Incorporating traditional coexistence propensities into management of wildlife habitats in India

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Traditional tolerance of wild animals, which may be harmful to humans, their settlements and livelihood have contributed substantially to India's successful record of conserving some of the larger mammals and their habitats. This attribute is at variance with the developed world, where a number of large mammals have been extirpated through active eradication campaigns. Incorporating intrinsic traditional tolerance has so far, not featured in the country's conservation planning. On a broader level, the UNESCO Man and Biosphere Reserve concept seeks to combine conservation concerns with sustainable use of ecosystems' resources through close cooperation with local communities, taking advantage of traditional knowledge, indigenous products and appropriate land management. However it falls short of incorporating variance among settlements in their propensity to coexist with wildlife and their habitats into reserve design. This paper, thereby, attempts to augment the biosphere concept by proposing a protocol which discriminates settlements on their propensity for coexisting with wildlife and their habitats. A framework for discrimination is suggested using a set of hypothetical parameters which quantify attributes affecting the coexistence propensity of settlements. Based on this discrimination, a scheme for prioritizing settlements for relocation is elaborated. It is also proposed that the prioritization is considered along with a landscape and socio-economical analysis before ultimate relocation decisions are made.

COMPARED to other countries in South and South-east Asia, India has a credible record of conserving some of its larger mammals and their habitats. This is despite considerable population expansion in a large part of the country and a concomitant demand for land arising simultaneously from the poverty of the landless and economic development. A number of these species come into regular conflict with human beings through direct encounters, resulting in death or injury to people and wild animals or depredation on crops or livestock[1]. In most of the developed world, such conflicts are viewed with great intolerance and result in major campaigns targetting offending single animals, groups, or in some cases all members of a species inhabiting a geographical area. This has led to extirpation of some species. It can be argued that the Euro-American historical and cultural bias towards eliminating large predators (specifically after Columbus) has resulted in their declining status. Large carnivores have long been viewed as agents of death and a direct threat to human life. Negative feelings have been compounded by the threat carnivores pose to economically important livestock, game species and other land issues[2,3]. Some North American large mammals that have dramatically suffered from persecution include the grey wolf (*Canis lupus*), the mountain lion (*Puma concolor*), the grizzly bear (*Ursus arctos* horribilis) and the American bison (*Bison bison*). West and South-east Asia have similarly witnessed a decline of large vertebrate populations[4]. It could be convincingly argued that the underlying philosophy within most parts of the Indian sub-continent is at major variance to the above. The reasons are multifarious and analysing the relative influence of religious and socio-economic factors towards prevailing attitudes are beyond the scope of this discussion, but are eruditely discussed by Rangarajan[5].

It may be illustrative to add that a major geographical pattern exists in India (and most of south and south-east Asia). The plains are densely populated with large-scale cereal cultivation and a few relic tracts of wildlife habitats. The hills, in contrast, have more forest cover and wildlife habitats, subsistence or livelihood-based agriculture, dispersed settlements and lower intra-village disparities. The Forest Department wields considerable influence in these areas and controls a large percentage of forest lands, which comprise 23% of the total land area of the country (Rangarajan, pers. commun.). Much of the discussions presented here pertain to the latter situation,

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where conflicts between the government and local communities are frequent.

The UNESCO Man and Biosphere programme (UNESCO MAB) prescribes three basic functions of biosphere reserves; conservation (protection and conservation of biota and natural processes), logistic (basic and applied research, monitoring of natural processes, development of sustainability indicators, environmental education and training) and development (promotion of sustainable use of natural resources through close cooperation with local communities, taking advantage of traditional knowledge, indigenous products and appropriate land management. Regional and local development is promoted by incorporating all concerned social actors in the reserve planning)[6]. The last function incorporates management of range-lands and land use planning. It requires all social actors to be involved in the planning process. Here one has to make an implicit assumption that most communities located within a biosphere reserve utilize natural resources in a sustainable fashion. This is an attribute often ascribed to indigenous communities. This is not necessarily true for many biosphere reserves. For example, the human population in the Nilgiri Biosphere Reserve, located in southern India[7], is today dominated by ecological refugees[8] and other settlers who exploit resources in a manner which is not sustainable and has led to deleterious environmental consequences. In planning of this reserve, the variance in the propensities of communities and settlements to coexist with wildlife and their habitats, and the root causes of people–wildlife conflict as a consequence of conservation planning have not been directly addressed. Given that this is a significant lacuna which could well be included in future conservation planning, this article discusses perturbations of people–wildlife coexistence leading to conflict, it defines ‘coexistence propensities’ of settlements and suggests discrimination of settlements based on coexistence propensities for appropriate conservation action.

