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Nicobar
Islands

Current Conservation carries the latest in research news from natural and social science facets of conservation, such as conservation biology, environmental history, anthropology, sociology, ecological economics and landscape ecology.

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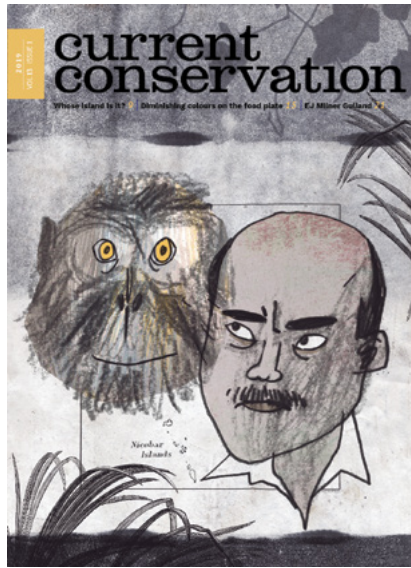
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Cover art **Prabha Mallya**Cover art **Roshini Pochont**

‘There is no frigate like a book to take us lands away’ – Emily Dickinson

This issue of Current Conservation is an invitation to travel. Our first stop is the Ganga. Mayukh Dey’s article lets us explore the soundscape of this mighty river, its “[n]oise and tranquillity”, through the ears of the Ganges river dolphin. Next, we move south-eastwards, to the coconut and areca plantations on the island of Great Nicobar, to hear Ishika Ramakrishna’s stories about encounters between the long-tailed macaque and humans. From the islands, we move up, latitudinally and altitudinally, to the world’s first “organic state”, Sikkim. Radhika Gupta presents a nuanced picture of the impact of recent government policies on agro-pastoral practices and food habits of the Sikkim’s mountain villages. From Sikkim, we travel out of India, to the grasslands of Kazakhstan, to talk to EJ Milner-Gulland about her efforts to study and protect the saiga antelope. Finally, we travel all the way back to the south (yes, we know, the routing could have been better!), to the Palk Strait between Sri Lanka and India, to learn, from Michael Adams, about the natural and human history of the shankha. Once you have read these articles, you will probably relate much better to Anusha Shankar’s reflections on why, despite the miserable pay and often-treacherous working conditions, she chose to become an ecologist (to see the world!).

We wish you a fun journey!

—**Hari Sridhar**

In this issue of CC Kids, we meet Anusha Shankar and learn about her work studying hummingbirds at high altitude, on top of a 3000m plateau in Ecuador. We are usually taught that some animals, like reptiles, are cold-blooded; while others, like mammals and birds, are warm-blooded. But these hummingbirds, it seems, can be both. Anusha Shankar is investigating how this could help these unusual birds to fuel their high-speed lifestyles.

—**Matthew Creasey**

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Of ancient dolphins and threatened sounds: an unheard ecological story from the Ganga

Author **Mayukh Dey** | Illustrator **Viplov Singh**

Platanista's predicaments

Perceptions of the Ganga in India are often as diverse as the many states the river flows through. From being a living embodiment of a Hindu Goddess in one, to just a navigable channel in another, the Ganga oscillates in identity. One section of society ascribes ‘personhood’ to the Ganga while another abuses the river for economic benefits. Even people who believe in the holiness of the Ganga, litter and pollute. Devotion, it would seem, is not equal to reverence. The river is, therefore, constantly shrouded by a fog of duality and contradictions. So is the case for an inhabitant of the Ganga, the Ganges river dolphin (*Platanista gangetica*).

The Ganges river dolphin is the national aquatic animal of India, yet this animal is threatened by a wide range of issues, including declining water levels, increasing pollution, depleting fish abundance, and greater traffic in the rivers. But among these factors, one issue, a kind of pollution, is often overlooked. The pollution that I speak of is not the well-known chemical or industrial pollution of the water but a far more subtle pollution that severely affects the Ganges river dolphin: noise.

To understand why noise pollution is problematic for the river dolphin, we need to understand the animal’s biology. Unlike its marine cousins, these ancient cetaceans have almost lost their visual powers, probably because eyesight in a sediment-rich river is not a very useful sense. These dolphins navigate and forage by producing high-frequency clicks, much like bats do, to echolocate in the dark and murky waters. The dolphin relies on sound not only for navigation, but also to communicate with one another and to hunt.

