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editor's note



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Most conservation effort focuses on animals and their habitats, and often ignores the voices of people living in these landscapes. Almost all the essays in this issue revolve around the inhabitants of lands of conservation concern—their problems, and solutions they want or practice to deal with pressures like climate change and conflict. Before solutions can be implemented one needs to understand their practices and use of resources, argues Anirban Datta-Roy, in a detailed examination of hunting practices of the tribes of Arunachal Pradesh. Tenzing Ingty tells us that communities in wild landscapes, like the Dokpa and Lachenpa of Sikkim who use the traditional ecological knowledge gathered over generations to cope with climate change, can often assess change and threats better than scientists.

Most of the articles in this issue can be categorised into either the Eastern Himalayas or the Western Ghats, two biodiversity hotspots in India that have been in the news for a variety of reasons, says special issue editor Siddhartha Krishnan. In his essay he weaves the studies showcased into a narrative on conservation issues in these two spatial units. He goes beyond this to touch on the philosophies of the nations involved—Norway and India—both with socialist bents, and a desire to balance environment and development.

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RED RESERVOIRS

Tailings (residue) washed off from iron ore mines accumulate in reservoirs and adversely affect agriculture, people, and wildlife around these areas. These water bodies are also used as dumping grounds for excavated earth debris.



Conservation conversations

THE IRONY OF GLOBALISATION, CREATING CONSERVATION CHALLENGES EVEN AS IT ENABLES CONSERVATION RESEARCH PARTNERSHIPS TO ADDRESS SUCH CRISES, NEED NOT BE LOST HERE. NEITHER SHOULD WE DISCOUNT POLITICAL CRITICISMS OF THE IDEOLOGICAL BASIS OF MANY BILATERAL (TYPICALLY TEMPERATE RICH COUNTRY-TROPICAL POOR COUNTRY) CONSERVATION INITIATIVES, WHICH TEND TO PRIVILEGE LARGE CARNIVORE PROTECTION BY ENCLOSING LARGE SPACES IN TROPICAL COUNTRIES, EXCLUDING IN THE PROCESS THE INDIGENOUS FOLKS WHO FARMED AND FORAGED IN THESE SPACES. BUT THE BILATERAL RESEARCH PARTNERSHIP THAT HAS ENABLED THE RESEARCH BEING COMMUNICATED HERE HAS BEEN AN INCLUSIVE ONE IN MORE THAN JUST A SOCIAL SENSE. A cursory reading of titles of essays in this edition of Current Conservation could convey a threefold sense of research that lies behind them. In terms of range, there is research on greenhouse gas fluxes to research on pastoral and forest livelihoods and associated rights. In terms of representativeness, there is research on climate change, local knowledge, biodiversity, forest rights, plant-animal interactions, human-wildlife conflicts, hunting and ecological restoration. In terms of interdisciplinarity, there are the cultural aspects of hunting, ecological restoration and livelihoods, and Himalayan climate change and local perceptions. And in policy terms-pastoralism and policy, and the Forest Rights Act and livelihoods. In this essay, which puts into perspective the essays that follow, I provide the larger contexts in which such diverse research ensued even as I draw broad conservation implications from the research being communicated here.

GLOBALISATION, CONSERVATION AND INCLUSION

Globalisation, for our purposes, the increasing irrelevance of national boundaries in economic trade or its environmental consequences, a process best exemplified by climate change, has not only wrought negative changes but also fostered positive conservation partnerships between nations. The irony of globalisation creating conservation challenges even as it enables conservation research partnerships to address such crises need not be lost here. Neither should we discount political criticisms of the ideological basis of many bilateral (typically temperate rich country-tropical poor country) conservation initiatives, which tend to privilege large carnivore protection by enclosing large spaces in tropical countries, excluding in the process the indigenous folks who farmed and foraged in these spaces. But the bilateral research partnership that has enabled the research being communicated here has been an inclusive one in more than just a social sense. The research partnership, conceived as an academic exchange project 'Conservation of biological diversity and sustainable use of natural resources: Capacity building for interdisciplinary research and application', has been funded by Norway, a socialist nation, as part of its 'country strategy' for India, itself a nation which has been socialist for a major part of its independent history. Let us not harry ourselves here with liberal tendencies of Norwegian and Indian socialism, but engage with solidarity, the core tenet of socialism.

For instance, the institutions involved, the Ashoka Trust for Research in Ecology and the Environment (ATREE), Bengaluru, and the Department of International Environment and Development Studies (NORAGRIC), University of Life Sciences, Norway, have historically sought solidarities between 'ecology' and the 'environment', and 'environment' and 'development', respectively, as institutional identities.

Let us subsume the environmental and ecological research topics at hand in that classic spatial unit within which much social-ecological work and thought has occurred in the past the 'region'. And for our purposes the regions would basically be two mountainous ones, the Eastern Himalayas and the Western Ghats.

EASTERN HIMALAYAN CONSERVATION: PASTORALISM, CLIMATE CHANGE AND HUNTING

Noted first for being a biodiversity hotspot, this region is now being noticed as a climate change hotspot. Glacial melt serves as emphatic evidence. But more evidence lies in people's and plants' sensitivities to warming. Thomas' essay on the implications of conservation policy and climate change on pastoralism provides interesting insights into such sensitivities. From interviews with the pastoral Gurung and others of Tibetan origin in the Nepa-Darjeeling-Sikkim tri-junction, Thomas observes 'great historical memory' of climatic change. Memory that inevitably accrues from organised movement and stationing that regulates transhumance in the region, which entails winter descent to warmer plains and alpine and sub-alpine ascent in summers. The herders claim that summers have advanced. Early flowering is evidence. Similar phenological observations have been made by the Dokpa of North Sikkim. In Ingty's essay, the high altitudinal Dokpa ascend even higher in winters to snow-free, windblown pastures. They, along with the Lachenpa, who like the Gurung descended in winter and ascended in summer, felt that winter snowfall had either ceased or decreased. But what was indicative of climate change for the Lachenpa was parasitical and not phenological, as was for the Dokpa. The Lachenpa mention mosquitoes, which they claim have made their presence felt in less than a decade. The higher altitudes are warming, was the point. The Dokpa noticed that plants that flowered just before winter were now flowering late and that some other plants were flowering elsewhere. Ingty got the Dokpa to identify five such species that had shifted their range and were growing at elevations that were anywhere from between 200 to 700 m higher. Range shifts were spatial and temporal. In a pastoral landscape, movement is adaptation. It is crucial. And now it appears that plants, like humans and

livestock, are also moving. While other research findings have made a case for traditional knowledge serving as baselines for climate science, Thomas is wary of climate narratives taking off from 'conservation narratives of similar urgency'. Conservation had earlier restricted movement— that crucial adaptive measure. Now climate change mitigation could reinforce conservation by incentivising forest enhancement and protection for carbon stocking. It seems we now have a geochemical—as against a biological—basis for conservation; and also a curious possibility of climate change mitigation whose benefits are intangible, trumping adaptation whose requirements are very tangible.

Pastoralism is not the only resource culture in the Eastern Himalayas that attracts anthropological and conservation attention. Hunting for wild meat also attracts such attention. Roy's feature article seeks to explain its persistence in Arunachal Pradesh, despite the provisions of the Wildlife Protection Act, 1972. Hunting, Roy says, has socioeconomic and cultural roots and implications for the Mahayana Buddhist and animistic Donyi-Polo communities of Arunachal Pradesh. Cautioning against a trend of commercialisation of wild meat in the region, Roy also imparts some caution to conservation policies that attempt blanket hunting bans without considering the consequences. Presently there are institutional arrangements that regulate hunting, including religious beliefs or secular community rules. Legal bans would criminalise hunting-related religious or secular customs. Hunting would become a subversive activity far removed from a local institutional ambit that offers the best scope for sustainability.

WESTERN GHATS AND CONSERVATION: RESTORING FORESTS AND RIGHTS; MITIGATING CONFLICT AND CLIMATE CHANGE

The Western Ghats have always been in the news. But in the last year and a half they were more frequently and intensely so. Newspapers and television channels reported conservation and related conflicts. Columns of print were dedicated to the efforts of one group of people to get the Western Ghats successfully nominated to the UNESCO's World Heritage list, and the efforts of another group of people to identify ecologically sensitive zones in the Ghats that can be notified as such under the Environment Protection Act, 1986. In fulfilling their mandates, the former (an officially nominated committee), and the latter (an officially appointed panel), faced civil suspicion, both environmental and developmental, and administrative and ministerial apathy. Such conflicts cannot be elaborated here. But the requirements stated by UNESCO in deferring its examination of the nomination of Western Ghats present an interesting context to discuss the essays by Paramesha, Balaji and Chetana that are good case studies reflective of UN concerns. Among other things, UNESCO required the nominating party to take into account the recommendations of the Western Ghats Ecology Expert Panel, reflect fully on the ecological and biodiversity values of the Ghats, account for any changes in protection status, improve ecological connectivity, build stakeholder awareness and support and nurture participatory governance approaches.

Paramesha's essay on human-wildlife conflicts in the Doddasampige-Edeyarahalli and Chamarajanagar-Talamalai corridors that connect the Biligiri Rangaswamy Temple (BRT) Tiger Reserve to Sathyamangalam and Malai Mahadeshwara forests, respectively, argues a case for strengthening ecological connectivity and building stakeholder awareness and support. Communities from Soliga adivasis to Tibetan refugees cultivate in these corridors. The Soligas who traditionally cultivated subsistence crops such as ragi and sorghum, frequently find their standing crops raided by elephants and boars. During the ragi and maize growing months, one has to guard not just against wildlife but also sleep, to prevent food insecurity and searching for alternate employment. Today, lands either bear non-subsistence crops or lie fallow. A local constituency for corridor conservation can ensue if people are compensated well for crop loss, and better still, provided with fencing assistance, argues Paramesha. Significantly, his essay mentions that the Soliga worry more about their eviction than crop raids. Granting of land and conservation rights is crucial.

