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Balancing conservation planning and mitigation: perspectives from a case study of the Asiatic lions

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Diverse, often inter-disciplinary, approaches have been proposed to advance the conservation of lions (*Panthera leo*) and their natural habitats. The IUCN guidelines for the conservation of lions in Africa call for effective national policies at all scales, and legal frameworks with specific Action Plans preferably at a regional/population level, to achieve the goals of lion conservation while also planning for the equitable distribution of costs and benefits amongst local communities. However, general approaches must be tailored to specific circumstances, so here we provide an overview of the factors relevant to the particular case of Asiatic lions (*p.l.leo*). Taking stock of what has contributed to the remarkable recovery of these lions from the brink of extinction, we provide readers with background understanding of the steadily growing lion population in Gujarat, India. We focus on the management challenges that have arisen during the past two decades during which lions have increasingly moved, and dispersed, beyond the Gir Protected Area (Gir PA). We illustrate how the positive intersection between cultural predisposition, regulatory frameworks, and management interventions have contributed to this accomplishment. Despite the apparent history of success, the currently fruitful intersection of these factors are in fact dynamic and, to remain positive, need continuous review and adaptation. We highlight how mitigations that may strongly foster conservation when applied in moderation may be counter-productive in excess and also go on to evaluate the extent to which some of the lessons learnt can be generalised.

KEYWORDS

Asiatic lion, Gir Protected Area, human-wildlife conflict (HWC), conservation management, cultural tolerance

Introduction

Amongst the Felidae, big cats of the genus *Panthera* are the most at risk, and are a global conservation priority (IUCN SSC Cat Specialist Group, 2018). Their expansive spatial requirements, and potential for conflict with people, combine to make their conservation challenging (Bjordal, 2016). Diverse, often inter-disciplinary, management

approaches ranging from facilitating access to ecological resources, safeguarding against anthropogenic mortality, designing effective compensation, and framing legal responses that mitigate livestock losses, injury and human death have all been tried (Redpath et al., 2013; Krafte et al., 2018). These interventions can fruitfully be considered within the framework of case-studies that offer insights for what might, or might not, work elsewhere (Krafte et al., 2018). We suggest that the successful recovery of the Asiatic lion (*Panthera leo leo*) from the brink of extinction is a particularly informative example (Singh, 1997; Singh and Gibson, 2011; Singh, 2017a; Singh, 2017b). For readers interested in appreciating the wider canvas on which this case study has been drawn, we provide here an introductory review.

First, we will identify, and somewhat explore, the facets of management that appear to have contributed to positive conservation outcomes (Figure 1). We assess the role of each factor and draw from a wider perspective at a national scale as well as from published literature and compare with outcomes of our on-ground surveys in the Gir Ambardi Complex (GAC) (Figure 2). We, led by the first author, have focused on this area for long-term study (summarised from Meena et al., 2014; Nar, 2020; Meena et al., 2021). Lastly, we go on to consider whether interventions that are helpful when applied in moderation are at risk of being disadvantageous in excess.

Costs and benefits: the utilitarianism approach

For people residing in and around protected areas, the forests provide livelihoods, goods, services and recreation besides playing a significant cultural and spiritual role in their lives (Atrayee and Chowdhury, 2013). Conservation models based on utilitarianism may not readily accommodate this complexity (Knight, 1999). Of the diverse set of benefits they acknowledge, local communities widely specify ecosystem services as the most significant contribution of the protected areas (Allendorf, 2022). However, a conservation practitioner may evaluate benefits differently (Knight, 1999). Similarly, monetised measures of depredation 'cost' account for cause (livestock loss) and effect (economic loss) but generally ignore indirect effects and fail to account for less tangible emotional effects (Dickman et al., 2011; Jacobsen et al., 2021). As a general rule, despite a suite of benefits, local perceptions of big predators may often be ambivalent, based on overall costs and benefits experienced (Allendorf, 2022). Surveys of peoples' relationships with protected areas may too often miss important nuances and therefore risk misdirecting management planning (Bragagnolo et al., 2016; Allendorf, 2022). The fact that 50% of Asiatic lions now range outside Gir PA indicates that the dimensions of coexistence are varied, hard to quantify and even more challenging to reconcile. Here, we list some tangible benefits and costs, before exploring what we have learnt regarding peoples' values and perceptions.

