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Cover art **Sumedha Sah**

We open this issue with Janet Mays Carpenter's account of human-coyote conflict, and the drama that is played out in urban areas in Colorado. Priyanka Hari Haran narrates her encounter with colour in the forests of the Western Ghats through the delightful array of birds that she encounters during her field visit. Rachael Knight writes about community-led approaches to secure customary and indigenous land rights, and the role that Namati plays in facilitating these processes. Michael Adams uses opercula—the little lids that marine snails use to close their shells—as a metaphor for both persistence and change. So much of today's conservation is about separating humans and nature, but shells and opercula remind us of the long relationship we have had with the ocean. And what we can learn from communities that have lived closest to it. Chrissy Henriques brings us back to the issue of conflict, and how the mining of minerals (for products such as cell phones) and other factors are threatening the survival of Congo's great apes.

Nearly a decade ago, CC (Issue 3.1) put together a special collection of articles on field assistants as a tribute to their contribution to ecology, biology and conservation projects in India. We revive this with Madhuri Ramesh's entertaining account of her adventures with Ganesan *anna*, the story of a young field biologist and a crusty but ultimately invaluable field mentor. We also carry Rohan Chakravarty's comic illustration of a Research in Translation, featuring a paper on the effect of dams in the Andes on fish populations.

—**Kartik Shanker**



Cover art **Jennifer Powers**

In this issue we travel to the tropical rainforests of South America, with their strange and magical sights and sounds.

David journeys for three days, to get to a remote part of the forest deep in the Amazon. Learn how he investigates the health of leaves growing at the tops of trees that are 40 m tall. (That's taller than a 10-storey building!)

Then join Pizotito and Paquita as they discover the diversity of animal life in the Costa Rican rainforest.

—**Ankila Hiremath**

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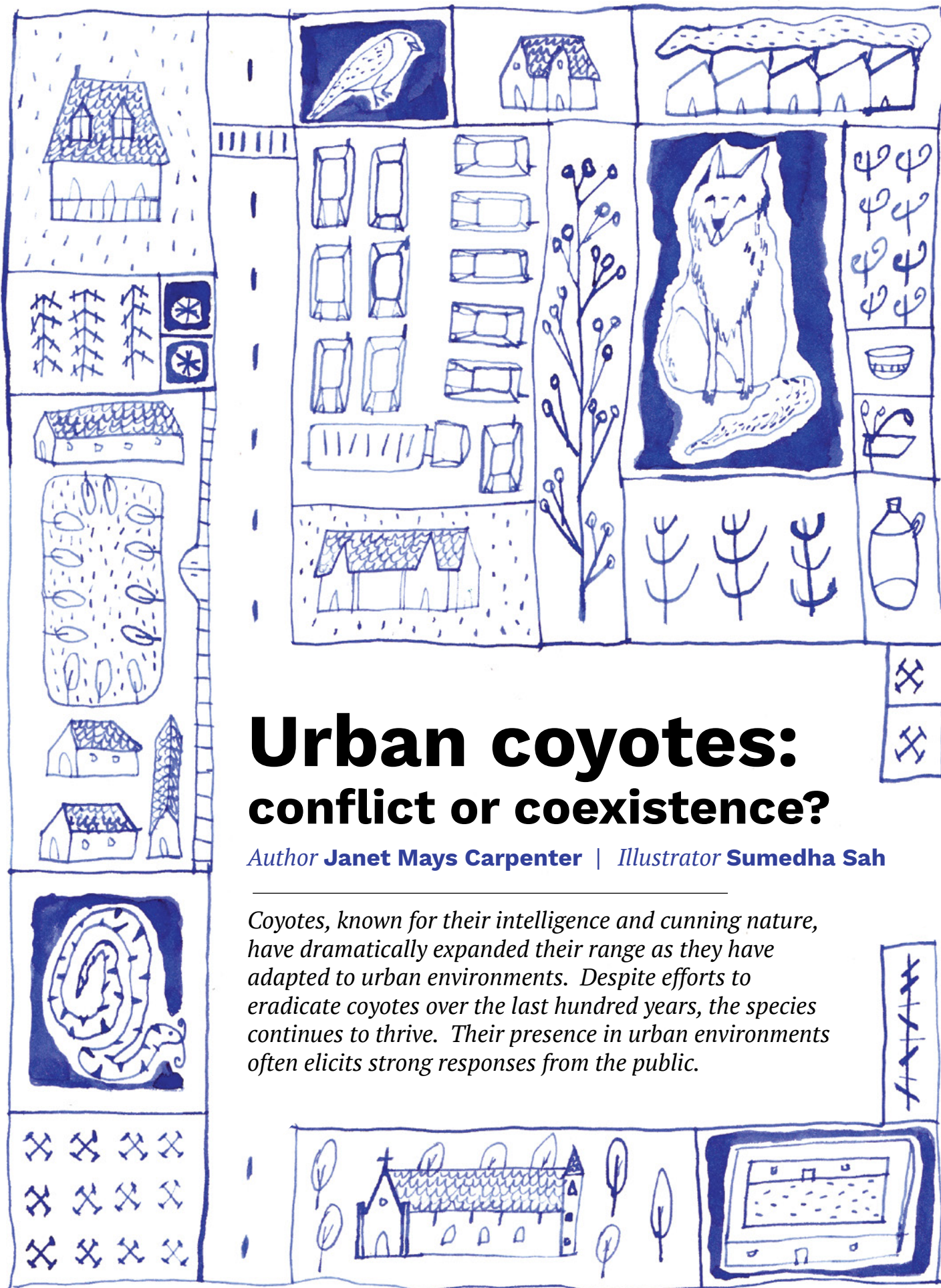
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Urban coyotes: conflict or coexistence?

Author **Janet Mays Carpenter** | Illustrator **Sumedha Sah**

Coyotes, known for their intelligence and cunning nature, have dramatically expanded their range as they have adapted to urban environments. Despite efforts to eradicate coyotes over the last hundred years, the species continues to thrive. Their presence in urban environments often elicits strong responses from the public.

It is an early Saturday morning in the Denver suburbs and I am awakened at 5 AM by my dogs, who are eager to go outside. I open the sliding glass door to the deck and the dogs disperse into the backyard. At first glance, there appears to be an additional dog in the backyard but upon closer inspection I realise it is a coyote. Concerned for the safety of my dogs, I step off the deck and into the backyard. I use my loudest voice and yell at the coyote, waving my arms overhead. Startled by my voice, the coyote leaps over the fence and continues trotting along the open space trail away from the neighbourhood houses. This type of encounter is common in communities across North America and may not always end as well as this one.

Human-coyote conflicts may involve an attack on a domestic pet or human, or an incident where a coyote displays aggressive behaviour towards humans, causing a public safety concern. As dogs may be considered prey or viewed by coyotes as a competitor, attacks on dogs are more common than attacks on humans. Over time if coyotes become accustomed to humans, a process known as habituation, coyotes may lose their fear of humans and no longer keep their distance from humans or pets. Such habituation can lead to human-coyote conflicts. In effect, habituation due to the unintentional or intentional feeding of coyotes has been linked to incidents where people have been attacked by coyotes. The (limited) research on human-coyote conflicts in urban areas suggests that most of these encounters occur in backyards, near homes, or while walking a dog, especially if the dog is off-leash.

Coyotes, known for their intelligence and cunning nature, have dramatically expanded their range as they have adapted to urban environments. Despite efforts to eradicate coyotes over the last hundred years based on the assumption they preyed on large game animals (e.g. mule deer, bighorn sheep, pronghorn antelope) and livestock, the species continues to thrive. Coyotes tend to avoid humans and spend more time in fragments of natural habitat where humans are less active and will increase their use of different habitats at night. As habitat becomes more fragmented and human populations continue to grow, human-coyote conflicts are on the rise; the presence of coyotes in urban environments often elicits strong responses from the public. These responses can be positive or negative and may be based on previous experiences with coyotes and may also vary based on other factors such as gender, pet ownership or whether one hunts. However, fear contributes to more negative responses due to concerns for safety or spread of disease. Thus, wildlife managers need to find effective management methods to address these conflicts and therefore it is important to understand coyote ecology and behaviour.

Coyote ecology in urban landscapes

Coyotes, considered a keystone species, play a critical role in the health of urban ecosystems by maintaining biodiversity. As the top predator in many urban cities across North America, coyotes may regulate the populations of mesopredators (medium-sized predators) such as skunks, foxes, and raccoons by suppressing these species through competition. As a result, bird diversity may improve as there are fewer mesopredator species to prey on songbirds and their eggs. Coyote also control rodent, white-tailed deer, Canada geese, and feral cat populations through predation. Conversely, where coyote populations are significantly smaller or absent, mesopredator populations may explode, reducing bird and plant diversity and altering the relationship between the species in the food chain below coyotes. Despite their positive effects on urban environments, they may have a negative impact on urban communities by preying on domestic pets, such as dogs and cats.

Home range of coyotes in urban landscapes

When it comes to mitigating human-coyote conflicts, an understanding of the size of the home ranges is critical to understanding how coyotes use urban landscapes and how human-coyote conflicts may emerge. Coyotes favour smaller home ranges in urban areas compared to non-urban areas, which may be attributed to





Human-wildlife conflicts provide a valuable learning opportunity for wildlife conservation, especially when carnivores are present in urban communities undergoing rapid change and where they play key roles in preserving biodiversity.

fragmented landscapes and the availability of food, including both natural (e.g., rabbits, mice, voles, deer, and plants) and anthropogenic (e.g., garbage, dog food, fruit trees, and pets) food sources. As coyotes are opportunistic predators, they may alter their tendency to avoid people in order to consume anthropogenic food sources near homes or prey on pets (in fact, this latter habit is a major source of human-coyote conflicts). These reduced home ranges, coupled with higher survival rates, drive high urban coyote population densities. As a result, communities across North America have established urban coyote management plans to manage coyote populations and address human-coyote conflicts.

Human-coyote conflicts: management of coyotes

Today, urban coyote populations are managed by a variety of regulatory stakeholders including United States Department of Agriculture (USDA) Wildlife Services, state wildlife agencies, and local governments. To effectively manage coyote populations, a combination of non-lethal and lethal methods may be used. Non-lethal methods include preservation of natural landscapes as buffers between coyotes and human populations, enactment of laws prohibiting the unintentional and intentional feeding of coyotes, enforcement of dog leash laws, and community engagement through public outreach and education programmes. In contrast, lethal methods include non-selective and targeted killing of coyotes, which may be used in response to attacks on humans or pets. However, these lethal methods can be controversial and are often ineffective because coyote populations have adapted by breeding at an earlier age and having larger litters when their populations are suppressed.