Case studies

Two case studies will describe existing and potential perturbations to people–wildlife coexistence.

The Kabini Reservoir, created by damming the Kabini River in 1972 lies on the border of the Bandipur Project Tiger Reserve and the Nagarhole National Park in Karnataka. These protected areas are contiguous and comprise excellent wildlife habitat with some of the highest densities of ungulates in tropical Asia[9]. The reservoir banks provide prime wildlife habitat in the dry season, when the waters of the reservoir recede and the banks are covered with fresh, palatable grass (dominated by *Cynodon* spp.), providing graze to a high density of mammalian herbivores. This results in a spectacular congregation of herbivores, including hundreds of Asian elephants (*Elephas maximus*). Despite extensive inquiry I have been unable to determine what the distribution pattern of mammals in the dry season was prior to the damming of the river. This is important, as it is possible that the original scenario was a system in relative equilibrium and the dry season wildlife densities arising from damming could have introduced a degree of instability. Fishing in the reservoir by human inhabitants of the banks, could be a source for instability. The reservoir has been partitioned into two sectors; the protected and the non-protected zones of the two parks. Fishing is ostensibly not allowed in the protected zone and the waters have been parcelled out in the non-protected zone to local fishermen relocated there in the early seventies. The human settlements have also increased here as a consequence of further relocations of settlements from the Bandipur Project Tiger Reserve. A major protein source for them has always been fish and given that there is a paucity of fishing waters in the non-protected zone, they are forced to fish illegally in the protected area. This activity reaches a peak in the dry season when the reservoir waters are low and netting of fish is easy. This impedes usage of the banks by larger herbivores, such as elephants, as fishing occurs both diurnally and nocturnally, which has led to increasing competition for very scarce dry season resources. Tribal settlements left in traditional locations (for example, spread evenly on the bank of the reservoir) may have had a minimal impact on the surrounding ecosystem. Concentration of settlements in the non-protected shore, where resources are presently strained, has led to human–animal competition in the rather limited protected area. Perturbations of the above nature may lead to sub-optimal intake of nutrition by elephants during the dry months. Large mammals, such as elephants may then be forced to crop-raid intensively during the cropping months, highlighting the unstable nature of the above scenario. Prior to the damming of the river, their possible strategy was to forage over a larger area rather than depend on relatively more localized resources (i.e. the present reservoir banks).

The second case study concerns a wildlife corridor connecting the Bhadra Wildlife Sanctuary (recently declared a Project Tiger Reserve) with habitats further south in the Chickamagalur district (Figure 1). During surveys[10], it was suspected that elephants were using this corridor, but doubts were raised about the intensity of movement, given the highly fragmented nature of the corridor. It was striking to discover that elephants were using this corridor regularly. It was even more interesting to note when crop-raiding occurred, it was well tolerated by local communities who were largely caste Hindu cultivators (pad marks of elephants in fields were actually worshipped, as the visits of elephants were considered a good omen!). When asked about the problem, local inhabitants were under the unanimous opinion that elephants had an equal right to their lands. Poaching for ivory is also rare in the area demonstrating the people’s reverence for these animals. Attitudinal characteristics of this corridor vary considerably from others that are equally fragmented. In the latter, local communities are highly antagonistic towards conservation strategies and general intolerance towards the presence of large mammals prevails. What exactly is responsible for, what I would term a coexistence situation? Only the analysis of a serious attitudinal and socio-economical survey could shed some light on the underlying reasons. However, a few recommendations could be warranted at this stage. Firstly, if this area is notified as an important wildlife corridor by the government, large-scale relocation of settlers from the area may replace traditional tolerance with antagonism. It is therefore not an advisable option. At one level it may be far more prudent to identify and minimize causes for existing levels of conflict. An example would be the location of paddy fields amongst coffee or cardamom plantations. For elephants to get at the former, the latter may suffer considerable trampling damage. Keeping in mind local soil factors, a rearrangement of cropping patterns may therefore be necessary with affected communities compensated suitably. Alternatives could include optimal relocation with forest restoration work taken up in the abandoned lands or subsidies for the cultivation of another crop not favoured by elephants.