The Forest Rights Act (FRA) guarantees such wellbeing as the Soliga desire. The Western Ghats Panel's report explicitly supports the implementation of the FRA's provisions. The FRA offers one of the best bets yet for the kinds of participatory forest governance that the UNESCO desires. Balaji's and Krishnan's essay examines how the FRA's entitling of land and conservation rights process fared in Wayanad, a Western Ghats district in Kerala with a sizeable tribal population. Specifically it sought to get a sense of entitlement that the Paniya, an Adivasi people with a history of indentured labour, experienced. That the FRA was 'a piece of paper' was an expression that Balaji heard frequently from the Paniya. This pessimism, the essay explains, stemmed from a history of failed legislative attempts to regain land taken over by migrants and land entitlement not ensuring security, given the small forest landholdings amongst the Paniya. Following indentured-labour abolition, they lead an itinerant life in search of work in migrant farms.

The FRA, then, has created a nationwide legal context for rights restoration. At a more regional level, some economic and legal contexts have emerged for ecological restoration, which relate to UNESCO's other requirement of accounting for changes in protection statuses of lands. Chetana and Ganesh discuss one such context in their article on tea estates being 'abandoned' in the Agasthyamalai range. The expiry of long-term tea plantation leases or the final years of the lease had coincided with unfavourable market conditions and estate managements either favoured or were forced to stop plantation operations. Plantations thus abandoned were being colonised by invasives such as *Lantana sp.* and *Eupatorium sp.* Even as it considers restoration prospects in plantations, the article also grapples with socio-economic issues entailing the livelihoods of plantation workers and their families.

There is no corresponding phenomenon in the Western Ghats like the Himalayan glacial melt that triggers scientific and policy activity on climate change. Nonetheless, the ecosystems and resource cultures of the Ghats have adaptation needs and offer mitigation scope. The article by Raut communicates their measurements of methane fluxes from soils of BRT. Methane is one among other greenhouse gases that are implicated in global warming. The author offers comparative methane sinkage estimates across seasons in disturbed and undisturbed portions of BRT.

CARNIVORY AND FRUGIVORY: CONSERVATION IN PRODUCTION LANDSCAPES

Even as I write this section, the UNESCO has decided to inscribe 39 sites in the Western Ghats into the World Heritage list based on their significance for ecological evolution and biodiversity-nurturing habitat values. But there are landscapes in India other than the Ghats or the Himalayas that serve as conservation legacies of their own devise involving unique social and ecological dynamics. And conservation also needs to move beyond protection landscapes and engage with production landscapes. Ghosal's and Home's articles examine human and large carnivore conflict and coexistence, and frugivorous activity, respectively, in agricultural landscapes. Ghosal reports from the sugarcanedominated landscape of Akole district of Maharashtra, at the northern fringes of the Westen Ghats, where leopards thrive despite no proximate conservation zone and the absence of wild ungulate species to support the carnivores. Ghosal elaborates upon an Adivasi custom of deifying the leopard that signals coexistence rather than conflict that symbolises the relationship between leopards and more urban sections in Akole. The Adivasi Thakkars and Mahadeo Kolis have



deified the big cat as a local deity called Waghoba. Ghosal provides an institutional juxtaposition between customary and modern—read policing—negotiations with leopards.

Home's article informs us of frugivory in the semi-arid Abdasa taluk of the Kutch district of Gujarat. The fruit is also harvested locally and so market surveys were also conducted. Seven bird and five mammal species were identified to consume the fruit. Even as she makes some interesting observations of fruit removal behaviours of birds and mammals, Home expresses concerns over the implications of new industry-oriented land use policies on plant-animal interactions. Conservation needs to begin engaging with agrarian landscapes also, which are threatened by industrial conversion.

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A tragedy on the commons

OLD PREJUDICES AND PARTIAL SCIENCE COMBINE TO DESTROY A PARTICULAR FORM OF MOBILE PASTORALISM IN THE DARJEELING AND SIKKIM HIMALAYA

"They stopped issuing (grazing) pattas in 1992, soon after the Park was notified, but we resisted till 1998. The officials came and broke down the goths, beat up people. Then they threatened to bring in the CRPF. You must understand that this was in the years after the first Gorkhaland agitation, and there was widespread fear of the paramilitary. We had no choice. Finally, a meeting was called in Gorkhay and the DFO issued a deadline. We were promised jobs. Those promises were not kept."





Guru Tseten Bhutia, 58, was recounting the days when pastoralists were evicted from the Singalila National Park. "A way of life has ended. It is hard to imagine the Singalila ridge without herders and their stock." Today, he runs a petty business. Others have fared worse, he tells me.

Conservation policies have impacted historical mobile pastoralism in the Kanchenjunga– Singalila landscape, with policy regimes in the Darjeeling district of West Bengal, Sikkim, and the adjoining districts in eastern Nepal causing varied challenges. Today, only remnants of a once widespread practice exist in pockets of this region. Access to traditional grazing areas, migration pathways and markets have been curtailed or significantly reduced. A particular form of mobile pastoralism and a culture have almost been destroyed.

A FORM OF MOBILE PASTORALISM

Mobile pastoralism in this landscape involves herding of yaks, yak-cattle hybrids and sheep between summer and winter pastures across an altitudinal range. Yak herding is limited to the upper reaches of the high Himalayas and the Sikkim trans-Himalaya. Sheep rearing has for long been a feature of this landscape, particularly by Gurung herders in the lower reaches of the high Himalayas and by ethnic groups of Tibetan origin in the high and trans-Himalayas. Yak-cattle hybrids occupy a wider altitudinal range. The males are used as pack animals and are prized because they can adapt to a wider altitudinal range than yaks. The female yak hybrids produce more milk than yaks and are therefore in demand.

Yak pastoralism was introduced to the southern slopes of the Himalayas by settlers from the Tibetan plateau. In some areas in the northern parts of Nepal, this goes back several

hundred years, by some accounts to the 9th Century AD, but in other areas it is more recent. North Sikkim and some of the higher reaches of Kangchendzonga National Park have a long history of yak herding, but going by several personal accounts during this study, mobile pastoralism involving yak hybrids arose sometime during the early to mid century. The herds are moved down to as low as 2500-2700 metres above mean sea level in the winters and moved up to 5500 metres to sub-alpine and alpine pastures in summer. It represents the southern extent of a particular form of transhumance that was adapted to this region.

CONSERVATION LANDSCAPE, CONFLICTED COMPONENTS

A slew of Protected Areas (PAs) were created across the Eastern Himalayas: Sagarmatha National Park (1976), Khangchendzonga National Park (1977), Singalila (Wildlife Sanctuary in 1986, National Park in 1992), Barsey Rhododendron Sanctuary (1988) and Kanchenjunga Conservation Area (1997). In all these areas there was a disproportionate interest in 'grazing pressures', and ecologists began to talk about the negative impacts on biodiversity and the competition with wild herbivores for scarce resources. In 1998, Sikkim declared a ban on grazing in all reserve forests, around water sources and plantation areas. The move against grazing by yak and yak hybrids in the higher reaches was based on similar arguments, that domestic livestock were competing with wild ungulates for scarce resources and that it was resulting in degradation of forests and drying up of springs. Herders contest both these and say these are mere assumptions. A third argument was also invoked. Nomadic pastoralists were described as 'outsiders,'Tibetan herders from Nepal. The numbers of herders and livestock may have increased with Tibetan refugees moving down around the middle of the last century, but the standard narrative tends to highlight this over a longer and more nuanced environmental history of the landscape.

By 2003, the eviction of graziers and their livestock from Barsey Rhododendron Sanctuary was complete. In the Singalila National Park, evictions started in earnest right after the declaration of the National Park and most of the goths (herder huts/cattle stations) were evicted. Some held on until threatened with force. The recording and settling of rights was arbitrary, and by most accounts, unfair. Only two herders got 'jobs' with the forest department, as a form of compensation, and both remain on the casual workers list even today. Some herders who kept cattle in the lower reaches, and also worked on road maintenance, were settled in the villages on the periphery. Most nomadic pastoralists got nothing.

The creation of PAs on the Indian side essentially transferred 'the problem' to the Nepal side of the border with serious implications for mobile pastoralists and their herds. On the Nepal side, community forestry, mediated by external agencies and supported by the government, and legislation on land administration in what were originally ethnic homelands managed under the kipat system, dismantled traditional pasture management practices and the manner in which these traditional institutions interfaced with the nomadic pastoralists.

THE IMPACTS ON PASTORAL LIVELIHOODS

In India, ecological arguments against grazing and a strict interpretation of the Indian Wildlife (Protection) Act formed the basis for evicting livestock from protected areas. The strict exclusion has had huge impacts on livelihoods. A minority shifted to tourism services. Many sold off their stock or mixed them in informal arrangements with herds on the Nepal side. Meanwhile, community forestry user groups (CFUG) in Nepal are also placing restrictions on grazing and movement of livestock. The success story of community





Shristi Kamal

forestry in Nepal masks these exclusions, as well as how rights are determined and what are considered conservation-friendly practices. This has, along with the closure of trans-border ranging between Nepal and Tibet in 1978, reduced ranging areas and affected mobility and flexibility. Herders also say this has led to genetic erosion, with breeding now restricted to and within existing stock. The restricted movement and localisation has resulted in degradation in some areas, further fuelling the argument that mobile pastoralism is bad for the environment.

By various accounts, mobile pastoralism in this area has declined by over 75 percent, in terms of the number of goths and livestock populations. Sheep-herding has been affected the most and the reasons for this need more research. Some herders have managed to retain access to certain areas by negotiating with CFUGs, while others continue to stock their herds along the border, their herds foraying often into the Indian side with clear risks. In at least a couple of CFUGs, there was evidence of emerging conflicts between members and mobile pastoralists. In both cases, the members said they wanted to stop grazing. In negotiating with a wide range of institutions and actors across a shrinking space, some of

the mobile pastoralists preferred a return to the traditional kipat system in Eastern Nepal, as they believe that the management and control of common property resources was better.