These human-wildlife conflicts provide a valuable learning opportunity for predator conservation. Through such experiences, wildlife managers can learn what tactics are more successful and apply these tactics to minimise human-coyote conflicts. An important step in the management of coyotes is understanding the perceptions and attitudes of the public towards coyotes and management methods in urban landscapes. By understanding the preferences of the public, wildlife managers can determine the types of management methods the public would support and the methods that might be most effective in addressing the issue of human-coyote conflicts in urban landscapes. More research similar to studies conducted by Hudenko et al. (2008), Lawrence and Krausman (2011), and Draheim et al. (2013) is needed on public attitudes towards coyotes in various urban landscapes to understand how to effectively work with the public to address the issue of human-coyote conflicts before such conflicts escalate further.

Opportunities for coexistence

An integral part of any urban coyote management plan, community outreach and educational programmes focus on increasing understanding about coyote behaviours and the coyote's ecological role in urban landscapes and can help mitigate human-coyote conflicts. For example, Denver, Colorado implemented a coyote management plan that focuses on community outreach programmes centred on creating an understanding of coyote behaviour and sharing hazing techniques with the public to minimise negative encounters with coyotes. The plan has been successful in reducing human-coyote conflicts: The city started seeing a decrease in incidents within the first year. In fact, Denver's plan is one of eight that influenced the creation of The Humane Society of the United States (HSUS) Template Coyote Management and Coexistence Plan, which is available for use by communities across the US. Tactics like those outlined in the plan can help increase tolerance of coyotes, especially in areas where coyote populations are more recently established. Increasing tolerance of coyotes and promoting coexistence are important goals of education campaigns and should be a part of any coyote management plan.

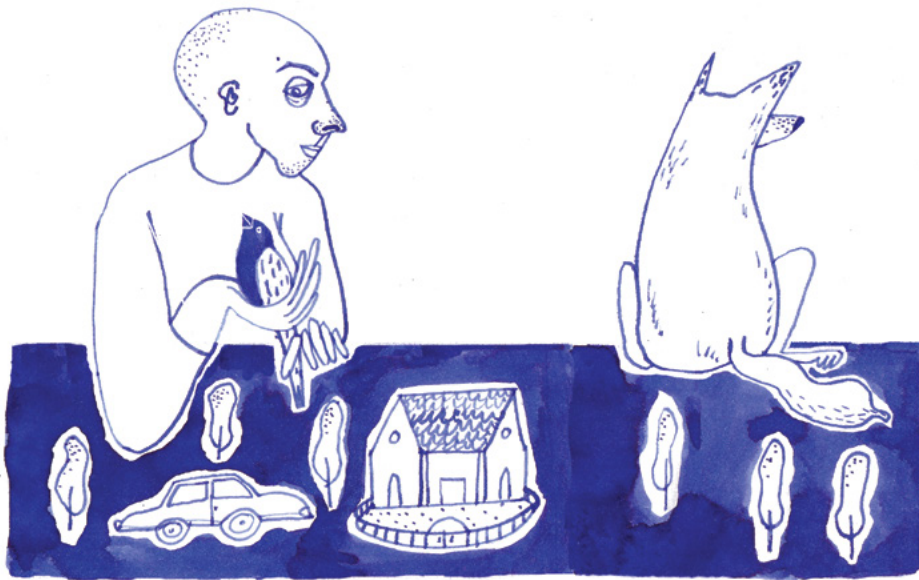
Tips to promote coexistence include the following:

- 1 Prohibit the intentional feeding of coyotes.
- 2 Remove food attractants from around the home by securing garbage, keeping pet food indoors, and, for homes with fruit trees, remove fallen fruit from yards.
- 3 Never allow coyotes to approach pets.
- 4 Haze coyotes encountered near homes or open spaces by using a loud voice, waving arms, or throwing objects if the coyote's behaviour is perceived as threatening to people or pets.
- 5 Always supervise children and pets when outdoors.
- 6 Keep cats indoors.
- 7 Keep dogs on leash when walking dogs in neighbourhoods or on open space trails.
- 8 Contact local law enforcement agency or the state wildlife agency if an aggressive coyote is encountered.

Conclusion

In reality, human-wildlife conflicts are increasing around the world as habitat continues to become fragmented in response to human population growth and as humans and wildlife compete for land and resources. Many of these conflicts involve predators, such as tigers in India, snow leopards and wolves in Mongolia, and lions in Africa. Experiences with predators, whether positive or negative, can influence public perceptions and views. Opportunities exist to reduce human-wildlife conflict through public education campaigns and community outreach programmes that





focus not only on increasing public tolerance towards these predators but also on altering both human and predator behaviour to prevent habituation. The story at the beginning of this article demonstrates how such education can be successful in mitigating human-wildlife conflicts. By taking a closer look at coyotes and developing a greater understanding of their behaviour and how such conflicts are being addressed in the US, opportunities exist to apply similar knowledge and understanding about other predators to address these conflicts in other parts of the world. Human-wildlife conflicts are complex by their very nature and there is no one-size fits all solution. Understanding predator behaviour, attitudes towards predators, and how our behaviour may contribute to some of these conflicts, are the first steps to finding solutions that encourage coexistence. History has already demonstrated that coyotes are not likely to be eradicated and that they are here to stay in urban landscapes. Coexistence between humans and coyotes is possible but it will require changes in not only attitudes but also behaviour. The question will be whether humans can take a lesson from coyotes and adapt to the presence of these wild neighbours, just as they have adapted to living in our urban landscapes.

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A not at all exhaustive list of colours in Anshi

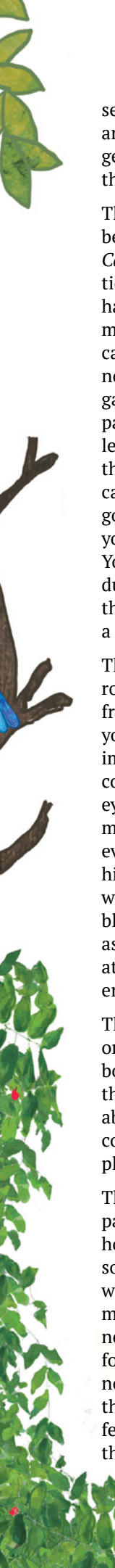
Author **Priyanka Hari Haran**

Illustrator **Maanasa Ganesh**

Immediately, arrestingly, there seems to be serene, unadulterated green. But look a little closer, and you'll see that it's a mishmash of many greens all co-existing, as they have for years and years.

From a rocky outcrop, you see the landscape of jade, emerald, moss, and seaweed, and you can't help but marvel at their sheer diversity. In the senescence of the full grown tree's leaves, you





see not just green, but also the strangest shades of red and brown. They cling on desperately, so close to the gentlest, shyest of greens. The green that is so new to the world, and is growing resolutely every day.

Then there is the green that strikes fear in your heart, because when you walk through a dense patch of *Carvia*, you know you don't walk out alone. Dozens of ticks have come out with you, on your pants, on your hands, on your legs – you've walked through a veritable metropolis of their homes. There is the excellently camouflaged vine snake who makes you stop short and notice his slender body, his grace as he watches you gawk at him. You move, he moves. He doesn't like any part of the vibrations you're causing. You've made him leave his spot in the sunlight now, slithering away into the undergrowth. The leafbird who forages high in the canopy has no time for you. She will not let you get a good look at her, even if only to watch her and make your observations. She's busy, she merges into the trees. You see some greens that have invaded this land – the dull grey-green of the *Casuarina* and the white-green of the dying *Acacia* leaves. You walk past them many times a day, in the village.

Then there is that astonishing blue of the sky, which robs you of all thought for a second, when you duck out from under the canopy. Or, more beautiful still, when you catch glimpses of it amidst the green. It's hard to imagine that any photograph could capture the startling contrast in all its glory in that visceral way the human eye can. But blue flies through the forest too. The monarch, with his petite black cap, calls in seemingly every flock of birds you see. The fairy bluebird suns himself on top of a leafless tree with his partner for a while, and with a final sharp call, they're off. The bright blue of the flycatcher who wags his tail up and down as he sits on a branch for minutes on end – only to dive at the ground to catch a flying insect – will keep you entertained as long as he is around.

There are those purple flowers that stubbornly grow on well-walked trails, wild and obstinate. But also bold in the brown of the forest floor and the green of the undergrowth. Later, you see it take over rice fields abandoned for the season, unknowing of what is to come in the following summer when the crops are planted again.

The flashy yellow and orange of the spider that painstakingly builds a web across shrubs. A large web, hoping for a multi-course meal. You walk right into her sometimes, and by then it's too late. You've torn the web apart and she must rebuild it. The orange of the minivet biases you, because what bird wouldn't look dull next to that plumage? The abundant fulvettas of the forest stand no chance – their nondescript browns are no match for that orange that begs the question, 'Hasn't this bird heard of a little thing called camouflage?' The female is no quieter in her yellow plumage, only smaller than the oriole of a similar shade.

The flameback woodpeckers work in pairs, trying to crack open *Entada* pods with their strong beaks. You hear the racket from quite a distance away. They do not care – they are determined to get those insects that are theirs only to claim. But you certainly see the rapid movement of that red crest as they work their way through pods larger than their whole bodies. Not far away, you see ripening berries in shades of red and yellow hanging on a tree that is being overrun with doves and bulbuls galore.

The lonely brown that signifies death in a tree, termites feasting now on the fallen giant. What a spectacle it must have been, the day this tree fell to the quiet forest floor! How the mighty have fallen indeed. You look in awe at the stately trees still standing around you, and then your eyes travel back to this one, crumbling slowly to powder and dust.

Crunch. Crunch, crunch. That's you walking on the forest floor in your heavy shoes, unlike the quiet cats of the forest with their velvet pads. Whoever knew there were so many colours of decay? There is green, grey, red, yellow, orange, purple and brown. And mottled black where you see fungus feeding on the remains. There are dead leaves choking small streams, deceiving you into thinking you can step on them.

There is black and white too, you know. Black in the thieving drongos, in shimmering bronze, ash, and long racket-tailed. They swish and swash from the canopy to the forest floor, everywhere at once, and incite a flurry of activity in every flock they steal from. On a lonely road near a one-house village, you see ten cattle grazing. They must be ushered through the forest, back home, from where they've strayed. And as they herd onto the path, you see that last one is white, with an oval patch of black on his bottom. There is no way this cow will leave without eliciting that smile from you, as he trots merrily away with his friends.