People who haven’t seen the Gangetic dolphin often assume that, like their marine counterparts, they too are athletic when they dive. However, this dolphin only does the bare essential required to breathe; it will only breach the surface, ever so slightly, exposing its blowhole right behind the head, and silently plunge into the murky water to resume swimming in an unconventional manner.

Unconventional because this dolphin is a side swimmer and at times, uses its flippers to sense the bottom of the river, probably to orient itself. Most of the time, one can only see their arched back, head and the snout studded with sharp, pointed teeth. But on certain occasions, the animal

will leap out of the water gloriously and dive in head first, showing that it too is capable of acrobatic skills. Although the river dolphin does display such diving behaviour during courtship periods, this behaviour is also characteristic of stress and is probably a response to motorised vehicles plying close to them.

In the 21st century, given the volume of traffic and noise in the river, stress is probably a constant for the dolphins. One needs to only look at China to witness the threats that increasing river traffic may lead to. Following the development of the waterway in the Yangtze River, continuous vessel movement and dredging became the 'final nail in the coffin' for the Chinese river dolphin and it was labelled extinct in 2008.

Because of our reliance on sight, it may be difficult to imagine the sonic perceptions of a river dolphin. However, an analogy with light may make this clear. Imagine being exposed to harsh and blinding stroboscopic light for every single hour of the day. It is sure to leave you blinded, disoriented and exhausted. What the Ganges river dolphins perceive when exposed to noise may very well be the same.

However, there is more to the Ganga than noisy vessels and dirty waters. Beyond the polluted waters and vast agricultural fields, there exists a land where otters and jackals roam without boundaries, where riverine birds flock by the hundreds and fishes as large as humans still dwell beneath the river. In the popular discourse, we hear how polluted and filthy the river is – which is true – but we miss out on other stories of the river. In trying to understand how noise affects the acoustic behaviour of dolphins, I have begun to appreciate this other side of the Ganga that is rarely seen but is frequently heard. Out in the floodplains, the unseen captures your attention. Despite all the problems associated with the Ganga, and the popular notion of it being a 'dead' river, the part that flows through in Bihar still resonates with sounds that befit the living. This 'other' Ganga that I wish to write about is surrounded by charismatic animals on land, in water and air; areas that still retain their rustic nature, might and 'wildness' as was documented in the 1920s by the Bengali author Bibhutibhushan Bandyopadhyay in his book, 'Aranyak'. A place that triggers a sense of being lost in time.

Riverine symphonies

The Ganga, especially in the northern state of Bihar, is a breathtaking place. The river and its floodplain is a vast expanse of sand and silt, bordered in most places with a carpet of agricultural lands as far as the eye can see. The river itself, in some places, is about three kilometers wide and looks like the sea. After sundown, however, one starts to sense the landscape not through sight but through sound, similar to a river dolphin. A particular incident during my fieldwork made me experience the night-time ambience of the river and remains etched on my mind.

I was based in a small town called Kahalgaon in Bihar right on the banks of the Ganga. At about 3:00 in the morning, as my boatman and I climbed down to the water's edge to place our sound recorders and underwater microphones in the water, the howling North-Eastern winds that blow during March and April created ferociously crashing waves on the river. Our small fishing boat stood no chance in navigating the river in this tempestuous weather. However, the storm didn't last too long and disappeared as swiftly as it had arrived. The ambient sound too changed dramatically. Soon after the roaring winds and crashing rain, all we could hear was the gentle





lapping of waves against the hull of our fishing boat and the sound of the oar breaking the water's surface. As we sailed across the river, a lone Ganges river dolphin started trailing our boat. These animals are known to follow small fishing boats at night in hopes of getting an easy meal from the scattering fish when the fishermen start hauling their nets. Although you cannot see much in the dark, the river dolphins reminded us of their presence by breathing air out of their bodies with a characteristic 'sus' sound. This sound is why these dolphins are known as 'sus', 'susu', 'sons', and 'hu', in various vernacular languages.