People living around the Gir PA, are not dependent on the forest for their livelihoods: most are farmers (Meena et al., 2014). The villages within GAC differ in their interactions with lions and our surveys (955 interviews) examined the impact of the forests and lions on residents (Meena et al., 2021). Residents rated their frustrations related to agriculture – seasonal monsoon, market-rates for crops and crop-raiding – as more onerous than their conflict with lions in their village (which involved livestock depredation and anxiety for human safety). A majority of the farmers felt that lions helped in reducing crop raiding by ungulates, and in that sense were an asset. Livestock keeping was a traditional practice and predominantly (82% households) reared for subsistence (household consumption). In a 10-year period (2006–2016), about 432 livestock predation events occurred, of which only 167 (2% of 7000 livestock) incidents occurred in one-year (2016). Only 35% of livestock owners out of 350 claimed financial compensation. 38% of 121 livestock predation events involved free-ranging (unproductive) livestock between March and June 2020 (Nar, 2020). The free-ranging cattle lower the predation pressure on the expensive productive livestock. When weighed against other advantages of living close to the Gir PA, the financial implications of depredation may not be as considerable as at first it appears to be (Banerjee et al., 2013; Meena et al., 2014). The prevalent view amongst those surveyed was that ecosystem services provided by the forest via stabilising the seasonal monsoon and better crop productivity, and the role of lions as the apex species in maintaining the integrity of the forest,

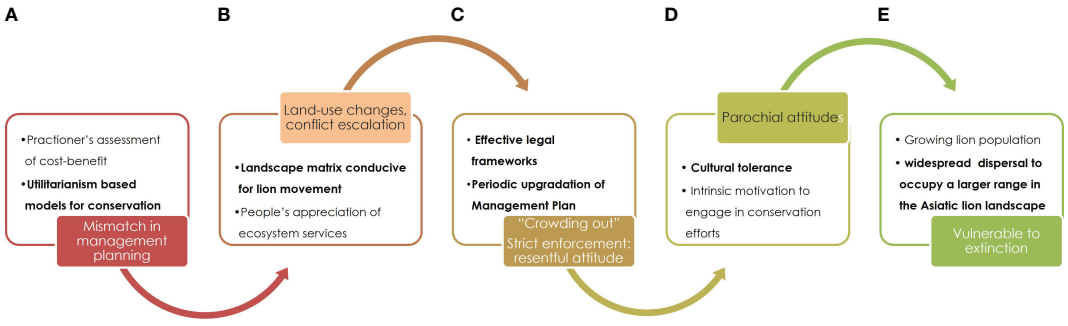

FIGURE 1
Diagram highlights five important factors contributing to Asiatic lion conservation success. The shaded boxes **(A–E)** indicate the negative repercussions of these factors when not in moderation. The diagram justifies holistic planning.

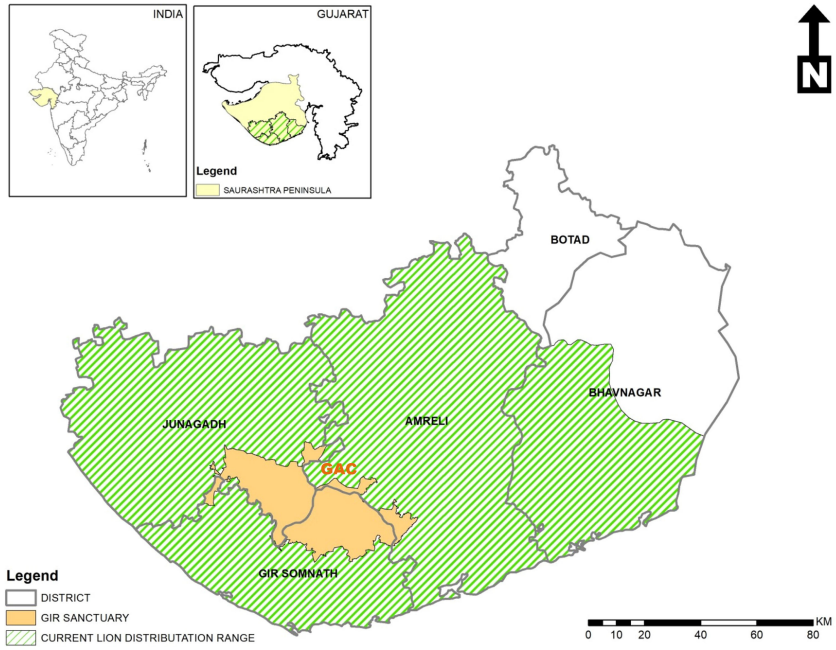

FIGURE 2
Map showing permanent range of the Asiatic lion in and around Gir protected area. Inset shows the location of the Sauarashra, the peninsular region of the Gujarat state which is the home of the Asiatic lion.

were the principal benefits of the protected area (Meena et al., 2014).