Then there are colours that cannot possibly be described. To call the sunlight golden as it bathes the trees in the morning and warms the forest seems somehow inadequate. Can sunlight be a colour? In its absence, the forest has so very solemn a glow to it – you begin to understand where the fairy tales learnt to describe their forests from. You look around, and there you are, in all the most ethereal ones, all at once. Colours cascade around you, as they have for millennia.

Priyanka Hari Haran is currently a research assistant at the Ashoka Trust for Research in Ecology and the Environment (ATREE). This piece draws on her master's dissertation work with mixed-species flocks of birds in Kali Tiger Reserve.

Maanasa Ganesh is a designer, Japanese aficionado, and ardent bird enthusiast. As travelling and studying new cultures refreshes her creativity, she is shifting her base to Tokyo to explore and absorb the design landscape.



Drafting community bylaws for community-driven conservation and legal empowerment

Author **Rachael Knight** | Illustrator **Dhwani Shah**

In partnership with innovative local land rights organisations, Namati supports communities to protect, document, and defend their customary and indigenous land rights.



For billions of rural people, land is their greatest asset: the source of food and water, the site of their livelihoods, and the locus of history, culture, spirituality, and community. Yet population growth, climate change, and increasing global demand are putting pressure on increasingly scarce lands and natural resources. The resulting commoditisation of land tends to increase competition for natural resources and precipitate a breakdown of the customary and indigenous rules that govern their equitable and sustainable use — rules that in the past functioned to protect the land rights of vulnerable groups and support conservation and flourishing of local ecosystems.

Global attention has tended to focus on strengthening household property rights, but studies have shown that rural families disproportionately rely on common wetlands, forests and grazing areas to survive. Rural families, both subsist from and earn their livelihood on these lands - gathering wild foods and medicines, hunting and fishing, grazing their animals, collecting wood for fuel, and sourcing building materials. As land has become more scarce, powerful elites are increasingly leveraging their power to claim communal lands in bad faith. Meanwhile, poorer families are finding it harder to subsist on increasingly scarce resources. Strong legal protections and local rules for shared community lands and natural resources are therefore critical.

A community-led approach to strengthen local rules

In Nepal, an estimated 5% of the population own 37% of the arable land, while 53% of farmers are functionally landless, holding less than a half a hectare of land, an area too small for subsistence requirements. Moreover, an estimated 480,000 rural families do not have access to any land at all. These landless families often live within community forests, which leads to conflicts with local Community Forest User Groups (CFUGs), elected groups of villagers who manage their community's forest to ensure sustainable use and long-term conservation. To address these challenges, from 2013 to 2016, the Community Self Reliance Centre (CSRC) and Namati piloted a process to help communities strengthen local rules for land and natural resources management and support community-driven resettlement of authentically landless families in Bardiya and Kailali, neighbouring districts in the southwest of the country on the border of India.

The region, known as the 'Terai', is primarily agricultural, with fertile soil. The indigenous peoples of the region are Tharu, and primarily speak the Tharu language (54%), with only 35% speaking Nepali. Other ethnic groups living in the area include Brahmins/Chhetris, Dalits and Newars. A significant percentage of the non-indigenous population of the Terai have

familial or ethnic links to India, as the border between India and Nepal is porous, with many Nepali men crossing the border to seek work for long periods of time. In the 1960s, a large influx of migrants from the mountain regions of Nepal and India marginalised the landowning indigenous Tharu people, who had no paper records of their land rights, by occupying their lands and registering the land in their names. As a result, many Tharu families lost the land to these immigrants and were forced into bonded labour.

Four 'communities'—encompassing over 27,000 hectares of land that together had a combined population of more than 80,000 people — were led by local paralegals and Community Land Reform Committees elected by their communities to complete the following activities:

1 Community visioning

In one three-hour meeting, community members reflect upon and analyse the condition—and relative flourishing—of their lands, natural resources, and socio-cultural life many years in the past, today, and many years in the future (if circumstances continue along their current trajectory), then create a vision of how they want their community to be for their grandchildren's children.

2 Valuation of community land and natural resources

In a second three-hour meeting, community members use simple math to calculate the monetary value that they are already receiving from natural resources gathered from their common lands, forests and waters. Community members make a list of all of the natural resources that they gather from community forests and common lands, then calculate how much they would have to pay to purchase these resources in the local market if they could not go into their common lands to freely gather them.

3 Drafting and adopting community bylaws

Over six to eight months, the community uses deliberatively democratic processes to create rules for the sustainable and equitable management of their lands and natural resources. The first draft is made by community members collectively "shouting out" all of their existing local rules and all the rules their ancestors followed in the past. Everything is written down onto big sheets of paper organised into three categories:

—Rules about leadership and land governance, including rules about who can be a leader, leaders' responsibilities, how decisions about land and natural resources should be made, how to resolve conflicts, etc.;

—Rules about use and management of natural resources, including rules about water, forests, livestock, hunting and fishing, thatch and building materials, seasonal users' rights, etc.; and

—Cultural and social rules including rules about women's rights, children's rights, rules for relationships with neighbours, etc.

Facilitators then provide legal education on national laws and support community members to review their existing rules, adding new rules, deleting old rules that no longer serve the community's best interests, and changing existing rules to reflect emerging community needs until a complete second draft is agreed upon. Lawyers then review the draft to ensure alignment with national laws, and then, after changing any rules that contradict national law, the community convenes a large 'bylaws adoption ceremony' at which the rules are read out, then voted on and adopted by consensus or supermajority vote. Local leaders, government officials, neighbours and stakeholders attend, and local government officials sign and stamp the bylaws as evidence of their endorsement. Some communities also elect a "Land Governance Council," composed of trusted community leaders and members of all local stakeholder groups, including women, youth and marginalised groups, to manage community lands and natural resources according to the adopted bylaws, and work with local leaders/governments to ensure that the bylaws are enforced.

4 *Community mapping and land use planning*

Communities document their lands using sketch maps and satellite imagery, then use those maps to make basic land use plans to connect their bylaws to the physical landscape and to ensure that the community develops according to its future vision. In Nepal, communities used their maps to identify unused or barren lands that might be used to plant forests or offered to landless families for resettlement.

Recognising conservation as an outcome

In Nepal, the visioning and valuation activities created an acute sense of urgent need to protect and conserve the local ecosystem. Reflecting on the impacts of these activities, a community member in Bardiya District explained how, even though the original goal of the project was to address landlessness, once they completed the visioning activity, the goal changed:

"The project taught us about remembering how the situation was 30 years ago, how the situation is now, and how it will be 30 years in the future. 30 years ago there was plenty of forest, and now that is decreasing, and so for the future we are trying to get our forest back, to restore our ecosystem to what it was like in the past, so we focused on conservation as the goal of the project."

He explained that after completing the visioning exercise, the community bought saplings from local Community Forest User Groups and planted the forest on what used to be a very degraded sandy area. He recounted how, soon after they protected the area with basic fencing, all the saplings grew, along with a variety of indigenous species they had not planted. Community members also attested to the fact that in the three years since they had planted the saplings, the earth in the area had become richer and less sandy, and the air under the trees had become cooler. In other communities as well, the visioning and valuation activities spurred analysis of the various causes of their lands' declining fertility and relatively reduced ecological abundance. As described by CSRC's project manager:

"Through the process, [community members] became very excited about saving community land. In the communities some people started to make compost fertiliser – because in the visioning exercise, they saw that the land's power/capacity has been decreasing, and asked, 'What is the cause?' They figured out that the chemical fertilisers were depleting the soil. And so they put rules about only using organic fertiliser in their bylaws."

As with the visioning exercise, project field staff and community members alike expressed astonishment at what they learned from the valuation exercise. As explained by one of the paralegals in Bardiya:

"When I did the practice at the community level, people gave a very long list of the things they get from the forest; I never thought that community people were using these things in every day life! And they too had never realised how much they were getting from the forest – 52 types of plants they use in daily life! This was surprising to all of us, even the villagers."

One woman in Jabdahawa community, the female secretary of the Community Land Reform Committee, explained that the valuation activity opened her eyes and helped her understand local natural resources more deeply:



“My birthplace is a little bit far from here, and there is no forest in my home place, it is like a city. I had heard about the forest, but I didn’t feel what was a forest. When I came here after getting married, and I saw the jungle, I started to go to the jungle every day. I used to carry firewood and other things from the forest. But it was not until I was involved in the valuation exercise that I understood properly what is a forest. A forest is nature, a forest is our life, the forest gives many things to us, so we have to give something to the forest as well. Without our support the forest cannot exist anymore.”

In response to future visions of environmental degradation, the Nepali communities passed bylaws outlawing the use of chemical fertilisers and mandating the use of natural, traditional fertilisers; prohibiting fishing using poisonous chemicals and electric-shock tactics; prohibiting water contamination; and requiring all community members to actively plant trees, among many other conservation-focused rules (see Box 1, which includes some of Bhajani municipality’s bylaws).

An informal 2018 assessment found that most community members interviewed could recite many of their bylaws from memory. For example, community members in Bhajani Municipality were collectively able to “shout out” a significant number of their bylaws. One man offered that:

“We made rules for ending poisoning in the river and no more fires in the forest. Until today, these rules are being followed and enforced!”

while others in his community explained how the community’s new rules outlawing child marriage and child labour, requiring joint land certificates for husbands and wives, mandating equal wages for women and men doing the same work, prohibiting forced unpaid labour, and calling for women’s participation in local land governance, were also being strictly enforced.

In Bardiya district, community members similarly reported how, in the two years since the 2016 passage of their bylaws:

“No one is now using pesticides in ponds and rivers—this has totally stopped—we made a very strong rule and have been enforcing it. Before this project this was happening massively, but now no one uses pesticides to fish in the river and the pond. Now, as a result, we had no idea if the water quality is enhancing or not because we have not tested it, but [what] we can say is that now we are getting more fish. The water is more clean, there are more plants.”

Although not every community member was equally knowledgeable about the bylaws drafting process, overall the communities interviewed reported a profound sense of ownership over the bylaws, citing that being directly involved in their community's rule-making process impacted both their knowledge of the rules and their commitment to follow them. For example, a man in Bhajani Municipality explained:

"I thought that the rules came from the top...but through the project I learned and realised that we should develop our rules at the community level; that it is very important to properly address our own issues. Also, we realised that we had very good laws at our community level traditionally, but these rules were not documented. Now we have documented our traditional rules, and this gives us a greater base—if we had not documented this, it could have disappeared, but now we have it written and printed."