Experiences such as the one I describe are rare, but there is beauty even in the ordinary, if one looks, or rather listens, in the right direction. A traveller visiting for the first time may even turn back because of the cacophony that one perceives as he or she travels through the cities of Bhagalpur and Kahalgaon. But, in a sense, exposure to this din in the city is crucial in appreciating the more comforting and peaceful sounds of the river and its floodplain. This peaceful riverine orchestra is in fact quite rewarding if you listen close enough, for the musicians in this symphony are both human and non-human in nature. The wind and the rustling sand, during morning hours, form the foundation of the song, with the occasional motorboat acting as the bass, while the shrill calls of little terns, common ringed plovers, sandpipers, river lapwings, Eurasian curlew and small pratincoles form the melodious high notes. The soloist in this orchestra of the floodplain is the farmer who sings with his alto voice, a haunting tune that echoes through the vast floodplains.

However, come nightfall, the soundscape along the river changes drastically. Once, my boatman and I were camping on a river island near the town of Kahalgaon. His boat was anchored off the

island and was gently swaying along with the waves. After dinner, I decided to take a stroll along the island and absorb the gentle sound of the flowing water. The peace and tranquillity that I felt was absolutely mesmerising but little did I know that the midnight symphony of the Ganges was about to begin.

Past midnight, the crescendo of the wind becomes noticeable, and like the wind in the dawn orchestra, formed the bass and keynote for this midnight symphony. The waves too, emboldened by the wind, created a soothing, crashing sound, with water bubbling in the sand. Nearby, filling in the role of cellos, ruddy shelducks took flight and called. Their calls, although quite eerie in nature, fit the vast, moonlit darkness of the river. Whatever caused the disturbance to the shelducks soon moved nearer and displaced a dozen greater adjutant storks. Their wings produced the percussions that were necessary to complete the low notes of this soundtrack.

Like curtains rising to show the playwright of a play, a shrill laughter erupted from the grasslands, revealing the disturbance that led to the dramatic flight of the birds. The characteristic call of jackals was unmistakable. The jackals caused a ruckus among the nesting lapwings and their calls along with the alarm cries of the lapwings added to the much needed soprano of the composition. The end of this midnight symphony was heralded by a hunting river dolphin which, while chasing fish in knee-deep water, kept slapping its jaws, producing a very apt applause for the performance.

Navigating nature

Noise and tranquillity; wilderness and civilisation; filth and reverence; dolphin and destruction, existing cheek by jowl in the Ganga, challenge our notion of where wildlife should exist. Usually, when we visit a protected area, we are often surrounded by all things 'natural' and devoid of anthropogenic developments. However, river systems, like the Ganga, are strange places. One can experience both 'wilderness' and 'civilisation' within a span of 24 hours. The same river island, overrun by people who depend on the river for their livelihood during the day, can transform into an island that harbours exciting wildlife, rich with drama, during the night. Unfortunately, this fragile and boundary-less nature that exists in the river also experiences threats more intimately than areas that have been cordoned off for protection.

With rapid development of waterways looming in the immediate future, experiencing the river and its natural entities may soon be a thing of the past. The proponents of the national waterway which include several ministries of the government such as the shipping and water resources, road and transport and ironically, the Ganga rejuvenation and development, argue that waterways are in fact, 'eco-friendly', since the amount of fuel consumed for transporting materials over water is much less. Their arguments may make economic sense but make very little ecological sense since continuous dredging, alteration of river flows and construction of embankments and dams need to be ensured for navigation on the river. Hence, here too, the identity of the river is being contested with one section lobbying for economic growth while the other section argues for ecological stability.