PERCEPTIONS OF CHANGE AND CONTINUITY

The global climate change debate and the dominant symbols used to raise awareness tend to ignore many of the marginal spaces and livelihoods in the Himalayas. It has been predicted that climate change impacts will be far greater on already-stressed ecosystems of the Eastern Himalayas. Of particular focus is the role of water provisioning, since the glacier-fed rivers originating in the Himalayas comprise the largest river run-off from any single location in the world and the Ganga-Brahmaputra alone sustains the highest population density in the world. These concerns are likely to determine the future of conservation interventions and climate mitigation measures in the landscape.

There is little we know in terms of disturbance, recovery and ecological implications in this landscape. Herders, on the other hand, have great historical memory and knowledge of change. The movement of herds was organised around a calendar and involved cooperative grazing agreements, allocations and timing of movement across pastures, and the condition of fodder resources in the summer alpine pastures. In making these movements year after year and assessing the various conditions favourable for movement and stationing, herders have a clear understanding of climate variability and change. They have adapted and taken shocks where the state has been continually absent. In some bad years, the losses have been very severe. The standard insurance against such shocks was to overstock, but with reduced grazing areas and other constraints, even this form of insurance is not possible now.

Herders speak in great detail about changes in this landscape. They talk about summers advancing, evidenced by early flowering, and water sources drying up in some areas. In general, wildlife depredation is up and they attribute it to enclosure. If the forests are coming back, why is the wildlife outside the protected areas, they ask. Wildlife populations, according to them, always fluctuated, and were generally low in the high altitudes. The fluctuations were often caused by extreme weather events, which also took a toll on their livestock, but a run of good years could also result in significantly high populations. Most importantly, they use this to counter the assumptions that grazing is bad for the environment. They claim open forests are better for wildlife and that some of the arguments about degradation of pastures are flawed, since growth too is dependent on a range of factors, including precipitation, which is variable.

Most mobile pastoralists in the landscape would like to return to their old grazing lands and movement pathways. They see themselves as natural conservation allies who have long borne the costs of conservation even before the protected areas were notified. The predators, they say, preyed on their livestock and some, like the wild dog packs, followed the herds as they moved. Retaliatory killing was uncommon, not the norm. The mobile pastoralists have hardly known the welfare state, be it for service delivery or compensation for losses.

A FUTURE FOR MOBILE PASTORALISM AND CONSERVATION

Current climate narratives take off from conservation narratives of similar urgency. Therefore, it is likely that the current discourses and interventions focused on climate change mitigation in the region will only further such an agenda and privilege conservation concerns. States are already considering and speculating the values of their forests in terms of new financing mechanisms based on forest carbon stocks, among others. The threat to communities from climate finance is probably greater than from climate change. The other concern is that they will feed into unfinished conservation agendas, exemplified recently by the notification of 'critical wildlife habitats' within existing PAs, leading to more displacement of communities whose rights had barely been settled under the Recognition of Forest Rights Act, 2006 (FRA).

It is clear that more progressive institutional and policy spaces in Nepal have allowed for mobile pastoralism to continue in some form. But here too there are challenges, especially given the manner in which community forestry is being managed and the conflict with traditional land management systems of the region. Today there are rising calls from indigenous groups in eastern Nepal to revert to the kipat system. These calls are being made as legislators are working on a new Constitution and responding to the various demands for ethnic autonomy under a federal set up. On the Indian side, the notification of PAs in response to conservation concerns has resulted in displacement and undermining the realities of various traditional groups in the landscape. This is a conservation agenda that persists: it has gained institutional and policy dominance with severe consequences for local communities, and needs to be challenged with the policy spaces now enabled with the FRA.

Here, it is relevant to recall The Dana Declaration on Mobile Peoples and Conservation, to highlight the predicament of mobile pastoralists in the region. The Declaration calls for a new approach to conservation: one which recognises the rights and interests of 'mobile' peoples, whose "livelihoods depend on extensive common property use of natural resources, and who use mobility as a management strategy and as an element of cultural identity. Mobile peoples are discriminated against. Their rights, including rights of access to natural resources, are often denied and conventional conservation practices insufficiently address their concerns. These factors, together with the pace of global change, undermine their lifestyles, reduce their ability to live in balance with nature and threaten their very existence as distinct peoples."

At a landscape level, it is important for countries in the region to see how these choices can be respected and accommodated across borders, under collaborative management principles that respect the needs for mobility and flexibility. Some of the core issues against grazing can be countered by demanding adequate insurance and sound collaborative research that



can feed into rotational management strategies, insurance for herders and access to fuel. It is also important to ensure that the argument is not reduced to 'providing alternatives' (although some herders do talk of exit strategies) and compensations for losses. There is also a need for a critical review of the ecological arguments against grazing and the rhetoric that has been used against herders in this context.

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The way of the hunter

HUNTING IS BANNED BY LAW, YET PERSISTS IN NORTHEAST INDIA. ANIRBAN DATTA-ROY PROVIDES A CLOSER LOOK AT THE PATTERNS OF HUNTING, WITH DETAILS OF NUMBERS, SPECIES AND REASONS

"The ban on hunting doesn't mean anything. We will stop for a few days and then everything will be the same again," said a hunter in a remote village in the mountains of Northeast India. Although the ban he was referring to was an official notification in some districts only, it appeared symptomatic of the blundering approach to controlling hunting in Northeast India that has existed for long. Hunting in tropical forests is increasingly being recognised as one of the primary threats to biodiversity conservation. Considerable research has gone into illustrating the ecological effects of unsustainable hunting and the consequent changes in community composition of key faunal species. This can eventually result in 'ecological cascade effects', where the loss of top predators due to hunting leads to secondary extinctions of prey species. The resultant effects do not stay restricted to animals in the forests. Changes brought about by unsustainable rates of extraction (bordering on causing local extinctions) would mean a loss of ecosystem services for humans too. It would also mean a loss of valuable natural resources for forest dwelling people.

Northeast India, part of the Eastern Himalayas, is an area of exceptional faunal and floral richness and is designated as a global biodiversity hotspot. This area lies adjacent to Southeast Asia and bears close similarities to it in tradition, ethnicity and culture.

Hunting plays a major role in the lives of people here and wild animals are regularly used for food, rituals and medicine. Although prohibited through legislation in the form of the Wildlife Protection Act of 1972, hunting is common place in the Northeast. The reasons behind its persistence are poorly understood, but as an activity that has close linkages with the cultural and socio-economic life of the people of this region, it requires a deeper understanding of the causal factors.

I conducted an exploratory study on hunting in the Northeast Indian state of Arunachal Pradesh. Refraining from adopting a purely ecological approach, I instead addressed cultural and institutional factors that affect the persistence of hunting in Northeast India. The survey proved invaluable in laying the groundwork for a better-informed long-term study. The study was affected to a great extent by the official notification issued to villages banning all forms of hunting activities at the outset of the survey. Hunters in most places were apprehensive of speaking about their 'banned' activities and initially refused to cooperate.

The survey attempted to uncover hunting practices and the motivations behind villagelevel hunting in Arunachal Pradesh. This was done with four tribes—Monpa, Sherdukpen, Apatani and Adi. The Monpa and Sherdukpen belong to the Mahayana Buddhist sect and provided a contrast to the Apatani and Adi tribes who are animistic in their beliefs (Donyi-Polo religion). To allay fears stemming from the ban, I desisted from taking pictures or recording names of those who seemed particularly wary of speaking about hunting practices. This became especially necessary due to the timing of the government notification banning all forms of hunting two weeks before my arrival for the survey.

The study focused on areas where hunting occurred almost entirely in community-managed forests. A range of mammals was reported from these community forests with a total of 39 species being identified by hunters across all field sites. Among them, 14 were common to all areas. Among the animals hunted, the barking deer and wild pig are the two species that are most commonly hunted. The presence of endangered and rare animals such







Anirban Datta-Roy

as the Asiatic wild dog, the Asiatic black bear and the Malayan porcupine indicates that there still exists a great deal of wildlife in the human-use areas around the villages. Much of this is possible because of the presence of a matrix of community forests and jhum (shifting cultivation) fallows that support many faunal species. In the context of the current debate over 'inviolate areas', this is an important reminder of the faunal wealth that still exists outside the protected area network. It also serves to highlight the effectiveness of traditional institutions to manage forest commons in ways that further biodiversity conservation.

The primary reasons for hunting are said to be domestic use of wild animals for meat and medicinal purposes. It is difficult to distinguish very clearly between these two reasons as sometimes the meat is consumed with the belief that it can cure certain ailments, while at other times there may be specific body parts (like bear gall bladder) that are thought to have medicinal properties. This was consistent across all tribes. Hunting for meat is important to tribal people as the price of domestic meat is extremely high, when it is available for purchase. Most villagers rear domestic animals such as chickens, pigs and mithun, which are seen as a resource that is kept for the future. They are sacrificed on special occasions or used as a currency for fines and other exchanges, and are hardly ever reared for regular consumption. Wild meat, on the other hand, is seen as a 'free' resource that is there for the taking.

Commercial hunting was reported by very few respondents, and hunting for crop defence was also low. It is likely that some of the respondents may not have reported accurately on commercial hunting for fear of official reprisals in view of the newly introduced 'ban'. However, in later discussions it was revealed that products such as bear gall bladder, musk deer pods and takin skulls have a ready market across the border, while the sale of wild meat within the village is not uncommon.

Hunting during religious festivals and hunting to provide gifts were the other reasons provided. Community hunts that are organised during certain religious festivals are common across most tribes and in some cases a specific species (such as sambar, barking deer or orange-bellied Himalayan squirrel) is hunted. This form of hunting occurs infrequently, about four to five times a year, and the hunts are stopped as soon as the desired animal is killed.