Identifying coexistence propensities

Solutions of the above nature require detailed landscape analysis and discrimination of areas based on socio-economic information. For this purpose, a scheme depicting the propensity of settlement to coexist with wildlife could be developed, based on the following hypothetical protocol.

Consider an imaginary wildlife corridor with a set of settlements within and on the preiphery. Each settlement could be characterized using the following parameters (1–7) classified into groups A to D. Parameters within a group are similar in terms of their contribution towards the settlements' coexistence propensity within the corridor.

A. Parameters indicating contribution towards propensity due to characteristics which may ensure sustainable utilization of resources.

1. Proportion of indigenous people (e.g. ecosystems people versus ecological refugees)[8].

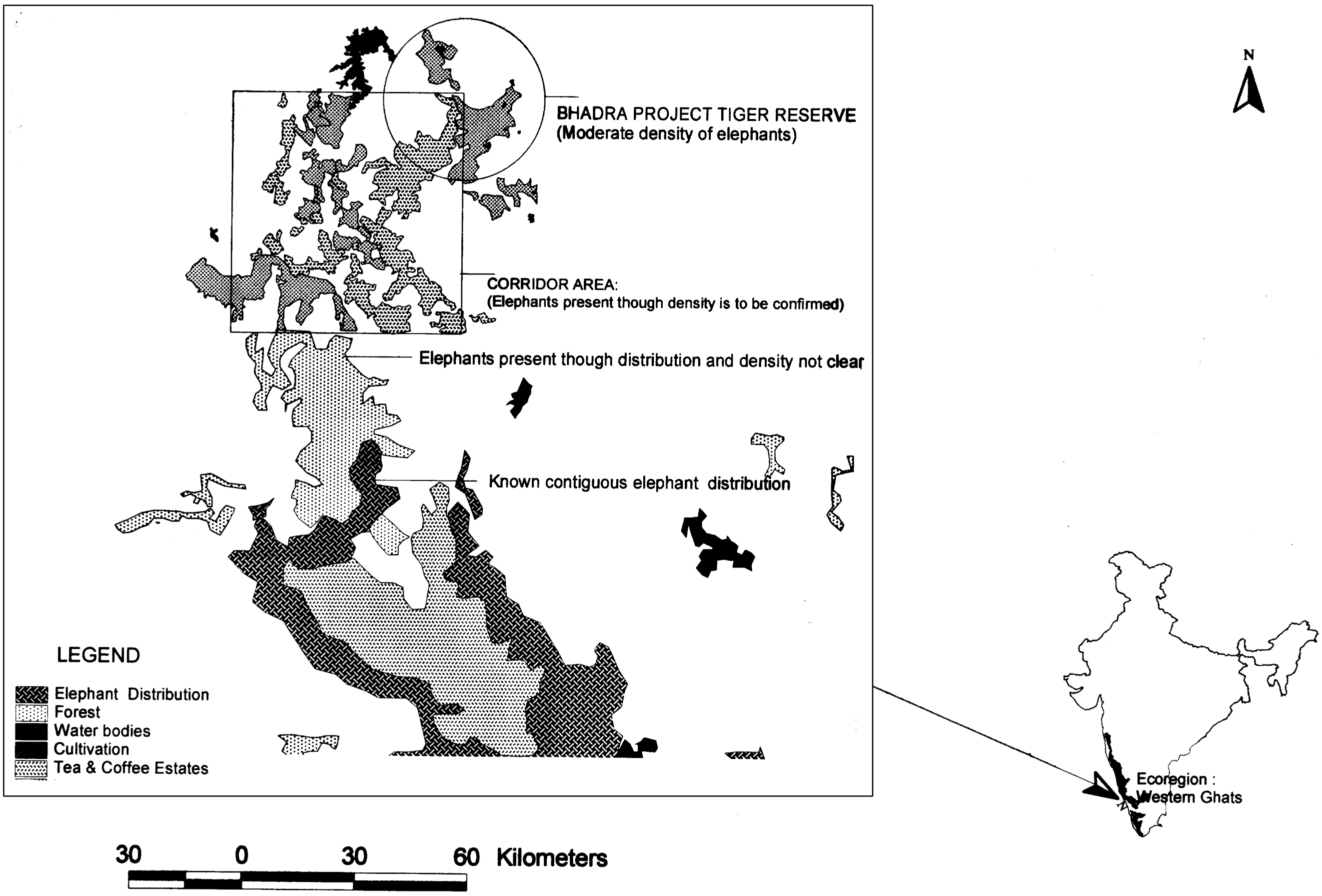

Figure 1. Map showing possible corridor area connecting habitats in and around the Bhadra Project Tiger Reserve to known elephant habitats further south. Specific boundaries of corridor are not delineated as further surveys are required.

2. Tenure of the settlement in the area.

B. Parameters indicating contribution towards propensity due to settlement growth profiles.

3. Rate of increase in cultivated/occupied land over the last five years.

4. Rate of increase of population in the last five years.

C. Parameters indicating contribution towards propensity due to livelihoods being threatened by wildlife.

5. Percentage of land cultivated with crops eaten by wild animals.

D. Parameters indicating contribution towards propensity due to livelihoods/activities having an impact on habitat.

6. Number of cattle in the settlement which graze in the forest.

7. Biomass of fuel wood extracted from the forest and consumed annually by settlement.