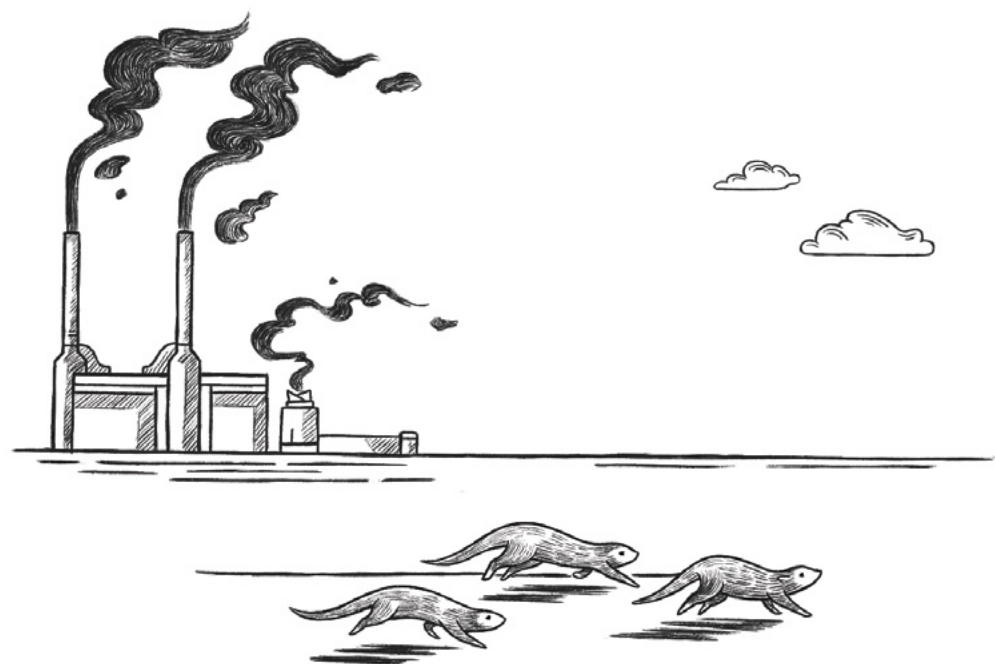
The rapid development of the waterways not only threatens the Ganges river dolphin but can also impact other organisms that depend on the river for their survival. Although tigers, sloth bears, and wild buffaloes that once roamed the land have gone extinct, otters, fishes, nilgais, wild pigs, jackals, the occasional gharial and mugger crocodile, hyenas, diverse waterbirds, and the shushuk (dolphin), still inhabit this timeless place. However, the fact that the dolphin and other wildlife still manage to survive here should not mislead us into thinking that the busy waterway has no impact.

If one is to develop and rejuvenate the Ganga, it is crucial to view the river through an ecological lens and not solely through an economic lens. The hydrology of the river, the status and health of other biodiversity, along with the community of people that depend on the river need to be taken into consideration if one is to revive this 'dead' river. Bihar remains one of the only states where rivers such as the Son, Gandak and Ganga run free, without any major alterations to their flow. Instead of viewing this as an underdeveloped state of rivers, it should be viewed as a source of inspiration on how rivers need to flow.

Some dualities in the river lend character, whereas others reduce it. Therefore, it becomes crucial that we as a community see not just one aspect of the river but also appreciate and honour the more nuanced bits that often go unseen and unheard. If only we were to use this sense of appreciation and reverence as regularly as our sense of gain and profit, much of the harmful dualities will cease to exist.

Mayukh Dey is an ecologist and a field recordist with the Nature Conservation Foundation. His research focuses on studying the behaviour of aquatic animals using sound.

Viplov Singh is a visual artist based out of New Delhi, creating stories and ideas in illustration and animation. His collaborators include Google, Red-bull, Giphy, Chronicle and Penguin books to name a few.



Whose island is it?

The complexities of human-primate interactions in Great Nicobar

Author **Ishika Ramakrishna** Illustrator **Prabha Mallya**

Under an overhanging banana tree, with its ripening fruits encased in gunny bags, I sat speaking with an elderly ex-serviceman from Punjab. Surrounded by coconut trees, with dense rainforest forming the distant backdrop to his tsunami shelter on the island of Great Nicobar, he looked out of place in his proud turban. On the contrary, this 11-acre tropical haven has been his home for the past thirty-nine years. While he wears his roots wrapped around his head, he is no longer a 'settler', as most people from mainland India tag him and others who first came to the island in the 1970s. He is a local, an islander, who has nurtured his farms and children with the limited resources available to him. The internal conflict pertaining to his identity never leaves, and it resurfaces every time he finds himself surrounded by other 'locals' from different communities. Are they one, or many? In a way, each person on the island holds dear two cultures - the one they brought with them when they first came to Great Nicobar, and one that they've created together by virtue of islandic isolation.