Community members across both districts explained how the process of sitting together as a community and critically reflecting on the state of their lands and natural resources helped to create a sense of responsibility. One man, when asked about the personal impacts of the project on this own life, explained:

"I learned that we have to look at long-term benefits rather than short-term benefits—and if we take actions towards our own short-term benefits without thinking of the long-term repercussions of our actions, it may create problems, especially in regard to use of the natural resources. For example, if we cut trees today, it will quickly give us firewood but will be very harmful in the long term."

Another community member explained how:

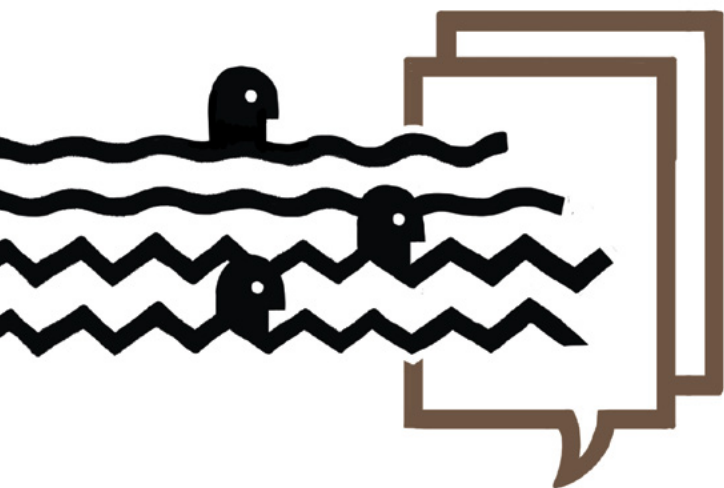
"We are working not only for our generation; we are becoming older. We are concerned about our future generations, so we are conserving our natural resources and using our bylaws to keep our future well for our children."

Learnings

Supporting communities to reflect on the past, present and future conditions of their lands, natural resources and culture, and then write down their customary/indigenous rules for local land and natural resources management which are updated to align with national law and evolving conditions, is key to community land and natural resource protection. Rules should not come from above, but be grounded in a community's culture, history, and specific ecological context. When community members are supported to critically reflect on the future they would like their grandchildren to inherit—and then to create rules to ensure that future vision of a thriving local ecosystem and a flourishing society—it is possible to change even seemingly-entrenched unjust or unsustainable practices. Local rulemaking can empower communities to protect their lands, drive the course of their own development, create more equitable societies, and preserve ecological and cultural diversity for future generations.

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Bhajani-Trishakti Municipality Bylaws, Kailali District

Adoption: 14 September 2016

Land-related policies

- 1 Use of organic compost manure will be maximized instead of chemical fertilisers while farming.
- 2 Regardless of the purpose, community discussions will be organised to decide whether to give or not community land to governmental, private and nongovernmental organization in case they want to take community land.
- 3 Genuine landless and squatters will be identified at the community level and campaigns will be organised to rehabilitate them within the community.
- 4 Families having registered land will make Joint Land Ownership Certificates and motivate others to do so.
- 5 Land use plan will be formulated to utilize community land:
 - Land for housing and agriculture will be categorized clearly.
 - In each ward of the municipality, public spaces for public functions will be specified.
 - Separate grazing land for cattle will be determined.
 - Outside the grazing lands, grazing is prohibited.
 - Specific places will be determined to mine mud to dye houses. Mining mud outside the specified areas is strictly prohibited.
 - Mining activities are strictly prohibited outside the specified locations.

Water-related policies

- 1 Fishing using poisonous chemical and electric-shock will be strictly prohibited, but instead traditional and customary tactics can be used.
- 2 Throwing rubbish and mixing drainage into the source of water will be strictly prohibited.
- 3 No one will be allowed to poison water.
- 4 Tree plantation on both sides of the canal should be done ensuring no disturbance to surrounding lands.

Forest-related policies

- 1 Forest protection should be the responsibility of all. For this, fencing and trenching. Forest fires should be strictly prohibited. In case of

forest fire, all community members should initiate immediate efforts to control fire.

- 2 All community people will collectively do afforestation in the empty forest area.
- 3 50 percent of the representation in both vital and minor positions in community forest user group by women will be ensured. Meaningful representation of other marginalised and minority groups will also be promoted.
- 4 Excessive extraction of stone, mud and concrete will be controlled.
- 5 Weeds, medicinal herbs and fruits will be used sustainably.

Social policies

- 1 Women will be also elected as Bhalmansa (traditional leaders) and should be given the same respect as that of the male Bhalmansa.
- 2 Compulsory representation of women or other marginalised communities in any committees at community level will be ensured.
- 3 Opportunities to women and other marginalised people will be provided to put forward their voices while planning and implementing community level plans.
- 4 Husband and wife will be encouraged to consult each other adequately while deciding on the household level issues.
- 5 Both mother and father will take care of their children equally.
- 6 Discrimination based on caste will be prohibited. In cases of such discrimination, the community will inform related government agencies for further actions.
- 7 Discrimination between children based on sex is strictly prohibited.
- 8 Equal wages will be provided to men and women for similar work with no discrimination.
- 9 Single women shall marry as per their choice and the society will accept that without any question.
- 10 Polygamy, child marriage and marriage of a couple having huge age gap will be prohibited.
- 11 Genuine squatters, landless and other marginalised groups should be identified and rehabilitated within the community.
- 12 Plastic use will be controlled.

Rachael Knight is the Senior Advisor for Land at Namati. She has been working to document and protect community land rights since 1998 when, researching the Zimbabwean land invasions, she understood that strong land rights are the basis of thriving, prosperous, ecologically-flourishing communities.

Dhwani Shah is an illustrator and graphic designer from Mumbai. She studied design from Sir J.J. School of Applied Art, Mumbai and National Institute of Design, Ahmedabad. She enjoys working on editorial illustrations, non-fiction comics and publication design projects.



Opercula

Author **Michael Adams** | Illustrator **Sagarika Bhatia**

I was born in India, but two years later my family were in Australia, part of the flotsam and jetsam of the British Empire washed up in a country none of us knew anything about. For the last thirty years I have lived close to saltwater country on the Illawarra coast of New South Wales, where I can daily and nightly walk the tideline. At my favourite and secret local beach I watch the energy dissipate from waves born in ocean storms hundreds of kilometres away, and those waves, like Empire, wash all kinds of things ashore.

Beneath the bright seaworn plastic and the bodies of exhausted shearwaters, small spiral-engraved discs shine amongst the sand and seaweed. My children call them mermaid money. These are opercula, little doors, the calcium carbonate lids that marine snails make to close off their shell homes. Opercula accumulate singly or in drifts as currents and waves bring them from the ocean to the tide zone. When part of the living animal, their owners etch their daily pathways in braille across the sand of ocean floors, their lives crossing and recrossing in minute encounters. Once those animals die, the soft parts of their bodies become food for carnivores and detritivores, and their hard shell parts strew across rocky substrate and sand, to be re-used and moved and recycled.

Opercula are persistent, the hard calcium carbonate material sometimes taking many hundreds or even thousands of years to disintegrate. They are often found in Aboriginal shell middens, signs of shoreline ceremonial feasts or humble family meals. Middens in my region are most likely between 3,000 to 8,000 years old, in part reflecting the time the coastline stabilised to its current position around 8,000 years ago as the seas rose at the end of the last ice age. Saltwater Aboriginal people lived through that long period of drowning coastlines, adapting and responding to momentous changes and opportunities as the sea moved landward at rates of twenty metres annually.

One of the joys and privileges of living on saltwater country has been spending time learning with local Aboriginal people and others who can trace multiple generations here. The deep time perspectives, the layers of more recent history traced on land and seascapes, the continuity of wild food gathering, the glimpses into a deeply storied landscape, all enrich and redefine my understandings of these coasts and waters. I also gather food here, spearfishing and diving for abalone, crayfish and urchins, and gathering edible seaweeds and native spinach on rock platforms and dunes. I have learned from Aboriginal and non-Aboriginal locals about habitats, seasons, relationships, changes of all kinds and

their opportunities and limitations in supporting life. This knowledge is not taught formally or abstractly, it is experiential, learned through using our hands and bodies and eyes, sharing labour across generations, walking and swimming and diving in this place.

I routinely beachcomb these shores, examining and sometimes keeping everything from rusty metal ship parts to shark egg cases to opercula. Most of the opercula I find in Australia are from the marine turban snail (*Turbo undulata*), commonly called conks by Aboriginal people, and turbos or turbans by others. Opercula are also found and used in India, particularly on the southern coasts, and I have found various different species on the coast at Rameswaram. The opercula of *shankha*, the sacred conch (*Turbinella pyrum*), and several other species are extensively used in incense manufacture. I have small collections of those spiraled discs on my bookshelves. They are found art, each individual operculum unique and beautiful. One smooth side has a pure and sinuous spiral, its precise geometry and form reflecting the unique conditions of its life and times; and the other more convoluted side marked by the anatomy of the gastropod muscle itself in all its diversity. Shells are the earliest jewellery, the most ancient currency, used in the first known examples of abstract art - all expressions of the relationship between our humanity and our animality.

Looking offshore, a limitless ocean reaches to the edge of visibility: vast, mobile, constant. Unknowable. The surging tidal edge where I stand is a microcosm and macrocosm of change: second by second, tide by tide, aeon by aeon, the deep constant matrix of evolutionary life momentarily expresses each unique and fleeting life amongst the great cycles of flux. Our simultaneously huge and puny human impacts are gathered and archived and neutralised by vast planetary forces far outside our knowledge. The small spiralled discs of opercula shining in my palm hold the stories of both persistence and change, of finding the appropriate ways to live on these shores.

An earlier version of this article was published on the Everyday Futures website.
<https://everydayfutures.com.au/project/opercula/>

Michael Adams is Associate Professor of Human Geography at the Australian Centre for Culture, Environment, Society and Space, University of Wollongong, Australia.

Sagarika Bhatia is an illustrator from Dehradun. She likes books by Ruskin Bond, and music by Bonobo. In her free time she likes to explore the country, read and catch up on some sleep.





The consequences of conflict on Congo's great apes

Author **Chrissy Henriques** | Illustrator **Madhurya Balan**

Our closest biological relatives, nonhuman primates, are facing an extinction crisis. While 60% of primate species are threatened with extinction, the great apes of the Democratic Republic of Congo (DRC) are experiencing increased turmoil due to the ongoing conflict occurring within the country. This conflict, fueled by the DRC's rich natural resources, has led to a decline in the population of chimpanzees, bonobos and all four subspecies of gorilla, as well as those of numerous other species.