Almost half of the respondents said that they preferred wild meat over domestic meat while only a quarter of the interviewed hunters said that they had no preference. The reasons for the preference of wild meat ranged from taste and tradition to more practical considerations such as the ability to preserve wild meat for longer periods. The source for this wild meat is primarily through hunting by individuals rather than buying. Buying of meat for consumption too was restricted within the village and no respondent reported buying meat from outside the village.

Hunters also reported that whenever a hunt was successful they would share the meat with their relatives and fellow hunters. In addition to being an effective way of strengthening



community bonds between people, this is also a sustainable way of utilising resources as this ensures that the greatest number of people benefit from a single kill.

The frequency of wild meat consumption is limited by the number of successful hunts that a hunter may have, as the meat that he receives from his relatives or fellow hunters is hardly enough for more than one meal. The frequency of hunting trips is limited in turn by other factors. Winter is considered the best season for hunting due to favourable climate and few farming responsibilities in the jhum fields. Farming is critical for food security and cannot be deserted. It is only towards October, after the harvest, that the villagers have the time to indulge in hunting. Most of the respondents therefore identified winter as the best time for hunting. Winter provides relief from leeches and mosquitoes, while being conducive for night hunting as the hunters can then walk without the fear of snakes. This is also the time when group hunts for high altitude fauna, such as the takin, take place. The seasonal patterns in hunting across different tribes appear to be a reflection of their livelihood practices to some extent. The Monpas live in high altitude areas where jhum cultivation cannot be practised, instead relying on terrace cultivation. The Sherdukpen and Apatani live in valleys and most of their cultivation is of a permanent nature that is irrigated by rivers and streams. The Adi, on the other hand, practice shifting cultivation (jhum) and are entirely dependent on the monsoons. The practice of jhum cultivation is much more labour intensive as it involves clearing, burning, sowing and harvesting the land across a large part of the year. There is hardly any time for hunting except with traps (which require less time investment) during any other time of the year other than the winter months.



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During the hunting season, most hunts do not last more than a day. This is typical of hunts that occur around the village. Most hunters prefer to hunt in small groups of two to three individuals except for community hunts organised during special festivals. Even the group hunts for takin that last for three to four weeks do not necessarily mean that the hunters hunt together, or that they hunt for the entire duration. They stay together in a common shelter, but mostly hunt on their own. These hunts typically last for barely two to three days while the rest of the time is spent in travelling. The distance that a hunter has to travel for a hunt varied across the different field sites. However, excluding long-distance group hunts, hunters rarely ventured more than 6-7 km away from their village. The variability was primarily due to the distance of forest or other appropriate hunting areas from the village and the difficulty of the terrain.

Hunting is almost entirely reliant on modern technology today. Traditional forms of hunting with bows and spears are virtually non-existent and except for one individual, all respondents said that they hunt with guns (in addition to traps and snares). The ownership of guns too provides a great advantage to the hunters as otherwise they are obliged to share a large portion of their kill with the person from whom they may have borrowed the gun. The use of new materials is evident in traps and snares too where metal wires are used instead of the traditional snares made of hide or yak-tail hair. A very large proportion of the hunters who were interviewed had their own guns. In areas like Shergaon in West Kameng, the passage of a major highway has taken gun ownership to surprisingly high levels (there are reportedly close to 150 guns for 130 families)!

An important finding of the study is that hunting, like most activities in the village, is governed by specific rules and regulations. These rules may be characteristic of clan, tribe, religion or might be unique to a particular village. The Buddhist tribes are seen to be more influenced by religious beliefs and the teachings of the Dalai Lama, who has, in the past, personally appealed to them to stop hunting. The Adi hunters stated that they are governed by the community rules established by the village with regard to hunting and other forms

of natural resource extraction. Hunting territories of villages are clearly delineated and failure to follow the rules invites heavy fines. At the same time, the Sherdukpen village of Shergaon decided to ban all non-Sherdukpen people from hunting within their area as they felt that outsiders were hunting indiscriminately. This demonstrates the power that traditional institutions still wield, especially in northeast India. If this can be harnessed appropriately, such local institutions can be effective partners to the conventional protected area model of biodiversity conservation. A recent study by Lauren Persha and colleagues (journal Biological Conservation) supports such an approach, suggesting that although strict protected areas are effective tools for biodiversity conservation, 'a singular focus on them risks ignoring other resource governance approaches that can fruitfully complement existing conservation regimes.'

Various taboos are also attached to killing of different animals and are found among all tribes. This is most prominently observed in the reluctance of the Buddhist tribes to kill primates. Various reasons were put forward by hunters in the case of primates, some of which were related to their similarity in physical appearance to humans, bad taste, as well as incidents when killing of monkeys resulted in disease outbreaks or death for villagers. The reasons for sparing certain animals are hard to locate and may be due to behavioural patterns and morphological characteristics of the species, the belief that they are toxic, cultural perceptions of the animal being part of creation myths or even representing religious symbols. These are, however, important inbuilt control measures that serve to regulate the intensity and magnitude of hunting.

The government notification on banning hunting hardly served any purpose as the implementation of such bans are logistically impossible for the concerned departments in such remote areas. Hunters stated that this ban would not stop them from hunting and they would continue to do so, as this is what they have always done. The ban disregarded the fact that hunting has deep historical, social and cultural connections among the people of the area. Such token bans in fact run the risk of criminalising a social practice and merely moving it underground, where it will continue to exist, free from local institutions as well as the government.

Future policies aimed at hunting need to break free from these conventional approaches that have proven to be ineffective in the past. Traditional resource management institutions in the village wield a great deal of power in the formulation and enforcement of rules in tribal societies. Without adequate involvement and participation of these institutions,

MAJOR

ΔΝΤΜΔΙ

GORA

OTHERS

15%

AR

BARKING DEER

PHEASAN[®]

7%

SEROW

28%

HUNTE



Anirban Datta-Roy

it is unlikely that any policy on hunting can be implemented effectively.

The biggest threat currently is the gradual commercialisation of hunting in Arunachal Pradesh, with growing demands for wild meat from urban centres, and for skins and other body parts from across the border. There are hardly any checks on the sale of wild meat in urban markets and token bans appear to serve no purpose. This threatens to cause dramatic changes that may affect wildlife populations as well as the people who depend on them. In view of these impending changes, it becomes even more imperative to equip the local institutions to tackle these problems on their own. An effective partnership could dispel

much of the distrust that exists between both sides and provide a more pragmatic approach to controlling hunting in Northeast India.

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Changing with the seasons

COMMUNITIES WITH CLOSE TIES TO NATURE SHOULD BE THE MOST AFFECTED BY CLIMATE CHANGE, YET THEY ADAPT QUICKLY TO THE CHANGING CONDITIONS. TENZING INGTY DOCUMENTS THEIR VAST ECOLOGICAL KNOWLEDGE AND THE WAY THEY USE THIS TO REFASHION THEIR PRACTICES.

Overall warming, earlier summers, delayed monsoons and shorter winters. These are some of the very definite observations of climate change made by nomadic pastoralists of North Sikkim.





The Himalayas hold the largest mass of ice outside the poles and are the source of the 10 largest rivers in Asia, which provide water for more than 1.3 billion people. Rapidly rising temperatures resulting in reduction of glaciers will have many implications, especially for future downstream water supplies, causing changes in river-flows, groundwater and biodiversity, and impacting livelihoods.

The Dokpa live in the high altitudes of the Eastern Himalayas, traditionally moving higher up the mountains during winter to escape the snow. They live in extreme weather conditions and in largely inhospitable terrain, and are directly dependent on the provisioning services of nature for most of their livelihood requirements. Indigenous people like the Dokpa use resources like grazing pastures, medicinal, aromatic or edible plants, water sources for irrigation, and any changes in climate would affect their lifestyles directly. It might therefore not be inaccurate to refer to them as the metaphoric "canaries of the coal mines" with respect to the effects of climate change. Yet they are rarely considered in academic and policy discourses on climate change.

Climate change is an all-encompassing global phenomenon that can have tremendous consequences for both human as well as natural systems. The 2007 report of the Intergovernmental Panel on Climate Change predicted that mean global temperatures would increase by about 1.8-4.0°C by the end of the century, and this has now been revised to 2-7°C, with an increase of 5°C seeming most likely given current emission trajectories. This increasing trend of temperatures is predicted to have numerous cascading impacts on biodiversity, including gradual upward shifts in species' range distributions, local or global extinctions, and altered flowering and fruiting patterns of plants.

Studies in the Himalayas, a global biodiversity hotspot, have shown that the mean temperatures in the Himalayan alpine zones have increased by 0.6 to 0.8 °C since the late 19th century. The Himalayas hold the largest mass of ice outside the poles and are the source of the 10 largest rivers in Asia, which provide water for more than 1.3 billion people. Rapidly rising temperatures resulting in reduction of glaciers will have many implications, especially for future downstream water supplies, causing changes in river-flows, groundwater and biodiversity, and impacts on livelihoods.

Although studies in the alpine Himalayas indicate that climatic changes have significantly impacted biodiversity, they also seem to suggest that the people of the region have in fact been adapting to climate change. It is often seen that they are not just passive observers, but are actively refashioning their lives through numerous strategies, like migration, water conservation techniques, land reclamation and livelihood adaptation. Nevertheless, one must consider the important issue of scale before using this versatility to dismiss impacts of climate change. While climate change is a global phenomenon, human responses are based on very regional or local variations. Most climate change projections are on a larger scale, and often ignore the local scale effects. Indigenous people experiencing local changes in their climatic conditions have often been found to have an intimate familiarity with the natural rhythms and processes of their ecosystem. Scientists have suggested that the traditional ecological knowledge of local inhabitants can be utilised as baseline long-term datasets to analyse climate change as these have developed over centuries of trial and error. This approach could be very useful in the Himalayas, where such long-term baseline data have not been recorded.