Introspective turmoil is, however, only one among many challenges these locals have had to face. The longest-residing of these families on Great Nicobar had first set foot on a deserted, undeveloped island during Indira Gandhi's Prime Ministership in 1969. Apart from a few settlements of the indigenous Nicobarese and Shompen communities, the island and its wildlife were unaccustomed to strong human presence. Over a period of thirty years, these settlers cleared and developed the southeastern stretch of the island. They cultivated rice, grew vegetables and created coconut plantations and orchards. Soon, people from diverse communities migrated to the island with their families in search of employment, sowing the seeds of the heterogeneous community present in Great Nicobar today.

The original occupants of Great Nicobar

Long before human settlers came to the island, it had been home to a healthy population of the endemic Nicobar long-tailed macaque (*Macaca fascicularis umbrosa*). They lived a predator-free existence, save for rare encounters with saltwater crocodiles. They mostly ate Pandanus fruit, supplemented by seasonal fruits from the forest, and insects and crustaceans. As early as 1903, C. Boden Kloss, an English zoologist who traveled the length and breadth of the Andaman and Nicobar Islands, spoke of the timid monkeys of Katchal and Great Nicobar. He found that they could, at times, be observed from close due to their innately curious disposition. On most occasions though, Kloss found that attempts to follow troops were a near-

futile experience, owing both to the challenging terrain in which they lived and their skittish nature. Kloss noted that these monkeys raided coconut and Pandanus plantations belonging to the native Nicobarese people, often to the point of hampering the growth of more fruit owing to the harm they caused to the trees.

Unfortunately, no one else spoke of these grey, frizzy-haired primates until a whole century later, when a survey was done across the three islands (Katchal, Little Nicobar and Great Nicobar) to understand how they were distributed. Dr. G. Umapathy of the University of Mysore and his team systematically travelled these islands to count the number of troops and monkeys within them, and learn about their basic biology. Today, we're slowly starting to learn more about these creatures by observing their movement, diet and behaviour, but the large lacuna in research between the early twentieth and twenty-first centuries has left us with more questions than answers. The islands that are home to these macaques are more accessible now than they've ever been before, providing us with an opportunity to study them better. This accessibility, however, has a flip-side, and has thrown the islands open to further anthropogenic development and modification of the macaques' natural habitat.

An attempt to fill the knowledge gap

When I first visited the island of Great Nicobar, I was intrigued by how close the Nicobar long-tailed macaques and people lived. While there may have been a time when these macaques roamed freely through the heavily-forested island, they were now sharing their home with nearly 9,000 human beings - not including those of indigenous communities - with no room for territorial expansion beyond the island's shoreline. Every person I met steered the conversation towards the macaques' shenanigans - of how every day was a constant battle of wits with the monkeys. I learned how the monkeys had found their way into the people's orchards, farms and homes, raiding their fields and gardens for food regularly.

The overlapping homes and home ranges of these two highly-intelligent primate species had clearly resulted in a wide range of interactions, and I decided to study how these had come to be.

I hoped to piece together the history of interactions between people and the macaques, understand what the nature of interactions between them are at present and unearth factors that had led to a seeming increase in conflict over time. Gathering this information required combining the social sciences and behavioural ecology. Put together, the people and macaques of Great Nicobar helped me understand the sequence of events leading from the settlers' arrival on the island up until present-day, where they go through life with monkeys in their backyards.

Interactions between human and non-human primates are inherently complex, owing to people's tendency to anthropomorphise and empathise with their evolutionarily-similar neighbours. The island of Great Nicobar provided an isolated system within which I could study the nuances of these interactions. Here, they are varied in their nature and intensity between macaques and people from different settler communities. Further, being on an island of unusually-high cultural diversity added another layer to the intricacies of conflict.

Given that the earliest academic records of the Nicobar long-tailed macaques were as recent as 2003, I relied on the locals to learn more about the longer history of this interaction.

"All this land once belonged to the monkeys alone"

The coastal vegetation and surrounding evergreen rainforests were first cleared to make room for human habitation from 1970 onward. Each family received 11-14 acres of land for agriculture from the Central Government, which resulted in the clearing of coastal Pandanus clumps to accommodate coconut and areca nut plantations. The southeastern coastline of the island was soon transformed into a developed strip of land, with one family residing every few acres. This pushed the otherwise-coastal macaques further inland or left them sandwiched between villages.

The long-tailed macaques, being new to such development and the dominant presence of human beings, initially maintained a safe distance from them. They feared people but gradually learned to venture into their fields and gardens in their absence. As the years progressed, the development of the island,





human population and the macaques' experiences with people increased. A combination of these factors led to the level of interaction between people and the macaques moving from negligible to noticeable.