The rationale for using the above parameters is the following. In Group A, settlements with a large percentage of indigenous inhabitants or those which have a long tenure within the corridor are assumed to utilize natural resources in a more sustainable fashion than settlers or settlements which have recent origins. In Group B, rapidly expanding settlements are likely to deplete habitat at higher rates than others. High population growth rates may strain existing resources and cause high levels of unemployment leading to a spurt in illegal activities, such as poaching of animals and timber. In Group C, settlements owning a high proportion of land cultivated with crops eaten by wild animals are less likely to accept conservation action initiated by the government or indeed, the presence of wildlife itself. Group D parameters quantify direct threats to habitats such as cattle grazing and fuelwood extraction.

A useful technique for grouping settlements based on these parameters could use K-means clustering algorithms. This method partitions settlements based on homogeneities among the 7 parameters used. The advantage of this method over single or average linkage clustering algorithms or multivariate methods is that dominant and sub-dominant parameters (1–4, listed below) characterizing clusters are clearly returned. In Table 1, priority values indicating a need for considering relocation, are assigned to resultant dominant and sub-dominant pairs characterizing each cluster of settlements. It is assumed that (1) rapid expansion of land or population contributes least to the propensity of a settlement to coexist followed by (2) large-scale pursuit of livelihoods which threaten habitat, (3) large scale pursuit of livelihoods which are threatened by presence of wildlife and finally, (4) settlements which are likely to utilize resources in a sustainable manner. The combined influence of the dominant and sub-dominant pair obtained for a cluster of settlements on its coexistence propensity is obtained from the above rationale. For example, (1, 2) would make the least contribution to the coexistence propensity followed by (1, 3) (1, 4), (2, 1), (2, 3) and so on. Combinations assigned lower priority values contribute less to the coexistence propensity and therefore clusters having these combinations as dominant/sub-dominant criteria should be considered a priority for relocation.