Two communities from the Eastern Himalayas that provide an interesting contrast at a finer local scale are the agro-pastoral Lachenpas and the nomadic pastoral Dokpas. Both of these peoples still maintain their indigenous political institution, the Dzumsa, which primarily manages the patterns of utilisation of natural resources. Over the years, this institution has enabled the community a certain degree of resilience by adapting to changes in their socio-environmental surroundings (due to socio-economic, socio-political transformations,



compromises for national security, and most recently due to the cascading effects of climate change). The two communities also practice transhumance—moving with the seasons. However, they differ in their patterns of movement, with the Lachenpas moving to the higher altitudes in the summer, and descending in the winter, while the Dokpas do just the opposite. The Dokpas move to higher altitudes in the winter to wind-blown, snowfree pastures. Comparing the observations of these two communities on the obvious links between changing climatic conditions and biodiversity has resulted in a wealth of traditional ecological knowledge. Some of the most significant recorded impacts of climate change on global biodiversity include altered phenology (patterns of flowering and fruiting). The two communities differed here, and the low altitude Lachenpa hardly noticed any kinds of changes. On the other hand, the Dokpas, who frequent the higher regions of the mountains, made detailed observations.

Local observations and perspectives of overall warming, the onset of seasons, snowfall amount and timing, glacier melting and water sources drying out, differed in some cases between the two communities. An almost unanimous number of Lachenpas pointed out that snowfall, which was a regular winter occurrence till seven years back, had not been experienced in the recent past. Similarly, all the Dokpas interviewed observed a decrease in the amount of snowfall where once there would be five feet of snow outside their temporary dwellings it was reduced to just a couple of feet or less. Both communities also noticed that the lowest altitude that received snowfall was now a village at a higher altitude. Similar results were recorded for overall warming, shifts in seasons as well as the duration.

Some of the most significant recorded impacts of climate change on global biodiversity include altered phenology, or patterns of flowering and fruiting. The two communities differed here, and the low altitude Lachenpa hardly noticed any kinds of changes. On the other hand, the Dokpas, who frequent the higher regions of the mountains made detailed observations. For example, they traditionally mark the onset of winter by the flowering of *Gentiana ornata*, a herbaceous plant with ornate blue flowers, as it would be the last flower to bloom before the snow covered their summer pastures. They pointed out that with the delayed winters, the flowering of the plant too has been delayed. The agro-pastoralist Lachenpas also noted that mosquito numbers have increased over the recent years. In fact, they remember no mosquitoes in Lachen till about seven years back, suggesting that mosquitoes are adapting to these higher altitudes as the climate gets warmer.

The local institutions of these communities, or the Dzumsa, have been able to adapt to some of the changes in climate using a combination of traditional knowledge as well as commonsense practices. With less snowfall and shorter but heavier spells of rain, pastures have become drier, causing large numbers of sheep to die. In response, the Dzumsa has banned the slaughter or sale of sheep for the next five years. The overall number of sheep has slowly increased in the past three years, and the Dzumsa plans to lift the ban gradually over the coming three years.

Yield of pheo (local variety of cereal) has decreased considerably, and the people believe that this is due to warmer weather. To avoid a shortage of food, they have turned to other crops. Crops from lower altitudes, like maize, cabbages and pumpkins, which were previously unable to grow here, are now grown successfully at Lachen (9000 feet above mean sea level).



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Carrots that were never grown at high altitudes are grown in Thangu (12500 feet above mean sea level). Beliefs and faith often also play a role in determining their solutions, and prayer flags, which some believe decrease snowfall, have been banned in an attempt to allay the severe impacts of the changing climate. The Dzumsa thus forms an important web, binding social structures with the natural systems.

Perception studies of indigenous people on observed or experienced changing climatic conditions in other parts of the world have similarly demonstrated that traditional ecological knowledge is an important source of information for climate sciences. It is important to have holistic approaches while adapting to climate change, with integration and feedback loops between climate change science and indigenous peoples. For example, the Dokpas reported that certain plants are seen growing at altitudes much higher than where they were found 50 years ago. To investigate the veracity of this, I collected point source data in the field for the plant species named. I then crosschecked the present day

What strategies do the Dzumsa employ to manage resources?	
PRIMARY RESOURCE MANAGEMENT STRATEGY	THE IMPLICATIONS
Management of the dates for migrating to new pastures, as well as the altitude below which they cannot graze.	Management of resources in grazing pastures. Allowing enough time for pasture re-growth over a season (summer) for winter grazing resources.
Setting of dates for fodder collection along an altitudinal gradient.	Equal opportunity for all to put up their winter reserves.
Setting of the sowing and harvesting dates, as well as selection of crops for the different villages along different altitudinal levels.	Deciding the most productive dates for sowing and harvesting based on traditional ecological knowledge. Ensuring potentially higher yield and productivity, working towards greater food security. Coordinates the entire community's effort and gives everyone time to repair fences that will protect their crops from freely roaming livestock.
Fixing the prices of livestock and livestock products.	The poorer members of society are protected.
Equal redistribution of money collected by the Dzumsa through fines, government contract works and all other sources.	Financial security provided by Dzumsa to all member households.
At the time of funerals, members bring one bundle of wood to the house of the deceased and one log for the funeral pyre. Logs are checked for size with a bamboo ring.	Reduction of economic stresses at times of crisis.

To effectively tackle climate change, local perceptions, adaptations, responses and solutions must be kept in mind, while also being inclusive of the traditional institutions like the Dzumsa that can effectively develop and implement adaptation and mitigation strategies.

observations with the range data of these plants from JD Hooker's 'Flora of British India' (1850-1872 A.D.) and his 'Himalayan Journals Notes of a Naturalist' (1850 A.D). We were able to confirm indications of range extensions of four plants. Rheum nobile, Gentiana ornata, Primula primulina and Bistorta macrophylla, whose highest reported altitudes were 4500m, can now be located at 4784 m, 5212 m, 4824 m and 4724 m, respectively.

Indeed, indigenous peoples have much to offer to the discourse and actions countering climate change. They must be empowered to exercise self-determination to deal with climate change that threatens their traditional livelihoods and indeed their very existence. To effectively tackle climate

change, local perceptions, adaptations, responses and solutions must be kept in mind, while also being inclusive of the traditional institutions like the Dzumsa that can effectively develop and implement adaptation and mitigation strategies.

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The winter sun beat down as thin slivers of water irrigated an otherwise parched land. I was riding through familiar back streets, making our way to a remote corner of the maze of valleys cut by rivers that make up Akole taluka in northern Maharashtra. These valleys were historically arid and parched outside the monsoons. Irrigation schemes over the last two decades have transformed them into lush croplands producing sugarcane, grains, a variety of vegetables and dairy products.

The landscape would appeal to poets and geologists alike, for its rugged beauty, but it held no charms for us. I was here because people and leopards lived together in this human-dominated landscape. Conventional wisdom makes the presence of these big cats in such an area seem counterintuitive; the area is neither close to any conservation protected areas nor does it have any wild ungulate species that we imagine support large carnivores. Yet, the

Intimate beasts or schizophrenic gods

NEGOTIATING LIFE WITH LEOPARDS AND MODERNITY IN A SACRED-MORAL LANDSCAPE

leopard population in the area is stable and in fact breeding. They live on a varied diet of dogs, pigs, chicken and rodents; not exactly our conception of a noble large cat but effective for survival nevertheless. Furthermore, they live not in 'forests' but in the safety of sugarcane fields, where they remain undisturbed for months on end.

In my initial visits to the area, I had braced myself for what I presumed would be overt conflicts between people and leopards. What I found instead, was a situation where people and leopards dynamically shared the landscape with a complex relationship ranging from conflicts to coexistence. Fascinated, I set out to probe these interactions and map the factors that create conflict and/or facilitate coexistence.

I explored the political, social and administrative institutions and strategies that were employed by people to share the landscape with leopards. The present journey I was making, with three local informers, was to the tribal belts, to engage with a cultural institution built around the large cats.

The road to the tribal areas penetrated deep into the mountains of the northern tip of the Western Ghats. These tribal areas are characteristically drier than the valley floors that are irrigated by water taken from the river systems that drain these areas. Besides being drier, the tribal areas are also perched on the political periphery of developmental activities, be it physical infrastructure or educational facilities or socio-economic integration. The tribal communities that live in these hills are primarily Thakkars and Mahadeo Kolis. They are primarily agro-pastoralists, though several members of the communities are also employed in the formal and informal sectors outside the village. Though good-natured and hospitable, the community I was visiting seemed reserved and guarded to my visible presence in the village. The reasons for this apparent wariness became evident in due course, but more on that later.

The time I spent in Akole, brooding over its reality, led me to realise that the physical landscape was pregnant with meaning, acquired through people's interactions with each other and nonhuman species. In this sacred-moral landscape, the large cats had a towering presence that was difficult to ignore. The tribal communities have deified the large cats in the form of a local village deity called Waghoba (the female equivalent is Waghjaimata, but she has a more spatially and morally restricted presence). To believers, Waghoba is at once a benevolent and violent deity with a strong sense of morality. This deity delineates space allowing people to intensively use part of the landscape, while also allowing space for wilderness outside the domain of the village. These communities are conscious of the fact that their long-term survival depends on husbanding resources in both domains. In this context, Waghoba plays the role of a guardian deity, enabling community members to live in the landscape as long as they respect his presence. Rituals like Waghbarsi are dedicated to appease Waghoba while also expressing gratitude for his generosity and benevolence.

Over the years, I had encountered several people in the valley who had scorned the Waghoba and associated rituals. They dismissed them as 'backward' and 'blind superstition' (though many of them later admitted that they did participate in the rituals, which they claimed are a social event rather than a cultural one). There were also people in the town who held the area as a production landscape meant for use by people, who petitioned the forest department for compensation for depredation losses and insisted that the leopards be removed from the area. Such demands are rare in the tribal area, be it for compensation or removal of leopards. But then the tribal communities have fewer resources to spend on negotiating with the forest department and even less access to political patronage. Instead, they negotiate with the large cats directly.