The extent of these interactions varied greatly across the island. Some houses and farms, being closer to the forest edge, were more prone to raiding by the macaques. Macaques began entering coconut plantations more regularly, foraging on fruit trees from orchards and raiding paddy fields when left unattended. To combat this increasingly-problematic raiding, people bred dogs and trained them to chase the monkeys away. An arms race began, with people trying newer and more creative ways of keeping macaques away from their produce, and the macaques learning to dodge their efforts. Both species involved were adapting to the dynamic life resultant from living in the other's presence, and people began to pay attention to the consequences of having set up home in what was once unchallenged monkey territory.

A fragile system, further ravaged by the tsunami of 2004

The tsunami of 2004 caused major upheavals in every avenue, affecting the lives of both humans and macaques on Great Nicobar through landscape modifications and mortalities. The island's boundaries were altered, submerging crucial stretches of land along the coast. Most settler families that owned agricultural land in these areas lost their only source of livelihood. The long-tailed macaques, whose diet requires a large proportion of Pandanus fruit, were left with very few individual trees along the coast, with different regions and their troops being affected in varying degrees.

Human survivors of the tsunami were rescued and accommodated in the most-developed and least-affected area of the island, Campbell Bay, for nearly five years. It took another decade of sustained relief effort to redevelop the island and relocate the affected families. During this time, the macaques of Campbell Bay found themselves in constant contact with humans, becoming progressively habituated and decreasingly afraid of them. The lack of sufficient natural resources may have led to them supplementing their staple of Pandanus with human-

provisioned foods as well. Similarly, in other regions of the island, the macaques learned to make use of abandoned coconut trees and kitchen gardens, and these foods became more common in their diet over time.

The tsunami modified agricultural practices, social structures within human communities, the distribution of human settlements across the island and what the macaques ate. New settlements were built further inland and on higher ground, cutting further into the macaques' habitat. These factors came together to create an environment ripe for conflict between monkeys and humans, exacerbated by the overlap in their combined need for space and resources.

People's perspectives towards conflict and on-ground realities

My interviews with the islanders and behavioural observations showed that between 1970 and 2018, the macaques moved from barely interacting with people, to a situation where a quarter of their diet came from human-provisioned resources. Naturally, this led to people facing financial and personal losses. I spoke to these people to learn more about their personal histories, their position on how serious the on-ground situation seemed to them, and to understand the perspectives of the macaques. Did the islanders consider their daily interactions with the black, furry, teeth-baring primates to be 'conflict'? Each person's familial backgrounds, geographic positioning, gender and socioeconomic standings affected how they perceived their interactions with macaques.

These perceptions navigated through a wide spectrum of positive to negative. The macaques' adaptability to human environments and latent politics between different human communities combine in curious ways to make the situation on-ground more layered than visible on the surface. Adding another fascinating layer, people's anthropomorphism towards these human-like creatures and stories of the monkey god, Hanuman, greatly influenced the manner in which they dealt with conflict scenarios. In a country like India, where mythology has seeped into each home imperceptibly, it's hard to disentangle the effect it has had on people, of any religion, and their outlook towards the garden-raiding Vaanars they see.

Even in regions that faced extremely low levels of macaque visitation, as I found through a citizen-science initiative across the island, people still felt a keen frustration towards the monkeys. All these factors came together to either increase or set at ease people's sense of loss at the hands of the monkeys. Finding these intricacies within an island so culturally and economically diverse made me believe that solutions to combat the rising conflict need to be well-informed and accommodating of its complexities.

Intricately, innately grey

Delving deeper into the complexities of why these interactions exist and the various permutations in which they are dealt with could fill pages of a sympathetic book. The chapters therein would cover the island's history, the macaques' biology, the game-changing tsunami of 2004, the steady development of the island, the different cultures of each community and the indigenous people, and detailed descriptions of what one may observe taking place today. A book, an article or an academic paper, however, would be suspended in time, a snapshot of a constantly-adapting land. Any author would struggle to pick a side while narrating the history of this islandic system, so far removed from our mainland. These interactions are entwined in ecological history and the nuances of anthropology, making the onset of conflict between two species like these more intriguing with each layer unearthed.