The DRC is home to a large portion of the Congo Basin, the second largest rainforest on earth, and is crucial for maintaining wildlife diversity. The Congo Basin houses a wide array of species, many endemic, that cannot survive elsewhere. However, civil war is taking a toll on the DRC's rainforest residents, both human and nonhuman. Despite 45% of the DRC's land surface being covered in dense forest, the great apes are not safe within it. Protected land and national parks are being exploited as laws safeguarding the land are disregarded. Kahuzi-Biega National Park, home to one of the largest remaining groups of endemic Grauer's gorillas, along with several other national parks, still have occurrences of bushmeat hunting, deforestation and mining. This worsening conflict, caused by political instability, is threatening the lives of many, but there are ways to help lessen the war's impact on great apes.

About the conflict

The war began soon after the 1994 genocide in neighbouring Rwanda, leading to an influx of refugees fleeing to the DRC. Many of these refugees were genocidaires, those guilty of the mass killings in Rwanda. They formed armed groups that the government of the DRC (formerly Zaire) was unable to defeat, leading to the First Congo War. The war ended in 1997 with the overthrow of Zaire's government, leading to the creation of the Democratic Republic of Congo. A new president, backed by Rwandan and Ugandan governments, took office, but that did not end the fighting for long. The new president soon switched sides, going against his former backers, which led to a joint invasion of Rwanda and Uganda. This invasion initiated the Second Congo War in 1998; this lasted until 2003, when the DRC's government, plus other nearby countries, fought the invaders and rebel groups until a peace deal was signed. Despite the peace deal and a new transitional government, political instability and conflict continued in the eastern region of the country and lawlessness and violence persisted. Powerful rebel groups continued to emerge, and over 70 armed groups are present in the country today.

The Congo's natural resources

Ironically, the areas that conservationists are trying to protect, contain the natural resources—minerals and forests—that fuel the conflict by providing the rebels with the financial means to operate in the country. Gold, diamonds, cobalt, copper, zinc and the more recently popular coltan (a component in electronic devices), are all found within the DRC. These minerals have garnered attention from major corporations, corrupt governments and warlords, keeping the country divided by giving the rebel groups incentive to continue fighting locals and each other to take control of the mines and the forests in order to stay in power. This has the further effect of keeping the locals living in poverty despite the country's mineral wealth, an inequality that facilitates the perpetuation of the conflict.

Threats to Congo's great apes

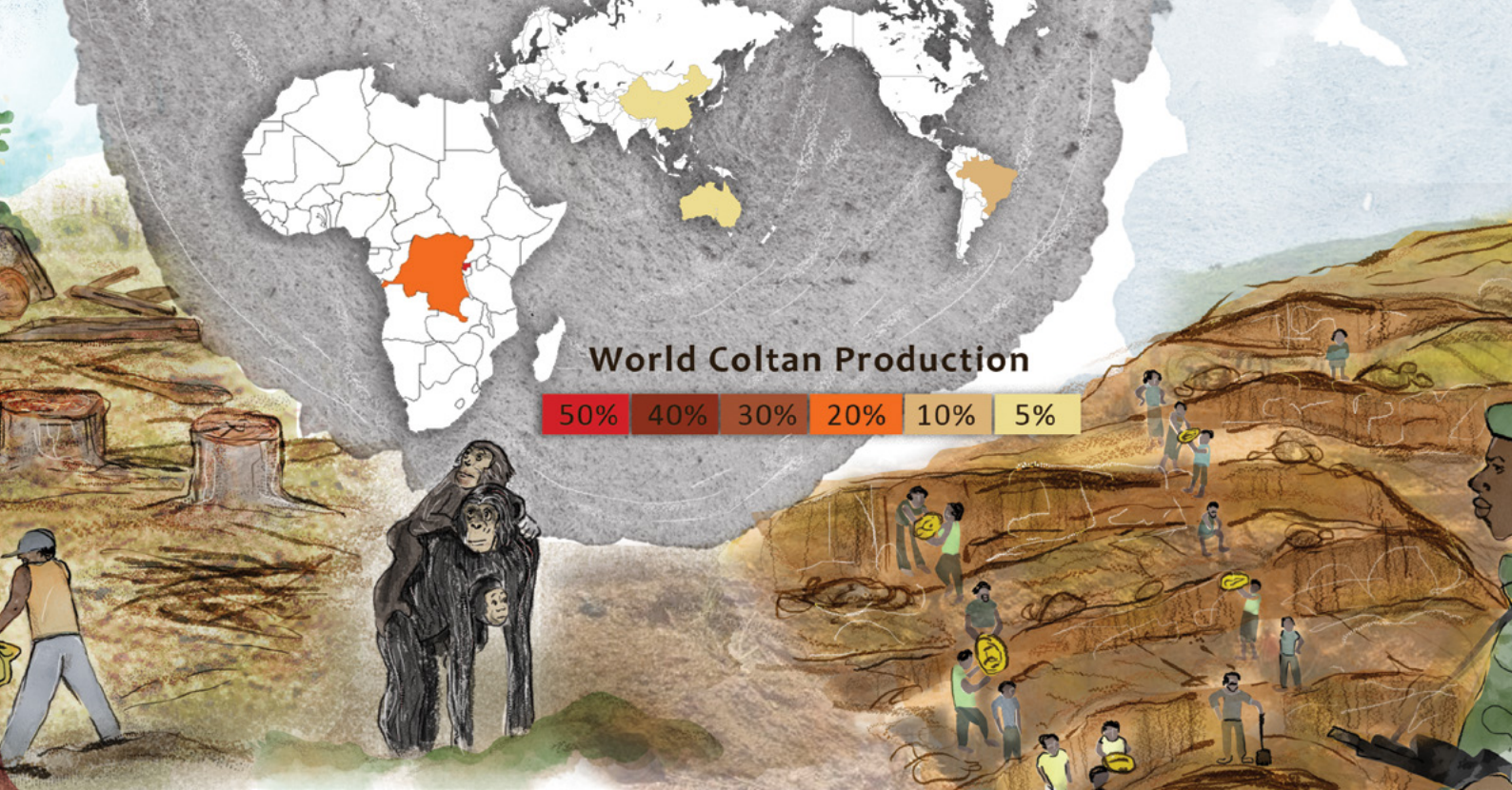
This long persisting conflict has led to both direct and indirect consequences that are endangering apes. The war has slowed the progress of many conservationists working to save endangered species, as it has become very unsafe to continue in-field conservation work due to the ongoing violence. Disease, habitat destruction, bushmeat hunting and mining have taken their toll on the populations of gorillas, chimpanzees and bonobos and have the potential to eliminate these species from the wild.

Disease

Disease is running rampant throughout the DRC, exacerbated by the wartime poverty that makes it difficult for people to afford proper medical treatment. Infections spread quickly not only through people but also to apes, who are vulnerable to human disease because of their biological similarities to us. The risk of transmission increases as soldiers and refugees encroach on ape habitat, increase their proximity to these animals as they move further into the forest to harvest resources and escape conflict, respectively. Particularly deadly are diseases such as Ebola, gastrointestinal parasites



Infections spread quickly not only through people but also to apes, who are vulnerable to human disease because of their biological similarities to us.



and human respiratory viruses, which the apes are not equipped to fight. Further, populations have trouble recovering from die-off caused by disease outbreaks because of slow reproductive rates: females usually give birth to only one offspring at a time and only have three or four offspring over their lifetime.

Habitat destruction

The economy of the DRC has been dependent on the extraction of natural resources, including timber, to bring in income. Many policies are in place to keep logging practices more sustainable; the DRC has tried to conserve its national parks, and approximately 60% of its original forest cover remains. However, deforestation is still occurring, including in areas (especially the Eastern DRC) that provide habitat for chimpanzees, gorillas and bonobos. The process of logging impacts the apes because it can change the composition and structure of the forest, leading to fragmentation and making it less suitable for the apes who rely on it for food and shelter. Chimpanzees and bonobos build nests in the trees and gorillas construct them on the ground using the surrounding vegetation. Sadly, the fragmentation also isolates groups of apes from each other leading to inbreeding, which reduces genetic diversity and lowers fitness, ultimately causing a reduction in ape populations. None of these species can survive without the forests.

Bushmeat hunting

Illegal bushmeat hunting is contributing to the decimation of ape numbers. There are two main reasons why people hunt apes. First, refugees who fled to the DRC rely on forest animals; apes are appealing because they are large and offer a lot of meat. Second, soldiers poach the apes not only for food but also as a source of income; their meat is considered a delicacy in several countries. It is difficult to assess the size of ape populations because of security threats posed by several different militia groups found throughout ape territory. However, it appears that bonobos have been particularly hard hit by poaching; during the active fighting that took place during the First and Second Congo Wars, about a third of the frontlines occurred within the home range of bonobos, which were killed in large numbers to feed the fighters.

Further, fewer than 4,000 Grauer's gorillas are thought to remain today. This staggering loss has pushed conservationists to establish education programmes working with locals to teach them about the value of great apes and why people should not be consuming ape species. Instead, community outreach programmes are working

with locals to create alternative food sources that are considerate of the environment and put an emphasis on the value of apes as a living animal and not a food source. To address the demand outside of the country, social media and the internet are being used to bring awareness about the issue on a global scale. By targeting young people and community decision-makers, social pressures are being placed on people who consume bushmeat for reasons other than survival and are pushing for cultural norms surrounding bushmeat consumption to change.

Mineral mining

Large surface deposits of coltan and cobalt can be found throughout the eastern region of the DRC. Coltan is a rare ore most notably used to make capacitors in cell phones and other electronics; demand for coltan has skyrocketed because of the short life cycle of mobile devices. Cobalt can be found in batteries. The increased use of technology and electronics across the globe has made coltan and cobalt desirable to countries around the world. Mining of these and other minerals, provides jobs for many of the Congolese people, including children, who are desperate for money. By selling minerals to different rebel groups or by working for those groups, natives are able to increase their incomes. However, these militia groups pay the locals very little and keep the remainder of their earnings—sometimes millions of dollars—for themselves. They use these profits to buy weapons, which they then use to threaten natives and force them to mine. Weapons also allow fighting to continue between rebel groups who attempt to claim additional territories that contain profitable mineral deposits; some of these sites include areas that were once safe havens for apes. People working in mines (and those in logging camps as well) are not only destroying the habitat, but also hunting apes for food. The biggest threat facing apes is the bushmeat hunting associated with mineral mining.