Here the socio-cultural institution Waghoba plays a central role. As a deity, ritualised negotiations are only one aspect of adapting to the presence of large carnivores in the landscape. I hoped to witness this negotiation and interview members of the community who participated in the rituals. Once we arrived in the village and were introduced to our hosts, I wondered if we would head off into the hills for the Waghbarsi rituals, as is the practice amongst communities living in the valley. Our host laughed and pointed to a hut in the heart of the village and said it is the Waghoba shrine where the rituals are performed. Most other

Waghoba shrines I had visited were sited in the hills and at important crossroads. I wondered why this shrine was located in the heart of the village but was told that its significance was lost in antiquity.

After a quick meal at the host's home, we planted ourselves near the Waghoba temple. Some village youth were milling around and started to chat with us. On hearing that we were interested in the Waghbarsi, they invited us into the temple and explained that Waghoba is a benevolent deity who ensures that no harm befalls the village. However, the youth added ominously, if one does not perform all the rituals with genuine piousness, the leopards and the tigers in the hills would harm our interest within three days. The youth named several individuals who had lost livestock to leopards till they performed rituals to appease Waghoba, after which the leopards caused them no harm! The rituals got underway with male members of households in the

community taking turns to offer a rooster at the Waghoba shrine accompanied by a prayer; occasionally a dry coconut was broken and a coat of vermillion and oil was added to the shrine. The rooster was taken outside the shrine, pinned down and offered water before its throat was slit. It was then beheaded and the head was respectfully placed at the Waghoba shrine as a symbolic offering. After the bird was plucked and cleaned, it was taken back to be consumed by the family, relatives and neighbours. The temple priest and the youth had also set up a make-shift kitchen beside the temple, where they cooked a broth of chicken, rice, lentils and vegetables. This was later distributed among the children of the village and people gathered at the temple. The last animal to be sacrificed was a goat, which was owned by the whole community. After being ritually slaughtered, the head and hooves were offered at the shrine, while the rest of the meat was distributed amongst the villagers. Other Waghbarsi rituals I had



observed, and heard reports of, did not involve animal sacrifices but involved a vegetarian feast instead. The gathering at this shrine pragmatically informed me that the offerings are symbolic, depending on the people participating. The important aspect of the ritual was piety and gratitude towards Waghoba.

Naively, I asked if the leopards and tigers in the area visited the shrine. The priest smiled and one of the youth said that earlier the shrine was uncovered and they would often see pugmarks of the big cats around it. Now that the shrine is covered, he added, they see pugmarks around the area but not inside the shrine. On being asked if they feared these big cats that could very easily kill a human, the gathered villagers responded that they were gods and would never harm anyone unless provoked. An elderly gentleman spoke up, saying that Waghoba governed the life of the village and wilderness. He

cluded that Waghoba belonged to ir pantheon of village deities that sured that the villagers did not suffer due misfortune.

iscovered that no one in that mlet had suffered losses due to pards. However, some people in neighbouring hamlet had suffered predation losses. The people at the ine had a ready explanation for s claiming that the individuals had pped doing these rituals or were ing it half-heartedly. Waghoba had nished them, and now they were once un participating in the rituals as they 1 for generations.

wards the end of the day we headed :k to the host's house for dinner. I :nessed how carefully the livestock in : village was protected for the night. Ir host said it was their responsibility take care of the livestock. The big s needed to eat meat as that was

their way of life, but as agro-pastoralists the villagers could not rely on the benevolence of Waghboba alone but also needed to protect their livestock. As we were about to leave, we heard rumours that some villagers claimed we were from rationalist groups and had come to ensure that they would not be able to perform these rituals in the future. This explained their initial guardedness. However, in retrospect, I realise that these rumours were fueled by the tension between upholding traditional socio-cultural institutions anchored to their sense of identity and negotiating modernity.

On the one hand is the institution of Waghoba, which enables the community to adapt to living with large carnivores. The institution also underpins shared values that hold the community together and provides a context for symbolic negotiations with the large cats. This intimacy with the large cats has yielded a deep respect for them, which ensures that livestock in these parts are well protected. Even when there are depredation losses, no compensation claims are put forth to the forest department (partly due to their socio-cultural beliefs and partly due to the complexity of bureaucratic procedures). Furthermore, the ritual ensures that the community members eat a protein-rich diet, atleast for a few days of the year. However, many community members, especially the youth, are aware that outsiders do not understand their myths and beliefs and regard them as superstition.

On the other hand is modernity symbolised by the state, NGOs, technology and interaction with nonlocals. In this context, the leopard and tiger are large carnivores protected by the state and its law. Depredation losses are partly compensated by a fixed rate (depending on the forest department), but otherwise these communities have no option but to tolerate the presence of large cats in their midst.

The interactions between large carnivores and people in a morally and politically-charged landscape is complex and dynamic. The choices are stark but very real. Communities and individuals face divergent and contradictory value systems everyday. Within larger realities, both facilitate large carnivore conservation but one encourages coexistence through existing socio-cultural institutions, while the other imposes it through the state's policing mechanism. While neither system is perfect, a little pragmatism can help integrate these two very different conceptions of nature and large carnivores. The outcome of these complex negotiations is far from clear and calls for a new (political and conservation) morality. Unfortunately, this window of opportunity is small and lacks an 'undo' button.

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The Forest Rights Act and Wayanad's Paniyas

A NEW BILL TO EMPOWER PEOPLE STAYS A PIECE OF PAPER

'A piece of paper' was how some Paniyas of Wayanad referred to compensation received under the Forest Rights Act, 2006 (FRA). Wayanad, a district in the Western Ghats of Kerala, lies in the state's north-eastern portion. Thirty seven percent of Kerala's adivasis (tribals) live here. These include, besides the Paniyas, the Kattunaikka, Kuruma, Adiya and Kurichian. The Paniyas were bonded serfs till the 1970s, after which bondage was abolished. They then became a timid and cheap labour source in local and settler farms. Despite government land distribution schemes after abolition of bondage, many continued landless. They form the majority of the landless in Wayanad.

The Forest Rights Act was passed in 2006, and aimed to redress "historical injustice" against tribals and forest dwellers, who were traditionally overlooked during the state appropriation of forests under the Indian Forest Act, 1927. This landmark bill aims to give forest dwellers the rights to own/claim land, cultivate, and collect non-timber forest produce, amongst other provisions. Why then were the Paniyas pessimistic about this piece of progressive legislation?

THE PROCESS OF VESTING RIGHTS

The FRA requires a number of institutional structures to be set up to accomplish the goals of the Forest Rights Act. Gram Sabhas (local self-governments at the village or small-town level) are required to elect a Forest Rights Committee (FRC) from amongst their members. The FRC is to assist the Gram Sabha in conducting meetings, and in collecting and verifying claims. A tier above them, the Sub-District Level Committees (SDLC) collate and examine claims; and adjudicate on disputes. The District Level Committees (DLC) examine and approve claims in consonance with the Act's objectives, and ensure that Gram Sabhas are conducted freely and openly, paying attention to participation by women at all levels.

In Wayanad, the State Tribal Department formed Gram Sabhas in December 2008 and FRCs were duly constituted. All the FRCs had Scheduled Tribe members with onethird being women in accordance with the Rules. The FRCs processed claims from colony members and verified them with the help of tribal promoters. These claims were then passed on to the tribal department from where they reached the SDLC. At the SDLC and DLC levels, most applications were approved. The process was well streamlined. Hand-written claims were computerized. Training was administered to persons involved in the online entry of the claims to be forwarded to higher authorities for approval. In Wayanad, this entire process was taken care of by three adivasi girls who had completed their schooling till tenth standard.

ENTITLEMENT IMPACTS

So what do the Paniyas from colonies

in Noolpulzha and Pullpalli Panchayats have to say about the entitling process and the benefits? What collective dispositions towards the FRA do their comments suggest? The landless will remain so, they argue. Because of their earlier bondage to farmlands and later itinerancy as plantation labour, they did not possess forest lands in extents that the FRA's entitling would render economically meaningful. Land rights now granted under the Act resulted in agriculturally unfeasible homestead rights. Additionally, with increasing population, three to four families lived in one house, and hence might not have been counted as separate eligible families when entitlements were paid. Records corroborate complaints over the small extents of lands that the Paniyas were vested with. The district received a total of 3,847 individual claims, with Paniyas representing a small fraction of this figure. Among Wayanad's adivasi applicants, most received land under a three-tier distribution scheme. The first tier included adivasis who have applied for more than one acre of land, the second included those who applied for lands between fifty cents to one acre, and the third included all adivasis who applied for less than fifty cents of land. Most Paniyas featured in the third tier.

Although the vesting of land rights under the FRA in Wayanad was far more satisfactory in comparison to other districts and states, community rights have not been vested, though claims were processed. Both the tribal and forest departments have no clear



explanation for the delay. The Paniyas had applied for community rights regarding firewood, fishing, amla collection, cattle grazing and burial grounds. A general feeling that they do not stand to gain much from such rights prevails, and is possibly the reason for the delay. While they did depend on forests for tubers, especially during bondage when they had little else to eat, post abolition of bondage, the situation changed. Work was available, especially in lands colonized and cultivated with cash crops by settlers, ensuring marginal income and food security.

FUNCTIONING REALITIES

In Noolpuzha, Paniyas generally did not recall participating in FRC meetings. They knew of only two meetings that were held. The Pullpalli Paniyas recall only one FRC meeting being held. It is interesting that the Paniyas mention that only those who attend Gram Sabhas were aware of FRCs. Not everyone attends Gram Sabha meetings, as it is perceived that the meetings are talk with no evidence of implementation. Participation by women is also not at the levels prescribed. Paniya women in Noolpuzhla are otherwise occupied with routine work during meetings, which keeps them from attending. Such dismal Paniya representation is a function of combining factors such as prioritising of work over attending meetings, lack of awareness about such meetings and a perception that entitlements, especially land, were in extents that were not of much productive feasibility.