That elderly, Punjabi man I mentioned at the start, sat under his banana trees, fruits shielded from the monkeys, and spoke with sparkling fascination

about their intelligence. Moving quickly beyond his description of the economic losses that the monkeys had caused him by destroying over 70% of his annual coconut harvest, he lost himself in a narrative of how the monkeys have learned to avoid every obstacle he placed before them. Despite his daily tussle with them and the frustrations of being 'stuck' on that inescapable bit of land floating in the Andaman Sea, he still found room in his wise, old heart to marvel at their antics.

Of course, it isn't every family that can afford to smile at their losses. People have deep-set reasons to justify their love for and apprehension of the macaques, sometimes both simultaneously. I have learned not to label their interactions with these curious creatures as 'conflict' anymore, unless characterised as such by the people themselves. I am a mere spectator, who has attempted to describe this system to the best of her ability using a combination of tools. When each person views the monkeys through a different lens, chiselled down by personal experience, who am I to pin an overarching negative connotation to their lives?

These interactions are dynamic and vulnerable to change. Our first step should be to understand the reasons for that change. Currently, human and macaques on the island of Great Nicobar are in transition-moving from co-existence to semi-harmonious co-occurrence. If we are lucky, with the right tools and the inclination to describe all aspects of the 'conflict' at hand, we could work towards curbing its escalation and safeguarding the wellbeing of all animals involved-human or otherwise.

Ishika Ramakrishna is a researcher, blogger and dancer interested in primates, people and all the stories they have to offer. She now builds curriculum for conservation education in rural schools.

Prabha Mallya is an editorial illustrator and comics creator. She is known for drawing insects in the margins, pressing flowers into endpapers, and populating spines with kittens.

Diminishing colours on the food palette?

Reflections on lost diversity of foods in West Sikkim, India

Author **Radhika Gupta** | Illustrator **Ladyfingers Co.**

In the 2000s, Sikkim banned its traditional pastoral practice in parts of the state due to 'serious degradation' of forests. This inevitably led to a loss of livelihoods and economic inequality between different groups. Perhaps the ban did lead to regeneration of forests where grazing used to take place. However, proof for this or that there was loss in forest cover before, is sparsely documented in scientific studies. Despite the absence of such studies, there remain entrenched views on the 'unsustainable and backward' practice of pastoralism.

Sikkim's Organic Mission launched in 2015 was another policy that embellished the state government's green image. This is, by any standards, a massive achievement since Sikkim is the first fully organic state of India that had completely stopped the use of chemical fertilisers for ten years before the policy came into being. However, a large population of its farmers who are below the poverty line (BPL) are still largely rice-fed by non-organic produce from outside, under the Public Distribution System.

Also, the earlier ban on grazing in forests stopped the production of large amounts of cattle dung required as manure to practice organic farming. Herds that numbered over 40 were collectively owned by two or three families, had to be sold. Today they have shrunk to 2-5 stall fed animals depending on the activities the villagers choose to engage in. Faced with high rates of unemployment, the ban also triggered the movement of the younger population to urban areas for education and jobs.

These changes are best understood through a specific case, the Semba* villages in West Sikkim, where I conducted a study in November 2016. The first agro-pastoral families migrated to Semba from Nepal in the 1960s when Sikkim was still a kingdom and the forest was not a designated national park. Sikkim went through a major shift in policies when it became a part of democratic India in 1975. These were amongst the regions that came under the grazing ban.

With a population of about 300, Semba is situated atop the Eastern Himalayas in India, disconnected from roads. Thus, all activities are conducted on foot. The villages lie close



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to the Kanchendzonga National Park (KNP), which is home to 36 species of rhododendron flowers and sometimes gives lucky trekkers a glimpse of the red panda.

With very apparent differences in altitude, temperature and livelihoods, Semba can be split into upland and lowland areas. The lowland is mainly covered in large cardamom crops as far as the eye can see, invading the kitchen gardens of residents who have planted them. This spice has a global demand and can sometimes earn farmers big money. However, fluctuating prices and recurring disease in the crops puts farmers under constant threat.