Clearly, the interactions of people with the Gir PA are multi-faceted so that costs related to co-existence with lions, whether real or perceived, should be viewed holistically. Thus, conservation interventions that mitigated crop losses to wild ungulates would promote positive attitudes towards wider conservation goals. Resolving human-leopard conflict is another key area for management intervention as local attitudes towards leopards tends to be more negative (Meena et al., 2021). Understanding these nuances and using that understanding to optimize perceived benefits will help foster better partnerships with local people. By piecing together these data, we have come to understand that low cost of upkeep, lesser livelihood dependency, monetary compensation and availability of unproductive stock, the financial impacts or tangible cost of depredation are relatively less in the Gir landscape than might have been expected.

Conducive landscape for dispersing lions

The landscape in which the Asiatic lion occurs consists predominantly of agriculture fields and patches of natural habitat – each the subject of various legal and administrative regulations - with human habitations scattered within this matrix of land-uses. Patches of natural habitat act as stepping-stones, refuges, and passage for lion movement between the source habitat of the Gir PA and various sink habitats (Ram et al., 2022a; Ram et al., 2022b). For example, the GAC extending from the north-eastern boundary of the Gir PA is an important movement corridor for the expanding eastern subpopulation of lions, and currently accommodates nearly 60% of the lions surviving outside the Gir PA. The GAC complex covering an area of 400 km^2, consists of 73% natural patches (Dense Forest, Open Forest, Scrub, Grassland and Barren areas), 26% agricultural lands while less than 1% of the area is Water and Settlement. In practice, excluding the latter 1%, the rest of the area is available for lions to move freely.

Thus, present land-uses, including expansive open areas, agriculture fields and natural patches, are compatible with lion survival (Ram et al., 2021; Ram et al., 2022a).

National and legal frameworks

Biodiversity conservation in India is largely achieved through a PA network distributed across the country, designed to represent all major biogeographic zones (Mathur, 2014). The numerous laws and legal guidelines applying to this PA system are important factors in the persistence of a variety of natural ecosystems and Indian wildlife. Depending on degree of protection and accessibility for resource-use, forests in India are notified as Protected Forests, Reserved Forests, Sanctuary or National Parks. The first two fall under the Indian (Forest) Act, 1927 and the latter under the Wildlife (Protection) Act, 1972 (WLPA). Conservation Reserves and Community Reserves, (WLPA amendment 2002), and Tiger Reserves, (WLPA amendment 2006), Critical wildlife habitats (Scheduled Tribes and Other Forest-Dwellers [Recognition of Rights) Act, 2006 (FRA)] have been designated to strengthen and expand areas under legal protection. Additionally, Eco-sensitive

zones (Environment (Protection) Act, 1986) are intended as "shock absorbers", around the legally designated PAs, adding another layer of protection within which detrimental developmental activities are forbidden. Indian wildlife is categorized from Schedules I to VI, and prioritized accordingly under the WLPA. Within this framework, Asiatic lions are designated as high conservation priority under Schedule-I of the WLPA and listed as 'Endangered' in IUCN red-listing. They are also on Annex I of CITES.

The Gir Wildlife Sanctuary (1153.4 km^2) and Gir National Park (258.7 km^2) together constitute the Gir Protected Area or Gir PA that is administered by the Gujarat State Forest Department (Figure 2). Mindful of evidence on the dispersal and range expansion of lions, the PA boundaries have been rationalized to include Paniya Wildlife Sanctuary (39.6 km^2), Mitiyala Wildlife Sanctuary (18.2km^2), other Reserved Forests (227.9 km^2), Protected Forests (10.7 km^2), and Unclassed Forests (77.3 km^2). Agriculture lands fall under individual ownership, while areas of 'commons' are managed by the village administration and categorized as Revenue lands.

While regulated activities and resource-use by people is permitted within the Gir Sanctuary, the National Park is inviolate. Tourism is regulated and permitted only along chosen routes within the Sanctuary. Tourism on private lands is considered illegal, and therefore punishable. Additionally, religious tourists are permitted to visit two temples located within the Sanctuary. The resident indigenous pastoralist community – *Maldharis* - are allowed to graze livestock within the Sanctuary, albeit under the restrictions of relevant regulations. Other communities living within 5km of the Gir PA boundary do not have this right.

