension of some of the models of conservation (Horta 2010). These are not the principles of ecology but human cultural values which have dominated wildlife management specifically in India. In effect, conservation management is neither leaving it completely to nature, nor actively monitoring and managing it. The baseline concept behind making wildlife reserves has been to create an “undisturbed” state where all “balances of nature” will be restored. The populations would saturate when the carrying capacity is reached and in due course of time one would see an undisturbed, balanced and stable ecosystem. The ecological balance and animal rights dominated “romantic naturalism” has underlined conservation practices in India.

Although ecologists know that the concepts such as ecological balance, carrying capacity and stable populations are too simplistic to be real and useful, wildlife management appears to be still largely based on this set of implicit assumptions. Complex ecosystems have multiple non-equilibrium, unstable and stable equilibrium states with delicate tipping points (Storch et al 2021). The dynamics of an ecosystem is hardly predictable after removing all human activities. Nevertheless, a belief implicit in the Indian model is that of a mystic stable equilibrium and the “do nothing and do not allow to do anything” philosophy (Sankhala 1977). A passive, custodial care or rewilding model (Anderson 2023) assumes that if human “disturbance” is taken out, the balancing mechanisms would work mandatorily. With increasing HWC predominantly around (but not restricted to) the well conserved reserves, it has started coming to light that reserves do not necessarily lead to a balanced ecosystem

with populations stabilizing at their carrying capacity; herbivores and carnivores regulating each other's populations and so on. Instead, populations are overflowing and expanding their range, inevitably coming into human habitation and leading to conflict situations.

Let us examine here in a thought experiment using simple and well-known principles of animal behavior and evolution, whether such a happy, balanced and human disturbance free reserve is at least theoretically possible in a country like India. The thought experiment will also address the question whether human encroachment and habitat loss is the necessary and sufficient cause of HWC.

The set of assumptions:

1. We assume that a protected area in created with sufficiently large tracts of intact natural habitat. Degraded patches within the reserve, if any, are allowed to restore. This area is also assumed to be made completely free of any human activity. This assumption is made in order to examine whether habitat loss and human encroachment or disturbance are necessary causes for HWC.
2. The area has populations of species occupying the necessary diversity of niches including primary producers, herbivores, carnivores, parasites and degraders. The reserve may have been established with depleted populations initially but sufficient enough to grow back given adequate protection.
3. All populations grow by the well-known population models where either the reproduction rate or the death rate is regulated by animal density vis a vis resource availability. Primary producers create the resource for herbivores. Herbivores consume the primary producers at specific rates. Herbivores constitute the resource for carnivores who consume the herbivores at specific rates and grow in proportion to the consumption. Carnivores have limited life span and die at a constant rate even when food is abundant. This set of assumptions in text book models are sufficient to result into stable or stably oscillating populations (Krebs 2009).
4. All animals can judge the resource density and move to areas with greater resources. Animals can also explore new possibilities (Reader 2015) and eventually learn to optimize their foraging related and other biological cost-benefits (Shinde et al 2022). Individuals differ in their exploratory behaviour and natural selection acts on genetic

predispositions and culturally transmitted acquired traits and the ones with optimized cost-benefits get selected.

5. The reserve is surrounded by human habitation, mainly agriculture and livestock. Their entry into the reserve is assumed strictly prohibited. We also assume that this is followed meticulously and no resource within the reserve is consumed by humans and domesticated animals. Nevertheless, the movement of wild animals is unrestricted and they can move out of the reserve, as with the prevalent management practices in India.

The thought experiment:

The question addressed here is whether a stable and balanced ecosystem will be ensured under these assumptions and what is the inevitable outcome of such a system. Since we assume all population processes that classically lead to balanced, stable or stably oscillating populations, we expect some form of ecological balance if the reserve was an isolated habitat. However, there is an added complication. The reserve is surrounded by human habitation that has agricultural crops that serves as alternative food resources for herbivores and livestock as alternative prey for carnivores. As the populations are allowed to grow inside the reserve, there would be a series of natural consequences as follows.

a. Since herbivores can explore, it is natural that they start utilizing resources such as crops from the human landscape. As a result, the carrying capacity, which is assumed to be resource limited gets lifted upwards and herbivore populations can grow more than what the resources inside the reserve would have permitted.
b. When the populations saturate the carrying capacity inside the reserve, learning or behavioral selection for exploration will become stronger. Even if we make a starting assumption that animals have a natural fear of humans due to which they avoid human vicinity and prefer to stay in their “natural” habitat, when the population is close to the natural carrying capacity, there would be selection for explorers (Reader 2015) that venture into human habitation. If hunting is prohibited as it is currently in India, the cost of this exploration is meagre and benefit is large, so selection on genetic predisposition and/or acquired behavioral traits is expected to be very strong. This would inevitably result into rapid loss of human avoidance behavior. As a result, animals will increasingly start occupying the human dominated landscapes.