Why apes matter

The great apes of Africa have immense importance to humans and the ecosystem they live in. Losing apes would have negative impacts not just on biodiversity, but also on the human inhabitants of the DRC (and beyond) and on the environment in which they live. Apes have many similarities with humans. They have large brains, use tools and share a similar evolutionary history; studying them can increase our understanding of ourselves and our past. Apes have taught and can continue to teach us about human behaviour, learning and more, if we allow them to persist.

Apes also play an important role in their habitat and their loss would not go unnoticed. Apes consume a large quantity of food per day and can disperse seeds of varying size across large distances as they forage for more food; they play an important role in plant reproduction, helping forests flourish. The extinction of great apes in the wild would alter the balance of the entire rainforest ecosystem, which is home to countless plant and animal species that are essential for food, medicine and other resources, and which performs a variety of ecological services such as producing oxygen and mitigating the impacts of climate change by absorbing carbon dioxide.

How you can save great apes

While the war in the DRC officially ended years ago, the continued difficulties in the country mean that great ape conservation efforts are still of the utmost importance. Through donations to conservation groups working to protect apes and provide assistance to community members, some of the hardships attributed to the residual conflict could be abated. Educating locals about the importance of ape species can be vital to reducing the number of deaths caused by hunting and disease.

Another way to alleviate this problem is to decrease the demand for the products coming from the Congo's illegal mining and timber extraction activities. It is difficult to ensure that a product is 'conflict-free', meaning the coltan and other minerals are not from miners who worked for rebel groups or mined illegally, but it is essential to



Oil's impact on the apes

Recently, the government of the Democratic Republic of Congo has agreed to allow areas within two of its national parks to be opened up for oil drilling. The two parks are Virunga National Park and Salonga National Park. Virunga is home to a large number of mountain gorillas and Salonga is home to both bonobos and dwarf chimpanzees. Despite the parks being UNESCO World Heritage sites (which should protect them from oil drilling), the government believes all parts of the country should be available for oil exploration. While the government says they will be mindful of wildlife, oil drilling will not only disrupt the apes and other rare species but will also lead to huge amounts of carbon dioxide being released into the atmosphere, adding to climate change.

try. Supply chains can be hard to follow, but consumers can ‘shop smart’ and support companies that are working to reduce corruption and mitigate the issue by analysing their supply chains and doing their best to avoid illegally mined minerals. Choosing companies like these can put pressure on other companies to pursue similar policies. If manufacturers only purchased sustainably-sourced resources, the miners of the DRC would be incentivised to either work legally and sustainably or even cease mining altogether.

An additional solution is recycling—not just cell phones and electronics, in order to reduce the need for newly mined coltan and cobalt, but also products incorporating other minerals and timber that otherwise would continue to be extracted from forests of the DRC. Lessening demand through smarter purchases would reduce income options for the rebel groups, thus potentially making it possible for the Congolese Army to defeat them. This, in turn, would help decrease the violence, allowing for the eventual strengthening of the Congolese government and a gradual ending to the enduring conflict. If the government regained control, they could more easily enforce laws against poaching, mining and logging, thereby allowing remaining ape populations to thrive and come back from the brink of extinction.

These issues may seem remote to many readers, but people around the world can contribute to ape conservation efforts by sharing information about the issues, the importance of apes and potential solutions—after all, you cannot solve a problem without first realising it exists. Once people have been educated, they should be inspired to seek out ways to help through donations, recycling and being a conscious consumer—ultimately improving conservation outcomes and helping ensure the maintenance of great ape populations.

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Chrissy Henriques is a graduate student at Miami University studying biology with a focus on primate conservation and awareness. She completed this project as a part of her work with Project Dragonfly at Miami University in Oxford, Ohio.

Madhurya Balan is an artist, illustrator, experiential learning facilitator, gardener and re-wilder. She is a believer and practitioner in free thought, speech and choices.

Past, present, and future of a freshwater fish metapopulation in a threatened landscape

Author **Iván Vera-Escalona** | Illustrator **Rohan Chakravarty**

The world we see today is very different from what existed 2.6 million – 11,000 years ago. During the glacial cycles in the Pleistocene era, ice covered most regions of the world. Such glacial periods witnessed the shrinking of available habitat for a number of species, especially those at high elevations or in regions away from the equator. This restricted movement among species populations due to the reduced connectivity between suitable habitats, thereby affecting gene flow and reducing the overall genetic diversity of the species. Although some species survived in ice-free areas, their populations shrunk during these periods. Studies show that species expanded their distribution following the last ice retreat (15,000 years ago) to areas where we now find them across the globe.

Such was also the story for a native freshwater fish from Patagonia, *Galaxias platei*, that survived the Pleistocene glaciations. Today, the species faces a new threat that restricts movement amongst populations, the construction of hydropower plants in the Puelo River Basin. The construction of dams is known to seriously limit connectivity among fish populations resulting from the construction of concrete barriers. However, their impact on the genetic diversity of freshwater fauna is not well understood.

Our study used a three-pronged approach to study the contemporary as well as past and future genetic diversity patterns of *G. platei* populations in the Puelo River Basin as a case study. This approach can enable learning from the past to understand the present, and predict future diversity patterns following landscape alterations. As such, it can be used to inform conservation policies that help mitigate impacts of human interventions and climate change on species.

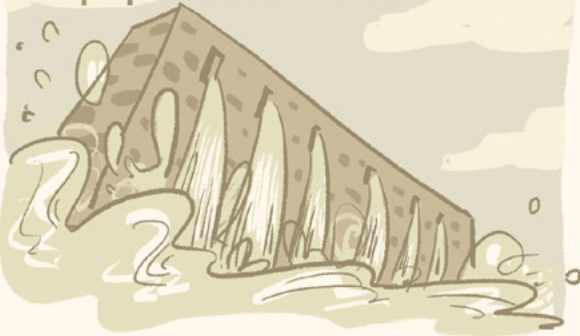
Unfortunately for *G. platei*, our study shows that although connectivity was relatively high in the past, there is low genetic diversity in the species today making them highly susceptible to changes in landscape. The construction of dams in the Puelo River Basin will reduce connectivity among populations which will only exacerbate the decline in genetic diversity and may even result in the extinction in three out of the four populations examined for this study.

Vera-Escalona, I., S. Senthivasan, E. Habit and D.E. Ruzzante. 2018. Past, present, and future of a freshwater fish metapopulation in a threatened landscape. *Conservation Biology* 32: 849-859.

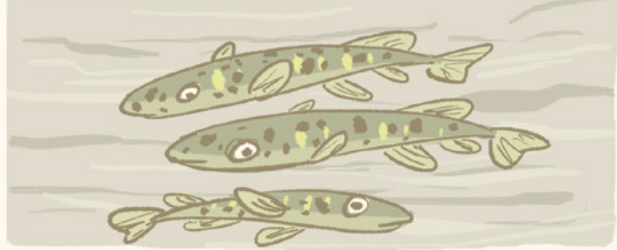
Iván Vera-Escalona is a Chilean biologist, PhD at Dalhousie University. He is interested in the historical and contemporary patterns of native species and the impact of landscape modifications and the introduction of invasive species on them.

Rohan Chakravarty is a cartoonist, illustrator and animation designer hailing from Nagpur. He is the creator of Green Humour, a series of cartoons, comics and illustrations on wildlife, nature conservation, environment, sustainability and all things green.

Hydropower plants have been detrimental to fish populations worldwide.



To prove this, researchers* in Patagonia studied and compared historic and current populations of *Galaxias platei*, a fish found in the Puelo River Basin.



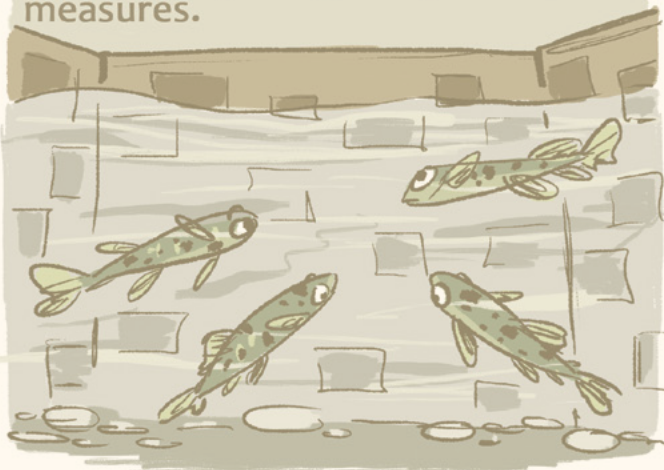
Their studies show that glaciation in the Andes created new populations of *G. platei*, which could migrate to different water bodies, maintaining a healthy exchange of genes between populations...



But now with hydropower plants forming permanent, concrete barriers, connectivity and gene flow between populations are severely restricted...



...adversely affecting feeding, spawning, and may eventually lead to the extirpation of these fish populations. The study thus emphasises maintaining connectivity using mitigation measures.



*Ivan Vera-Escalona, Shreeram Senthivasan, Evelyn Habit, and Daniel E. Ruzzante



Tracking Tortoises

Author **Madhuri Ramesh**

Illustrator **Debangshu Moulik**

Tortoises are difficult creatures to find in a forest. How does one search for a quiet animal with a shell the colour of wet leaf litter? Or for one that moves around mainly at dawn and dusk in a forest full of gaur, elephants, bears and assorted snakes, and still come out of it reasonably intact, with enough data to write a Master's dissertation?

When I began fieldwork in the Anamalai Tiger Reserve in 2002-03, it was a fairly well-researched place but few researchers had seen a Travancore tortoise in the wild. In 1983-84, J. Vijaya had done a pioneering study on these animals in the Anamalai—Chalakudy region but unfortunately, only a few brief articles had been published before her early demise and much of her remaining notes had been lost or had simply crumbled away over the years: the official record was a total of just seven tortoises and that too went a long way back, to E.O Moll, in 1989. Did that make this an extremely rare species or a particularly shy one?

When I decided to work on this species, I heard much well-meant advice against this choice of animal because there was the very real risk of not being able to gather enough information to complete my dissertation. But I was fascinated by what little I knew from watching captive Travancore tortoises in the Madras Crocodile Bank and was determined to give it at least one good try. In short, I was hooked even before I began.