Clear-cut legal demarcation of protected areas, together with stringently defined and enforced regulations, have been key factors in the effective conservation of lions. The result is that there are few cases of lethal retaliatory responses to conflict with wild animals, and consequently there are few prosecutions.

Management plans and implementation

Across the wider extent of the lion's geographic range, the species' general decline has been linked to poor protected area management, along with human-wildlife conflict, prey depletion, habitat loss and killing for trade (Bauer et al., 2022). In Gujarat State about 9.6% of land is forested, and there is a considerable budget for forest conservation (approx. 216 million USD), which supports also the Gir PA. Further, revenues from tourism made available through the Gujarat State Lion Conservation Society (GSLCS) are earmarked for lion conservation. Other funds under various schemes such as the India-ecodevelopment projects, Biodiversity Conservation & Rural Livelihood Improvement Project (BCRLIP) support the development of diverse strategies while adequately financing strengthened protection, resources and facilities for conservation action (Mishra et al., 2010).

The Management Plan is the manager's blueprint of standard operating procedures in PA management. Since its inception in 1965, the Management Plan for the Gir has been revised 7 times (Vasavada et al., 2022). The Management Plans prepared and revised every 10 years, have progressively extended from protected area management to landscape-level conservation planning (Singh, 2017b).

Meeting the challenges posed by dispersing lions, particularly at the human-PA interface, better outreach via *van mitras;* rapid response teams to allay people's apprehensions while also protecting lions from harm are enforced. Boundary walls around over 17,000 open irrigation wells have been secured through direct intervention or via NGOs to safeguard lions (Singh, 2017b). Furthermore, financial compensation is offered for livestock loss, human injury and death as a post-conflict mitigation package.

The foregoing schemes are under frequent review, and often upgraded. The number of state-of-the art wildlife rescue centres has grown from one in 2010 to 6 in 2023, and these are distributed across the Gir landscape. Financial compensation has been revised about 10 times since its first implementation, with payments scaled-up from an original yardstick of 15% to rates nowadays that are close to the market value of the livestock lost to predation. Recently, on-the-ground monitoring has been strengthened through use of technological interventions (Ram et al., 2022c).

Culture and religion

Cultural perceptions are critical in determining a community's outlook towards conflict and its resolution (Knight, 2000). Characterising the nuances of cultural attitudes that impact conservation is difficult, and local people find these hard to articulate (Allendorf, 2022).

In India, cultural acceptance, associations and a positive affinity towards wildlife and nature comes from the underlying philosophy or outlook to other forms of life advocated by the diverse faiths practiced here whether Hinduism, Jainism, Buddhism or Islam. In Hindu mythology, animals are venerated or worshipped as deities, or as *avatars* (incarnations) of God, and as *vahanas* (vehicles) of the deities, and therefore are sacred by association (Krishna, 2010). In the Gir landscape, religious faith is a strong candidate to explain tolerance of lions. Vishnu, regarded as the supreme God in Vaishnavism, is believed to have taken ten incarnations to protect his devotees. The Fourth incarnation of Vishnu is in the form of *Narasimha* - a lion-human form, with the body of a man and head and claws of a lion. This depiction is the direct association of lions as a form of God, and can be found in epics, iconography, and temple and festival worship for over a millennium (Divyabhanusinh, 2005). Another association of the lion is as a vehicle for the goddess Sakti or Parvathi when she took a ferocious form as *Chamunda mataji* to conquer two evil demons. In the *Chamunda* temple, the goddess is depicted with the lion as her *vahana*. The temple is in Chotila, Surendranagar district of Gujarat, where free-ranging lion populations were recorded till the turn of the 19th century. For many communities, particularly for the erstwhile princely community, the Kathi durbars (prevalent in the present lion range), *Chamunda maa* is the Kul devi or primary deity of worship. These communities venerate lions. It seems evident that these beliefs add impetus to the protection of lions within this anthropogenic landscape.