c. For some species some other resource such as breeding sites might be available only in the reserve. Such animals will have to feed in the human landscape but return to the reserve. For species that can breed within the human landscape, the range will start expanding.
d. For carnivores, if and when human fear starts reducing, hunting livestock is likely to be found easier than hunting wild prey and the food choice of at least some of the individuals is likely to shift. This will relax the predator control over the herbivore populations further on the one hand and increase movement of predators in the human settlement on the other.
e. Once predators start moving amidst human settlement, accidental encounters can result into human attacks; but the possibility that they are exploring alternative prey species is not impossible. Particularly when human fear is rapidly vanishing, if they explore humans as a possible alternative prey species, it is within the known principles of animal behavior. There is evidence that at some stage human ancestors were attacked by carnivores frequently. If at a later stage man-eating became rare, that must be because of some behavioral reason (Watve 1993). If the context changes, behavior can change accordingly. Therefore, increasing human attack might be an expected outcome of the prevalent conservation policy and not a rare freak incident.
f. For species that feed on crops and garbage in the human landscape and return to the reserve, the reserve will be now populated beyond its own the carrying capacity. Outside the cropping season, this excess population will have to feed within the reserve itself. This will lead to overgrazing and further depleting the habitat in the reserve and thereby reducing the effective carrying capacity further. This would increase dependence on food from human landscape, further leading to a vicious cycle. Eventually it is likely that the habitat within the reserve is impoverished by wild herbivore overgrazing without any human agency directly damaging the habitat.
g. A further consequence can be that the population which is already greater than what the habitat can support will be forced to move out and try to adapt to the human dominated landscape. Some species might be able to adapt to breed there. It is likely that very soon greater population will reside in the human habitation than in the reserve. The habitat within the reserve might get degraded by animal use rather than

by any direct human activity. Animal density would eventually be greater in the human landscape than in the reserve.

Throughout we have assumed that human entry in the reserve is completely prohibited. We have also assumed all the normally perceived population regulation mechanisms within the reserve to be intact. Thus, given sufficient time, rapidly increasing HWC will result even without habitat loss and human disturbance within the reserve. The results of the thought experiment differ from the implicit beliefs of ecological balance and natural population regulation mechanisms because of the following factors. The classical ecological models such as logistic growth, carrying capacity, natural population regulation mechanisms are based on the assumption of a closed isolated system with no inflow and outflow of populations. No wildlife reserve can be made this way at least in the Indian context. The assumption that animals are adaptable and exploring is also crucial for this result, which is a sound assumption supported by many behavioral studies (Reader 2015). Whether animals are attracted to crops and livestock due to push or pull factors (Sukumar 2019) does not seem to be crucial. In either case HWC is inevitable in the thought experiment.

It can be perceived that different stages of this thought experiment are already observable in reality. Many species including primates, wild pig and leopards are inhabiting and breeding within human landscapes more than in reserves. Leopards captured from conflict areas and released in to their “natural” habitats migrated back to human landscapes (Athreya et al 2011, Ram et al 2024). More anecdotes are in support of the predictions although systematic data are scanty. In some reserves more animal sighting are in the buffer zones and fringes than in the core areas. Crop damages have increases disproportionately greater than the population increase. Thus, there are already observable patterns compatible with the thought experiment.

If we reexamine the assumptions of the model once again, we see that by more realistic alternative assumptions the picture worsens rather than improving. The baseline assumption that animals prefer their natural habitat may not be true. Human settlements have greater all-season availability of water and also greater and easier food in the form of crops, livestock and garbage. Animals may have avoided human habitation so far not because they prefer “natural” habitats but because they avoid humans. With rapidly

reducing human fear, their habitat occupation is bound to overlap more with human settlements.

It is necessary to recognize that HWC is an inevitable outcome of prevalent conservation practices. In the light of increasing HWC, conservation practices need to look beyond giving effective protection to focal species and move to actively manage populations as well as shape the behavior of animals. The rapid loss of human avoidance behavior is a potentially important cause of HWC and therefore a primary concern.

Without a fundamental philosophical change behind conservation practices, any mitigation measures (Ministry of Environment, Forest and Climate Change, Govt of India 2021) are likely to be superficial and will have at the most some local and short-term success. For long term minimum conflict co-existence radical changes are needed shifting the focus from sentimental and idealistic perspective to a scientific one. The romantic naturalism will have to give way to a realistic, data driven and science based active interventional management of wild populations aimed at conservation of species, within species genetic diversity and complex interactions among them. The wildlife protection laws are based on principles believed at the time the laws were created. If science has progressed to find that the laws were based on wrongly perceived principles, there is sufficient ground to change the laws. Ecologists will have to come out clear on these issues. Actively dumping the oversimplified popular ecological theories implicit in conservation management is the first necessary step in changing the laws. Wild life researchers and managers will have to come out of the romantic naturalism mindset and focus on designing, modeling, experimenting, piloting, monitoring and scaling up a new set of management practices accompanied by a change in the legal framework for conservation.

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