So to field I went, with enthusiasm outstripping experience by a good margin. I showed photographs of captive Travancore tortoises and it soon became apparent that they were known only to the older Malaimalasar and Kadar people in the sanctuary. They too said it was hard to find. After a month of fruitless searches with a number of field assistants ranging from an old man (who was quite deaf) to a Forest Guard (who wanted to be home by 4 PM sharp), I was getting quite desperate since I had a tight field schedule at the end of which I would have to go back and write a thesis. Then I met Ganesan *anna*. He'd been away helping some filmmakers but I had left word with several people that I wanted to meet him since he had been highly recommended by other researchers who had worked in the Anamalai Hills.

Someone pointed him out to me when he sauntered into the Topslip teashop one day. By this time everyone around Topslip and the neighbouring Parambikulam Wildlife Sanctuary knew about my strange interest in tortoises, which seemed all the more odd in a region teeming with megafauna. But when I introduced myself to Ganesan *anna*, he first feigned ignorance about my project and then pretended to be too busy to work with me. I was really disheartened by his initial response since as far as fieldcraft went, he was a star. And it was very clear that he knew it! I spent another few days of precious field time way-laying him every time he stepped outside his settlement and asking him when he might be free. Fortunately, he eventually agreed to work with me and said that he had seen a few tortoises before and had some idea of where to start searching. I think more than my pestering, it was everyone else's conviction that this was too difficult a job even for him that did the trick, for he simply could not resist such a challenge to his expertise.

In the beginning, it was like working with a *prima donna*: I would go to our meeting point near the Topslip bus stop and wait for him to turn up. Some days he would be there on time and on other days he wouldn't. The times he didn't, I would be left sitting at the bus stop, shredding fallen leaves with immense concentration and vigour. My stomach would churn with the worry of losing yet another day of fieldwork. He would add to my irritation by rarely bothering to explain why he didn't come to work the previous day or failing to send word through someone that he had other plans.

However, the days he did turn up, I learned so much while walking in the forest with him that it seemed to be worth putting up with his temperamental approach to schedules. And best of all, he found us our first tortoise on just the third day of fieldwork! However, we went through almost two months of trial and error. At the end of each day, we'd discuss our hunches about how to refine our search. We realised that it was best to enter the forest in the afternoon and search intensively until dark, so it would often be well past nightfall by the time we returned. As he made it a point to remind me frequently, he knew the area like the back of his hand, so coming back in the dark posed no difficulties for him although we had to cut across long stretches of the forest before we hit a trail that could take us back.



Ganesan *anna* always brought a small bag with him when we went to field. It would have a torch, some soapnut to make a paste to keep off leeches and sometimes, a small matchbox and a roll of beedis. His machete was like an extension of his hand—I never saw him enter the forest without it. When we were a little way into the forest, he'd first stand still and silent and just look around, maybe wordlessly point out some fresh civet scat to me. Then he'd stand on one leg while he scratched at the other with his machete and pondered which direction we'd take that day. His deliberations over, he'd suddenly take off into the forest. I'd scurry behind, trying to spot birds in the canopy while avoiding tree roots which seemed specially designed to trip unwary researchers. It always took him an hour or two to thaw enough to actually talk to me, but since I enjoyed walking quietly, his silences were welcome and it meant that we missed little of the wildlife that came our way.


When we sat on a rock to catch our breath, he would point out medicinal plants and stinging nettles. Sometimes, he'd give me news from the settlement or help me learn the Kadar dialect. He'd make me recite the names of plants and animals we had seen so far. Or, we would have ten minutes of 'conversation practice' before resuming work. Initially when I made mistakes, he would condescendingly tell me, "Literate people are not used to storing information in their head and should stick to writing things down in their little notebooks." Perched on his rock, he'd look very pleased with himself after that declaration, unfazed even if I snapped back. As we grew to know each other better, he continued to say it, but with a big grin and I often shamelessly chanted it with him when I had forgotten something. If the going got tough with rain and leeches, he would cheer me up with a folktale because I had an insatiable appetite for stories and would scribble them down as he talked. His wife and cousin were also generous sources of songs and stories whenever I visited their settlement, and they kept a protective eye on me throughout my field days.

I usually left it to him to make a lot of the in-field decisions but sometimes I had to insist that certain sampling schedules were followed. This frequently involved a verbal tug-of-war and in one instance, it ended with Ganesan *anna* and me vowing we never wanted to see each other again. Then the sisterhood stepped in: the women gave him a piece of their mind for fighting with me (unnecessarily of course) and he actually came looking for me two days later (I was shredding leaves by the bus stop). As we both found fieldwork too exciting to stop on account of our quarrels, we went back to work immediately.

But the impossible man had found a new dialogue now – if he didn't agree with something I said, he would roll his eyes towards the sky, heave a huge sigh and say:



It's the best example I've heard of provocation masquerading as piety.




You may wonder why I wanted Ganesan *anna* to work with me despite all the drama – how hard could it be to find a creature that’s legendary for being dead slow? Well, tortoise hunting is incredibly difficult! Apart from the awkward hours the creatures keep, clambering up and down rocky stream beds and tick- or leech-infested banks is exhausting work. In summer, we also had to keep a sharp lookout for thirsty gaur and elephants.

Travancore tortoises often tunnel their way into lantana thickets or bushes bordering streams and these tracks are distinctive though it takes practice to identify them. Searching for the tortoise itself needs a lot of concentration and skill for they are beautifully camouflaged: sometimes you could be looking directly at one and still not realise it. You can almost hear a click in your head when the jumble of black and brown leaves you’ve been absent-mindedly gazing at for a couple of minutes suddenly resolves itself into the carapace of a Travancore tortoise sitting amongst leaf litter. It was usually at this point that I’d give a very unscientific whoop of delight and pounce on the poor animal to take measurements (altogether we found 79 tortoises over six months). Initially, I used to just tag along behind Ganesan *anna*, but with time, I acquired a keen eye for spotting tortoise trails and the animal itself. As I grew more experienced, when we reached a suitable place we’d split up and search. We had to be quiet as well because we discovered that noise made the tortoises hide under dense undergrowth. Whenever we separated to search, Ganesan *anna* insisted that we keep in touch using the soft ‘*hoo-hoo*’ calls of the lion-tailed macaques so he would know I was alright. My single-minded search for Travancore tortoises worried him because he felt I didn’t pay enough attention to the likelihood of stumbling across a sleeping bear. This was the only animal that made him nervous because startled bears tend to lunge straight at a person’s face and rake it with their long claws. He said that they were too stupid to realise a human was nearby until you got very close to them, and they were too mean to give adequate warning before attacking.

But it wasn’t only about being quiet. Finding tortoises needed sharp ears as well for sometimes you can hear the slow tell-tale sound of a tortoise ambling through the undergrowth. It was easier in summer when the leaf litter was dry and the deliberate scrunch of a tortoise’s footsteps could be heard several metres away. While I was quite happy with the way experience was honing my senses, I must admit I came a poor second compared to Ganesan *anna*. He had a sort of sixth sense about which stretch of the stream bed to concentrate on and which one to casually walk past. And of course, all the while, he would also keep tabs on me and the other creatures!

Later, when I asked if we could extend our search to other patches of forest, he told me about the forests around Anaikundhy and Varagaliar but hesitantly mentioned that it would involve camping in the Anaikundhy watchtower, which was about 15 km from Topslip. But by this time, like many women researchers before (and after) me, I trusted him completely so I was willing to go and stay wherever he thought it was safe. We had to carry our rations and trek to the spot. We had underestimated the amount of provisions we’d need but I didn’t mind in the least because he would cook



interesting forest food like wild spinach and tender cycas fronds to eat with *kanji*. On one of the trips to Anaikundhy, we found that the mahouts from the elephant camp nearby had carried away the plates and glasses kept there. We fashioned containers from bamboo and everything we ate and drank had a mild, salty bamboo-ish tang to it. The Anaikundhy area turned out to be an even better place for tortoises. In addition to patches of forest, amidst old teak plantations, it had large stretches of grassy swampland (called *vayal*) which harboured tortoises. By now we had a good idea of where and how to search - we were averaging at least one tortoise a day. (I assure you, that was actually an impressive rate!) But it was still such a challenging task that we gloated over every single one we found.

But Anaikundhy was memorable for another reason: I discovered the one animal Ganesan *anna* truly disliked. Ants! The watchtower was crisscrossed with ant lines that raided the rice and sugar that we and the anti-poaching patrol stored there. He would spend a lot of time squashing the ants with his machete because he believed that eating food with ants in it could make a person go blind. My giggling over his needing a huge weapon to eliminate a tiny creature never deterred him. He would simply ignore yet another pesky researcher telling him what's what and just get on with wiping out the ants.


If he could have written a book, Ganesan *anna* would probably have written one titled 'Bringing Up Young Researchers'. He has worked with several scientists, right from when they were young students and many of whom still come looking for him whenever they are in Topslip. He takes his job very seriously, and so when he was working with me, I not only heard a lot of forest lore from him but also lectures on the importance of courage and so on. Since 'why' is one of my favourite questions, we often had long discussions on many topics and I suspect I became more familiar with his worldview than someone who politely agreed with what he said.

As every researcher will attest, fieldwork is often grindingly hard work and there are days when the weather, leeches and ticks, hasty meals and inability to have a long, hot bath will all get to you. But what I found worse than all of those were the leering busybodies who flooded Topslip in the tourist season and thought a lone researcher was yet another strange animal to be commented on and provoked for a reaction. I had a few friends amongst the Topslip residents who would look out for me, but it was mostly having Ganesan *anna* and his family solidly on my side that helped me complete fieldwork. Their friendship and humour saw me through some stressful days.

It's due to people like Ganesan *anna* that researchers like me are able to convert academic pipe dreams into publishable data. It is some fifteen odd years since I worked in the Anamalais but Ganesan *anna* and I still keep in touch through sporadic postcards and phone calls. When I told him that I wanted to write about our tortoise search, especially my experience of working with him, he had a predictable response, "*Kadavule, yenna mattum kapathu!*"

Madhuri Ramesh has written two books on the Kadar people, with her colleague Manish Chandi. At present, she works with Dakshin Foundation on coastal spaces and resources in the Andaman islands.

Debangshu Moulik is a visual artist and illustrator based in Pune, India. He is mostly found painting on huge canvases or hunched over heaps of papers scribbling away.



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A RAINFOREST EXPEDITION


Words and Pictures David Bartholomew

My name is David and I study trees. In particular, I hope to find out how the trees in the Amazon rainforest are coping with our changing climate and global warming.