Our earlier published community surveys evidenced a general absence of direct persecution, together with stated positive opinions, all pointing strongly to cultural tolerance, notwithstanding a sharp increase in human-lion conflict. However, our interviews of residents of GAC suggested that religion was not associated with the tolerant attitude towards lions (Meena et al., 2021). Rather, we concluded that a positive ethos towards life situations, and compassion towards other life forms, underlay the cultural tendency for people to coexist with lions in the GAC (Meena et al., 2021). The culture of tolerance, especially love for lions albeit without a direct link with religion, has been a very strong factor contributing to the survival of lions.

Discussion

How are the foregoing, and powerful, factors affecting conservation, juxtaposed in the case of the Gir lions? We argue that all these factors must be aligned in order to function in synchrony, and when they are out of kilter each can undermine the effect of the others (Figure 1).

We begin with a utilitarianism model in lion conservation that aims simply to minimize costs while maximizing benefits (Figure 1A). The Gujarat Forest Department, having access to ample financial resources, is inclined towards such conservation management models.

Consider financial compensation for depredation losses as a cost reduction scheme. Critiques of financial compensation point out that it can increase stocking rates of livestock and weaken protection, due to an improved cost benefit ratio; on the other hand, proponents consider compensation a powerful tool for improving local tolerance of carnivores (Bauer et al., 2017; Nyhus, 2005). Even so, the perceived costs of the loss, in terms of cultural values and distress, may exceed even the full economic costs (Jacobsen et al., 2021; Jacobsen et al., 2022).

Apparently, the cost of depredation in Gir, is presently more or less harmoniously balanced by other factors such as partial grazing rights, reduction in damage by wild ungulates, and cultural tolerance, all in the context of the low-cost of impacts and the sufficiency of monetary compensation. The latter overcomes the common shortcoming of financial compensation not covering the real economic cost of the lost stock (Dickman et al., 2011). Despite these hitherto positive considerations, our surveys indicated that negativity towards lions is increasing as their numbers, and associated rates of depredation, have increased (Meena et al., 2021).

The Gujarat state government's tourism policy has increased tourist inflow and associated revenue in the past 10 years, notwithstanding even the travel lockdowns during the covid pandemic (Anon, 2022a; Anon, 2022b; Anon, 2023; Kateshiya, 2023). These revenues are not being explicitly shared with the local people who tolerate the lions, but instead spent in the overall PA management and protection. As a model for maximising benefits, it seems that a fairer distribution of revenues through a tourism-based economy would give added impetus to conservation goals. However, this may well restrict other land-use options and livelihoods (Dickman et al., 2013). Furthermore, the positive impacts of tourism on local incomes and conservation are sometimes exaggerated (Rao and Saksena, 2021).

Schemes thus configured under an entirely utilitarianism approach related to costs (financial compensation) and benefits (tourism promotion), typically "crowd out" or undermine people's intrinsic motivation and conservation ethics (Rode et al., 2015). Preoccupation with financial profit-and-loss could lead to drastic alteration of the landscape in ways inimical to lion survival (Figure 1B).

The legal framework has been thoughtfully designed to strengthen efforts to conserve and safeguard the Asiatic lions. However, laws that may have been well-conceived, and have contributed significantly to conservation success, can become unpopular when perceived as excessively harsh or stringent. For example, local people hosting tourists in parts of the landscape other than the designated tourist zones, are penalized for their involvement in "illegal tourism". The resulting disenchantment leads people to adopt a resentful sentiment akin to keep "your lions" in "your forests". Resentment risks currying an attitude that would favor confining the lions to forests rather than continuing shared coexistence. Therefore, laws and policies when indiscriminately enforced can erode the cultural tolerance that has so far underpinned lion conservation (Figure 1C).

Local pride in, and love for, lions has been a primary factor in their past and present survival in the Gir landscape (Meena et al., 2014; Meena et al., 2021). Numerous anecdotes illustrate the depth of this empathy with lions. For example, mourning the death of a lion in a road traffic accident, shopkeepers of Sasan village shutdown their shops for that day. In another instance, residents of Rajula village constructed a memorial for a lioness and her cub killed by a speeding train. Perversely, these same sentiments that foster conservation can harden into parochial and insular outlooks. A case in point is the local people's resistance towards the lion translocation project (Anon, 2013) (Figure 1D).

Our purpose in this brief review is to showcase, through the unusual case of the Asiatic lions, not only some of the best practices in human-carnivore interface management but also the limit of their efficacy. We recommend that all these facets should be interlaced as a holistic policy to foster both immediate and longer-term conservation success.

Author contributions

This is a perspective article based on previous collaborative work of the Authors. VM conceived and led the writing of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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