There is also not much dissemination, in Gram Sabha meetings, of community rights and duties prescribed under the FRA. Tribal promoters talk of such duties only in initial meetings. Only basic infrastructural problems are discussed, and people prefer to talk about lack of basic amenities. In discussions, Paniyas of Noolpuzha also talk of the forest department wanting them to vacate the forests. The Paniya, in general, exhibited a pessimistic disposition towards the FRA. For those who are familiar with these poor and powerless adivasis, the disposition will not come as a surprise. Many a state legislation on land reforms that sought to ameliorate the Paniyas' condition did not have any cumulative and positive outcome. One particular Paniya's opinion is representative of his people's condition. He asks, "What help will the FRA bring? They are not giving us extra land. Only a paper for the house that we already own." Further, "We are getting nothing more or nothing less than what we already have. And what we have is so little; two cents or five cents. If they were atleast giving us half an acre of land, one family could survive well. We could do agriculture".

It is unfair to solely blame the FRA for not improving the Paniyas' condition. The Act could end up adding itself to a long list of legislations that have remained 'just papers'. But one had hoped that adivasis like the Paniyas would have benefitted a lot more from FRA entitlements.

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Sourcing local solutions for conflict

FOREST-DEPENDENT PEOPLE IN THE SAME LANDSCAPE EXPERIENCE HUMAN-WILDLIFE CONFLICT IN DIFFERENT WAYS, BASED ON THEIR PRACTICES AND ATTITUDES

Altering or clearing forests for farming and other activities leads to fragmentation of wildlife habitat, which in turn results in a cascade of negative impacts. For instance, farmlands near or across an animal's migratory route can lead to crop damage and losses to both humans and wildlife, a situation commonly known as human-wildlife conflict. The Mysore-Nilgiri corridor in southern India is both a traditional route for wildlife such as elephants and a resource base for local people, and holds considerable conservation value. While studies have investigated direct and hidden costs of conflict, we still need site-specific understanding of the issue to provide solutions. In this landscape as in others, most proposed conservation plans and forestry policy decisions tend to ignore the livelihood resources of forest dependents. Somewhat contrary to this, one paradigm of biodiversity conservation research opines that natural resource extraction by forest-dependent people is one of the most viable alternative options to reduce poverty and enhance local livelihood. Different forest communities within one landscape might differ in their practices, socioeconomic conditions and attitudes, all of which will affect the kind of conservation solutions that must be proposed for them.

Biligiri Rangaswamy Temple (BRT) Wildlife Sanctuary, recently declared a Tiger Reserve, is biologically diverse but has lost its connectivity with Nilgiri Biosphere Reserve, Western Ghats and Eastern Ghats. The landscape around BRT is completely transformed into farmlands, settlements, road networks, etc. Corridors such as Doddasampige-Edeyarahalli and Chamarajanagar-Talamalai, at Punajanur and Mudalli, connecting BRT with Cauvery Wildlife Sanctuary on the east and Nilgiri Biosphere Reserve, on the south respectively, are also facing intense human presence. This leads to increase in crop raids, and human and animal loss.

THE DEPENDENTS

There are two major forest-dependent communities in the BRT-Sathyamangalam corridor: tribals and non-tribals. The Soligas were primarily a hunter-gatherer tribe and practiced farming through shifting cultivation for their subsistence. Following the declaration of BRT as a wildlife sanctuary in 1974 they were settled in forest lands close to the corridors. Then there are settlers from elsewhere who were allotted land for cultivation under the 'land for food' scheme, aimed at increasing crop production. They were allotted forest areas either close to or in the corridors.

According to recent work, around 60% of Soligas' income was lost due to the ban on non-timber forest products collection in 2007—mainly amla, honey, lichen, soap nut, soap berry and fuel wood. However, there are still some people harvesting products for domestic use. Tribal and non-tribal communities also depend on the forest for raising cattle for ploughing as well as dairy products, whereas the goats and sheep are raised for sale as well as for meat consumption as alternative income sources.

On average, tribals hold about one acre of land per household (mainly forest land), while for non-tribals it varies from one to five acres per household with land tenure rights. Without similar rights over 'their' land, tribals are economically poorer than non-tribals whose landholdings are fixed assets.

PRACTICES AND DAMAGE

Traditional crops in the predominantly dry landscape include ragi (finger millet), field beans, castor and vegetables. This crop diversity has enabled a more reliable income, providing enough even if any one crop fails. In the recent past maize, turmeric, potato, sugarcane and banana are becoming major crops due to interventions for intensification and commercialisation of farming.

People have frequently seen a number of animals in the forest-farmland matrix and major crop damage, in decreasing order, is caused by elephants, wild boars, spotted deer and sambhar. Incidence of conflict is very high during ragi and maize cropping which necessitates guarding the crop over three to four months. Abstaining from guarding even for a single night during the harvest season affects a farmer's entire effort, and puts pressure on his family because in addition to losing food security for a year, they have to search for alternative income sources. The increasing rate of farmlands being left fallow to avoid conflicts compounded with growing family sizes over the years directly affects net income levels.

CONSERVATION ATTITUDES

Tribals venerate the forest and its inhabitants, with the belief that their faith will earn them good harvests of both crops and forest products. Their philosophy tells them that the forest primarily belongs to wildlife. They do not consider conflict a major threat to their livelihoods compared to getting evicted from their present farmlands, which are mostly forest lands. Tribal farmers reminisce about strategies they followed in the past to reduce, not avoid, crop loss. Even today some of the settlements inside the forest cultivate coffee and other fruit trees instead of traditional crops to avoid crop damage by wildlife. In contrast to this, the non-tribal forest-fringe farming communities blame wild animals and management policies for their crop-loss.

While both groups are open to supporting any alternative strategies that could benefit forests, people and wildlife conservation, neither is ready to reduce their dependency on the forest. The tribals opined that the forest was their only source of income, and only a few of them worked in nearby coffee estates as daily wage labourers.

Because tribal lands are primarily forestlands, they are not allowed to use electric or solar fencing for their farms, and are also not eligible for compensation when wild animals raid their crops. The human-wildlife conflict is therefore a bigger problem for tribal farmers than non-tribals in the study area.

Both forest-dependent communities expressed their views regarding conservation strategies towards managing the forest resources and mitigating human-wildlife conflict. Some of their suggestions and demands are listed below:

- Solar fencing is not affordable to all farmers. So, it would be better to share a 'community-level solar fencing system' for the forest as well as revenue land to be effectively maintained by a beneficiary member regularly.
- Crop insurance for crop loss/damage with the support of conservation agencies will be a good strategy to avoid exploitation by insurance companies.
- The existing compensation schemes and bureaucratic processes fail to generate support for conservation in

the study area and it should be revised including inputs and requirements of the farmers.

- The state forest department must reconstruct the defunct elephantproof trenches in this area with revised measurement of width and depth as per the villagers' needs and inputs.
- Formation of an 'anti-depredation squad' that would include both local residents and skilled forest personnel to prevent wildlife conflict and chase problematic animals during cropping seasons. This will also help bridge a good relationship between people and forest managers.
- Along with existing eco-development committees in many forest areas, special 'Joint Corridor Management Committees' can be formed exclusively to address the issues of wildlife corridor conservation for safe migration of wild animals.

The tribal and non-tribal communities have shown great cooperation and even provided inputs for conflict mitigation measures, aimed at achieving sustainable conservation and utilisation of the corridors. It is necessary to develop alternatives in order to reduce pressure on the forests, based on the local communities' needs, mainly focusing on crop protection, participative management and crop insurance. These are affordable and reasonable strategies to help restore the habitat as well as livelihoods of forest-dependent communities

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After tea, what?

WHAT ARE THE IMPLICATIONS FOR HUMAN LIVELIHOODS AND NATIVE BIODIVERSITY AFTER THE ABANDONMENT OF TEA PLANTATIONS?

In the mid-1800's, many large plantations were established at the expense of natural forest in many parts of India. The British and the subsequent Indian government leased these plantations to private developers on a long-term basis, usually for a period of 99 years or less. In recent times, many such plantations surrounded by forests have been notified as Protected Areas (PAs). While most of these plantations have continued to function for decades despite falling within the larger boundaries of PAs, many are now being abandoned either due to expiry of leases that have not been renewed subsequently by the Government, or simply due to the decline in profitability of the plantations. What happens to these plantations after they are abandoned?

Tea plantations within the Agasthyamalai range (southern Western Ghats, Kerala) have been vulnerable to poor markets, decreased demand, increasing labour costs, fluctuating global prices and insecurity over lease renewals. Litigation between plantations and the government or amongst the plantation stakeholders themselves (plantation owners and workers) has also been responsible for the non-maintenance or cessation of operations in plantations. Recent data from the Tea Board showed that between 2004 and 2007, the tea plantation area declined by about 55

% just in the Trivandrum division. In this short note, we examine what processes are under play in abandoned plantations in the Agasthyamalai hills, Kerala, regarding the recovery of native forest plants and tree species, and the social and economic consequences of abandonment for the plantation stakeholders (owners, workers, etc.).

ABANDONMENT AND BIODIVERSITY

Following abandonment, if a plantation is left unmanaged and undisturbed, it experiences different colonisation patterns depending on its location. Many invasive species colonised plantations at different elevations. At the elevational range of 900-1000 metres above mean sea level, Lantana camara took over 70 to 80 % of the area in plantation abandoned for nineteen years. A similar trend was observed even in recently (seven yearold) abandoned plantations between 600-1000 metres in Ponmudi (Kerala), with invasive species like Eupatorium sp., Cromolaena odorata and Lantana camara taking root. Many studies have highlighted that the growth and spread of invasive species leads to changes in plant community composition, which can affect the recovery of native forest species. At elevations of 1300 m and above, tea plantations abandoned for nineteen years were colonised by the tea plant itself. In such cases, they can grow into tall trees that completely shade the forest floor, making growth of sunlightloving forest species difficult.