My research takes place in a remote part of the Amazon in Eastern Brazil. To get there takes me three whole days of travelling. First, I take three different flights to get from London to Belém, a city at the mouth of the Amazon River, where it flows into the ocean. Once in Belém, I stock up on enough food to last me for the month I will spend in the jungle. I have to buy everything I will need, as I won't see another shop for weeks. Belém is a busy city, acting as the main port for the entire Amazon. Here, I visit a huge market, vibrant and colourful, with lots of new sights and smells for me to take in, including tropical fruits of every size and colour, many I have never heard of before. The fish market is the most impressive though, as it sells enormous fish caught from the river. Some weigh over 80 kg and are longer than I am tall.



The fish market in Belém where giant Amazonian river fish are for sale.

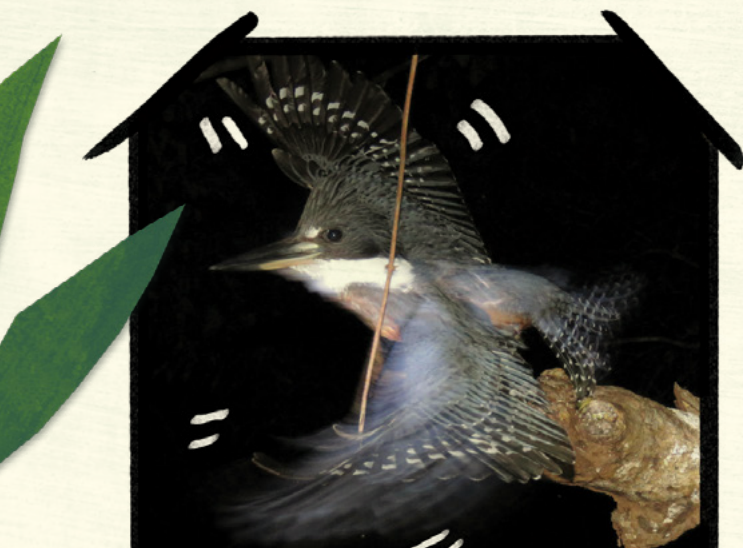


After visiting the market, I join the rest of my research team. We board a boat and begin the next leg of the journey. For the next 30 hours, we travel up the Amazon River to our field station, sharing a small cabin to sleep in, telling stories to pass the time. During these two days we travel 250 miles, passing only small villages on the way. As we enter deeper into the lush green forest, we see brightly-coloured parrots flying overhead and watch pink river dolphins swimming alongside the boat.



When we arrive, we unload the boat and set up our equipment, making sure everything is working and nothing has broken on the way. We then take our first trek into the forest to look at the trees we will be studying.

Over the next month, I undertake this walk every day. The heat and humidity are intense, but fortunately the canopy blocks out most of the sun. As I walk I keep my eyes open for wildlife, as I never know what I will encounter in the jungle. Some days it's birds I see; other days it's snakes.



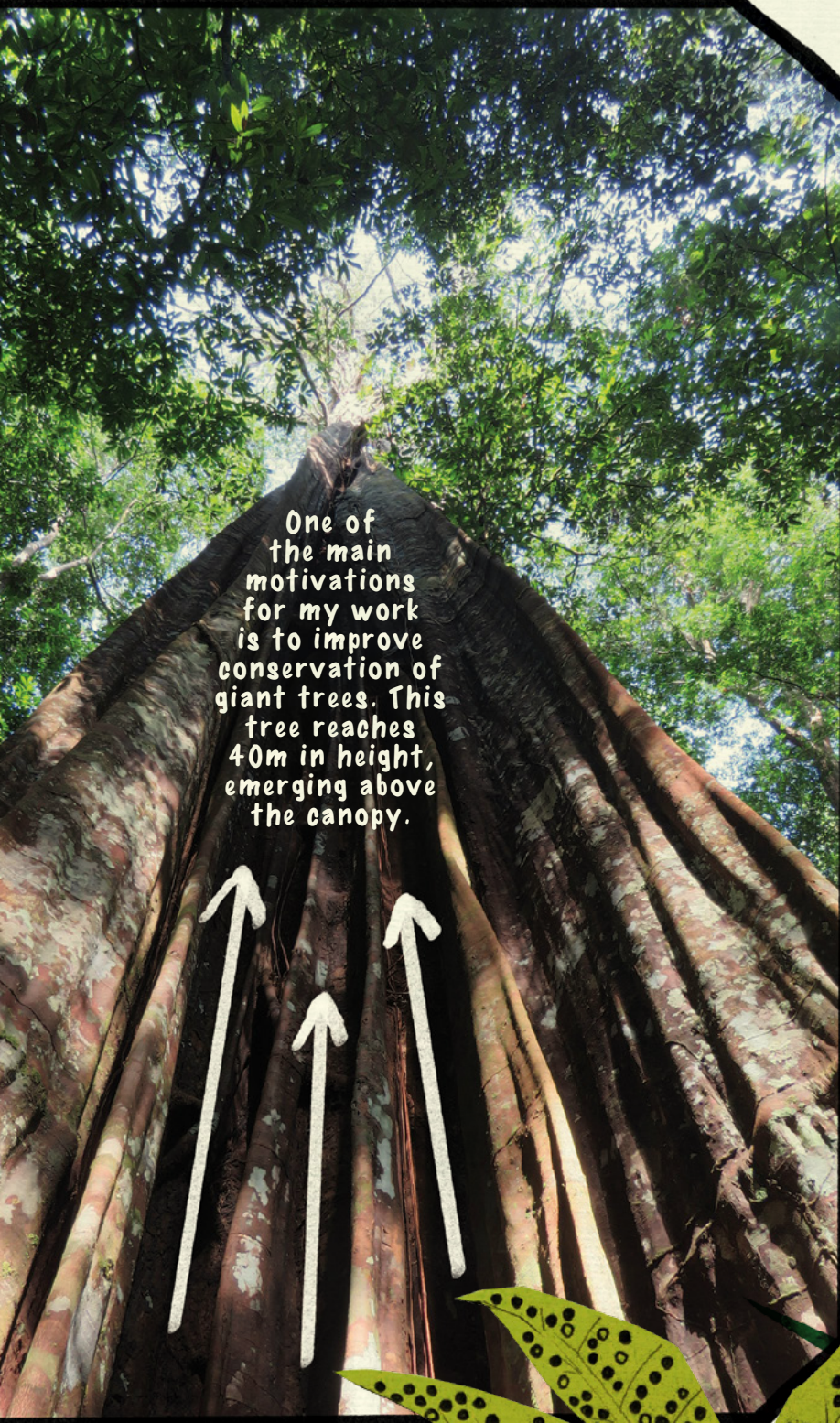
In the forest, my work involves measuring the health of leaves. To do this, I use a piece of equipment that can tell me how fast the leaves can make food and how fast they use it. I then use this information to understand if the forest is still healthy and to identify which trees are not doing so well. If the leaves have a high capacity to produce sugar, but consume very little, I know they are healthy.

Despite being in the middle of a forest, getting the leaves I need is actually a major challenge. Trees here can be very tall and some only produce leaves 40-50 metres above the forest floor. To reach these I work with some local people, who compared with me, can climb as well as the monkeys in the forest around us. Climbing up the tree trunk, they cut a branch down for me, carefully selecting a branch exposed to the sun. We try to have as little impact on the environment by only collecting one branch with roughly 40 leaves, leaving thousands more intact.



This is me working in the forest.

Days working in the forest are long and hard. I work through the midday sun, all the while fending off biting insects. Every day I eat the same food and do repetitive tasks. Despite these challenges, the forest is an exhilarating place to work. I love seeing new plants and animals every day and never get tired of the stunning scenery. The noises in the forest are magical, changing every hour as different animals become active. In the morning I hear birds singing, whilst the noisy cicadas wake up at lunchtime, producing an amazing racket with their wings. In the evening, I hear the terrifying howls of the howler monkeys as they warn the other groups – ‘this is our territory’. I love how dynamic the forest is and it is a real privilege to work in the biggest rainforest in the world.



One of the main motivations for my work is to improve conservation of giant trees. This tree reaches 40m in height, emerging above the canopy.



Before we realise it, one month in the forest has passed and it is time to leave. We are all sad to say goodbye to the forest and its animals, but we are excited to get home to our families and friends. We return with the data we came for, as well as many memories and new friendships. Just one last thing remains – a three-day journey home.



David Bartholomew is a tropical forest ecologist investigating the impacts of climate change on tropical forests. He is currently undertaking a PhD at the University of Exeter in the Geography department, funded by the NERC GW4+ Doctoral Training Partnership.

NIGHT AND DAY IN THE RAINFOREST

Words and Pictures **Jennifer Powers**






The sun was setting in a rainforest in Costa Rica. Parrots were squawking as they flew home to sleep for the night.



A young coati named Pizotito was not sleepy, as he explained to his mother.

Coatis sleep at night in the trees.





After his family was asleep, Pizotito climbed down the tree to explore the forest.

He was surprised to meet an animal he had never seen before.



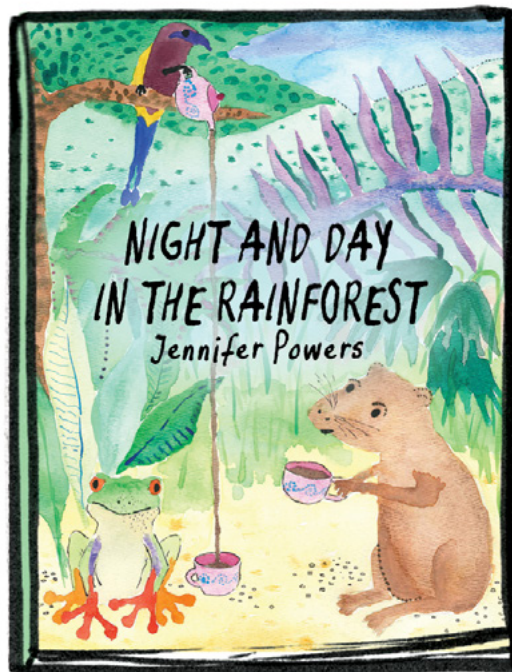
Pacas are nocturnal. They sleep during the day and are awake at night.

Paquita took Pizotito to meet some of her friends in the frog swamp.



Who else do Pizotito and Paquita meet in the rainforest?

Read the rest of the story, **NIGHT AND DAY IN THE RAINFOREST**, to find out ...



... at this link:
https://issuu.com/foreststories/docs/night_and_day

Jennifer Powers is an ecologist at the University of Minnesota, United States. She has been studying tropical forest ecology in Costa Rica and other countries since 1995.

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