Table 1. Priority values for relocation. Entries are ranks of relative contributions by dominant/sub-dominant pairs to coexistence propensities. The lower the rank, the higher the priority for relocation

Dominant parameters	Sub-dominant parameters			
	Group A	Group B	Group C	Group D
Group A	–	10	12	11
Group B	3	–	2	1
Group C	9	7	–	8
Group D	6	4	5	–

Juxtaposing coexistence propensities with landscape and socio-economic analysis

Subsequent to the actual prioritization process, settlements assigned a high priority for relocation should be assessed qualitatively at a landscape and/or socio-economical levels. For example, as pointed out earlier, a small area of crop fields raided by wild animals may actually be surrounded by cash crop plantations which are not raided but may experience trampling damage by animals in transit. A change in cropping patterns by encouraging a shift to non-favoured (i.e. for wild animals) crops may be advocated and if this minimizes conflict, relocation may not be necessary. Similarly the use of electric fencing or trenching could discourage animals to raid the settlement's crop lands. If the proportion of individuals indulging in deleterious livelihoods is small (the settlement is assigned a low priority for relocation on other counts), programmes targetted at providing and training in less deleterious livelihoods could be instituted. A small subset of the inhabitants within a settlement, who if deemed to have a lower coexistence propensity than the majority of the settlement, could be targetted for relocation. It is also expected that settlements which rapidly expand or have high population growth rates are least likely to coexist, subsequent to any landscape or socio-economic restructuring.

Discussion

This paper presents a scheme for objectively recognizing coexistence propensity zones within critical wildlife habitats. On one hand, the scheme elaborated could be construed as the reduction of a complex problem to a simplistic number regime. However, the essence of this idea has its roots in pure common sense and the decision rules discussed are similar (or in some cases identical) to what government agencies use for subjectively assessing the threat a settlement poses to wildlife habitats. Salient examples include a few settlements bordering and within the Wynad Wildlife Sanctuary, Kerala[11] where a significant proportion of inhabitants pursue elephant and other wildlife poaching as a livelihood. Most other settlements within the sanctuary do not harbour poachers, have not displayed any appreciable expansion or population growth in recent times, and largely subsist on agricultural income from paddy cultivation. Indeed they often act as 'social fences' transmitting information on illegal activities to the authorities. Their coexistence propensity could be enhanced if fields are adequately protected from crop-raiding wild animals. The prioritization scheme listed above does have the required sensitivity to identify such variations in propensities across settlements.

Additional support for the relevance of this scheme is the study of the grazing strategies of Gaddi pastoralists[12]. Based on the results obtained, it is convincingly argued that 'conservation agencies should turn their energies to documenting the biological resources that exist under current forms of land use, both within and outside protected areas, and to begin devoting more attention to understanding ecosystems of which humans are an integral component'.

It could still be argued that the 7 parameters listed earlier in the article are inadequate in portraying the true picture. These parameters have been chosen as they are subject to easy quantification. Other parameters could be added. Notable examples include intensity of pursuit of other livelihoods which may be deleterious to habitat. The choice and range of parameters may be context- and area-specific. For example, indigenous forest tribes may exploit resources in other modes which may not necessarily be sustainable.

The above scheme would be ideal in the design of biosphere reserves, where the prevailing philosophy is not very different from the concepts developed here[13]. The scheme also introduces a great degree of objectivity in conservation planning by eliminating social and other forms of bias when deciding relocations and if accepted by a consensus could attract minimal controversy. The strength of the efficacy of the protocol would largely be dependent on the quality of socio-economical and landscape level input. What has been presented here is really the basic framework and potential exists for further refinement. For example, platforms for problem solving arising from the superimposition of socio-economic structure and landscape level information are rife with possibilities and scope for very imaginative and pragmatic thinking. It is hoped that the above framework provides the necessary impetus for some re-thinking on how wildlife habitats and local communities have to be managed in the future. As a final note it may be useful to add that the success of such a framework requires active interaction between the government, key stakeholders of target areas, sociologists and ecologists.

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ACKNOWLEDGEMENT. Many of the ideas discussed in this paper have originated during and after surveys carried out by the Asian Elephant Research and Conservation Centre. I thank Mahesh Rangarajan, Kees Hulsman, Ram Guha and an anonymous referee for useful comments during various stages of this manuscript. I also thank Kumaran Raju for GIS support.

Received 29 March 2000; revised accepted 24 September 2000