SOCIAL AND ECONOMIC CONSEQUENCES OF ABANDONMENT

The tea plantation industry is one of the major agricultural sectors in India, providing the most employment. The current scenario of dwindling plantation areas leads to an increase in unemployment and livelihood-related issues of workers. In the Agasthyamalai region (Trivandrum division) of Kerala, many plantations have been abandoned and workers are struggling to find alternate livelihoods sources. Many families are working as causal labour in road constructions, or in some cases (eg., in Bonacadu estate) workers themselves started small areas of tea cultivation to sustain themselves, where they pluck the leaves and sell them to middlemen at low prices. In Ponmudi, after the Ecological Fragile Lands Act was enforced in 2003, many tea plantations could not sustain themselves, as the act prohibits estates from reviving non-cultivated areas within plantations. Managers from Merchiston and Ponmudi tea estates mentioned in conversation that now they do not have work all through the year for their plantation workers due to this Act. Workers from tea plantations are now registered under the National Rural Employment Guarantee Act to sustain their livelihoods.

The issues arising out of plantation abandonment are complex and need to be studied in greater detail. On the one hand there is an urgency to understand the ecological processes within the abandoned tea plantations and surrounding forests while on the other hand, social and ecological issues cannot be neglected, especially when large areas outside the PA network are constrained by newer laws. There are no win-win situations but a working compromise needs to be made where workers' livelihoods and ecological stability of the landscapes are met.

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Unassuming fruit-eaters

FLESHY FRUITS PROVIDE NUTRIENTS FOR FRUGIVORES, WHO IN TURN DISPERSE THE FRUITS (SEEDS) AWAY FROM THE PARENT PLANT, RESULTING IN A MUTUALLY BENEFICIAL RELATIONSHIP. HOW DOES DISTURBANCE TO HABITAT AFFECT BOTH PARTIES?

A group of eager eyes watched me doing fruit counts on a warm December morning. The shepherds and goatherds nearby seemed to be busy observing me, probably wondering why I was more interested in counting fruits than having a handful to savour. The fleshy fruits were of a common shrub colloquially called chania ber (Ziziphus nummularia). It belongs to the family of fruits commonly termed as jujubes. The ripe fruits are a delicacy for humans, though many of the marketed fruits are hybrids with other species. Chania ber largely occur in dry climates and are common in much of the arid and semiarid tracts in India.

THE PROCESS OF EATING FRUITS

Fleshy fruits spread by dispersal, which involves a specialised network of mutualistic interactions, where seeds are transported to new locations through a wide range of species—mostly birds and mammals. Such interactions are mutually beneficial to both the fruiteaters (food) and plants (dispersal of their seeds), and almost 90% of the plant species in tropical forests rely on animals for seed dispersal. Where precipitation is a limiting factor, fleshy fruits help supplement important nutrients and water for the frugivores. Fruit size and other characteristics determine its consumption, mobility and persistence within the environment. Regeneration of these plant species is also often dependent on the passage of seeds through the gut of animals. Fleshy fruits are typically produced in abundance, but are usually patchily distributed in space and time, which affects the movement patterns of the species consuming fruits (frugivores). In a way, the processes of frugivory and seed dispersal shape plant populations through complex interactions between the foraging decisions of animals and spatial arrangement of fruiting plants. Thus, frugivory and dispersal are important functions in an ecosystem,

engendering long-term benefits, and therefore maintenance of these relationships is important particularly in human-altered landscapes.

Calyani Ganapath

WHO EATS CHANIA BER?

In a human-altered savanna habitat in Abdasa, Kachchh, twelve species of animals and birds consumed the fruits of chania ber. These included seven bird and five mammal species: rosy starling, red-vented bulbul, white-eared bulbul, common babbler, lesser whitethroat, variable wheatear, Isabelline wheatear, black-naped hare, Indian fox, Indian porcupine, golden jackal and a rodent. How a frugivore handles a fruit actually says a lot about its potential as a disperser. If the species swallows the fruit and regurgitates the seeds at a location away from the fruiting plant, it is likely to be a disperser. However, if a species destroys the seeds in the act of frugivory, it is considered a seed predator. Some species may consume fruits but may not actually take the seed away from the parent plant and in such cases they are considered neutral in their function. Also, species that more frequently visit a fruiting shrub tend to consume more fruits than those species that visit occasionally.

Amongst the birds, the two species of bulbul were more frequent visitors at the fruiting shrub and were present throughout the fruiting window of the species (mid-December to early March), while rosy starlings maximized fruit consumption during the peak fruiting period (early January to mid-February). Bulbuls regurgitated seeds away from the fruiting shrub, indicating that they could be potential dispersers. The other bird species visited occasionally and consumed only the fruit pulp. Among mammals, blacknaped hare and Indian fox were the two most frequent frugivores recorded, and consumed almost half of all fallen fruits. While black-naped hares were 'neutral' frugivores, the Indian fox consumed whole fruits and defecated intact seeds, indicating it to be a potential mammalian disperser. The Indian porcupine was found to be a seed predator (consuming seeds and therefore preventing germination). Fruit consumption patterns also differed between birds and mammals. While

birds responded to total number of fruits (fruit crop) in the shrub, mammals (black-naped hare and Indian fox) were not affected by the total number of fruits or the density of fruiting shrubs. This difference could be attributed to the fact that birds generally respond to standing fruit crop while mammals largely forage on fallen fruits. Fruit collection by the local people was a common sight during the peak fruiting season. Considered a delicacy, many of the fruits are collected for personal consumption, though a proportion also makes its way into local markets for sale. Market surveys showed that large quantities of fruits came from far away taluks (Bhuj, Nakhatrana and Mandvi) with very little collection in and around the study area, and depending on availability, prices varied within the window of sale (mid-December to mid-January), ceasing rapidly after.

WHY TARGET FUNCTIONAL ROLES?

Chania ber is a commonly occurring shrub and its fruit consumers are equally common. Indian foxes and golden jackals are also found close to human habitation but how many of us actually think of them as mediators of plant dispersal? Unconsciously or consciously, our species-centric approach seems to obscure the importance of roles that a species performs in an environment. In India, priorities in conservation have been largely restricted to more speciose landscapes or charismatic animals. Arid and semi-arid tracts in India are currently undergoing a surge of development. We are losing vast tracts of grasslands and scrub habitats to industrial development and agricultural expansion. Considered largely as wastelands in India, they are being bargained by industrial honchos for solar farms and chemical industries. With these habitats vanishing rapidly, important ecological functions would certainly be affected. Though we may value species from an aesthetic or ethical perspective, functional roles are seldom taken into account. This necessitates further ecological research to create awareness amongst the human populace on the functional relationships that exist and how they benefit conservation efforts particularly in human-dominated landscapes.

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Ber Facts

Kalyani Ganapathy

- Family Rhamnaceae, fruit is called a drupe, has a stony endocarp within which are enclosed 2 seeds
- » Multipurpose plant; leaves used as fodder, fruit for food and medicines, twigs used for fencing
- » Distributed in India, Pakistan, Iran and Israel.
- » Ber plants have a single fruiting season per year.
- Parts of the Ber plant are used widely in medicinal systems across India, including in Ayurveda.

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Methane sinks in forest soils

FOREST SOILS ARE IMPORTANT SINKS FOR METHANE, BUT CAN HUMAN USE OF FORESTS REDUCE THEIR EFFICIENCY?

Forest soils are known to act as sinks for atmospheric methane, a major greenhouse gas. Methane is the most abundant organic trace gas in the atmosphere, primarily created by biological processes of microbes (methanogenesis). It plays an important role in global climate change, and forest soils are known to be effective sinks for methane. In soils, methane is primarily utilised by bacteria that oxidize it to produce carbon. However, the effectiveness of soils as sinks is affected by land-use practices such as agriculture, and forest or woodland soils are considered more effective sinks than soils in human landscapes.

Biligiri Rangaswamy Temple Wildlife Sanctuary is located at the confluence of the biologically diverse regions of Western and Eastern Ghats. Until the eighteenth century, these forests were hardly accessible to those residing in the vicinity. They were earlier inhabited by the hunter-gatherer Soliga tribe, who lived on non-timber forest products and practiced shifting cultivation. Shifting cultivation was banned by 1972, when the area was declared as a wildlife 🗢 anctuary, and Soligas now practice permanent agriculture. However, they graze cattle and continue to gather non-timber forest products from the sanctuary.

Despite protection, these forests are increasingly affected by anthropogenic influences (animal grazing, forest fires, etc.) of the people living in the vicinity of the sanctuary. These disturbances can be chronic given their impacts on the ecosystem. Grazing of livestock inside the forest encourages the growth of vegetation, in turn encouraging firewood collectors. Intensive grazing by livestock and other anthropogenic activities could pose serious threats to the natural habitat, including to forest soils. Treading and trampling by grazing animals leads to soil compaction, especially in wet tropical conditions. Soil compaction decreases the number of soil pores, in turn decreasing soil aeration. The condition of reduced soil pore volume and increased water-filled pore space reduces the ability of soils to absorb methane. Methane oxidizers in soils are also sensitive to disturbances.

A study in this landscape investigated the variations of soil methane fluxes in disturbed and undisturbed forest sites across four seasons, with forest grazed by cattle regarded as disturbed forest. Gas fluxes at the soil surface were collected from disturbed and undisturbed forest areas, and samples were analyzed for methane using a gas chromatograph in the laboratory. The net methane sink was higher in

undisturbed forest than in disturbed forest both overall and in each season. The accumulated methane sink value measured over four different seasons was highest during the monsoon, whereas the lowest value was post monsoon. During the monsoon, grazing activities are lower due to heavy and prolonged rainfall, which could be the possible explanation for higher methane sink values at this time. In contrast, the higher grazing pressure during the post-monsoon season leads to soil compaction due to livestock treading and trampling, thus creating anaerobic conditions in the soil with reduced airfilled pore spaces. This leads to increased methanogenic activity, and could be the possible explanation for the reduced methane sink during the post-monsoon season.

While human practices like agriculture are known to play a role in altering forest sink potentials, this study shows that disturbances due to animal grazing can also reduce soil's methane oxidation potential, hence reducing the overall methane sink strengths of soils in forestlands.

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