The upland, covered in clouds at all times, grows vegetables and has larger numbers of livestock compared to the lowland. One cannot grow large cardamom here due to colder climate. The upland is also closer to the forests. This drives considerable difference between the earnings as does the land holding size. Land availability decreases with increase in altitude and cost of carrying head-loads goes up as distance from markets increases.

Three major changes

The changes experienced in Semba's agricultural development in the last three decades have emerged due to several cross-scale interactions. The first was a shift from subsistence to commercial agriculture. The second, reduced livestock population owned by communities, and the third, restricted access of communities to forests. The overall result is a reduction in the diversity of food and food sources, and increasing dependence of communities on external markets and government subsidies for food and income. The main sources of food used to be subsistence agriculture, livestock husbandry and forest foraging which do not provide the same services anymore. A 'food plate' exercise with older community members to compare daily meals from 25-30 years ago revealed that the only item bought from the markets in the past was salt. The rest of the ingredients were available in the villages. The variety of foods had changed over time too and the current food was perceived to be less nutritious.

The careful mixing of colours on the old palette

Back in the day, yak and other livestock grazed in the forests of the now Kanchendzonga National Park (KNP) in West Sikkim. This pastoral tradition, known as the gothwala system enabled the pastoralists to practice subsistence agriculture. The monarchic rule allowed this under an elaborate tax system, the regulation of which is not very well known. The cattle dung which was rich in forest nutrients served as manure for an array of crops grown by the mountain communities. The benefits of dietary diversity obtained from the integrated practice of livestock herding in forests and agriculture have been documented. For example, dung obtained from grazing in forests as opposed to stall feeding indirectly contributes to dietary diversity through biomass flows. So does increased availability of manure, that increases the diversity of home gardens.

The variety of crops depended on land holding size and time available aside from that spent in the goth or tending the cattle in forests. Crops included mustard, wheat, buckwheat, barley, maize and millets. Mustard was used to prepare cooking oil. Millet was used to make the famous chaang, a fermented alcoholic beverage, and flour for pancakes. Maize was used to make popcorn. From the dairy itself, communities made curd, churpi or dried cheese, and ghee or fat which they also used to sell. Meat was also an obvious by-product. While having access to forests, communities had developed the skill and knowledge to forage for fruit like kawlo and banta, wild mushrooms, wild saag, laipatta, bamboo shoots, and wild garlic among other herbs and plants with medicinal values. Wild deer was also hunted for meat. Wax from oak trees was used for making tea. While some of these practices continue, they have diminished greatly.

Wild vs. the tame

When Sikkim came under the constitutional framework of India, the Wildlife (Protection) Act, 1972 became applicable. This along with the declaration of KNP in 1977, made it harder for communities to access forests. Following this, with an increase in human population and opening of new markets over time as Sikkim became integrated with India, the demand for cattle products increased. To save the forests from overgrazing, the government passed a ban on selective parts of Sikkim in 1998. The Semba communities shifted to commercial





farming from subsistence, and the upland communities suffered greater losses than the lowland ones, resulting in economic inequality.

This came about because while cardamom can be grown in the lowland areas, the upland climate does not support it. Government policies together with growing market demand for large cardamom has also pushed aside the practise of subsistence farming. In Semba villages, 60% of MGNREGA funds are used for daily labour wages for those who work in the farms and, and 40% for buying high yielding large cardamom seeds. Water sprinklers have been distributed under Rashtriya Sinchayee Yojana, to expand cardamom plantations which could earlier thrive only close to water bodies and under the shade of trees. Local seeds are replaced by hybrid varieties that are issued by the central government, thousands of which are wasted every year as they are not suited to local conditions.

Food subsidy

Interactions between people, ecology and economy work in non-linear ways. When development policies are designed, the history and context of a system matter. The Public Distribution System was first created in the 1940s before India became independent. After the merger of Sikkim with India, BPL ration card holders could claim 35kg of free rice, per family, per month. An upland resident recalled the time they first started to receive subsidised rice and described it as the moon rising on a dark night. While the policy can help save money and/or provide food security, farmers may feel no need to grow food when the government gives rice almost free of cost. The rise of external markets in conjunction with subsidised rice make it easier to buy rather than grow. For example, mustard oil which was produced at homes is now replaced with refined oil from the markets.

This has probably interacted with the increasing need for money, which encourages commercial farming over the 'toilsome practice' of subsistence farming. The staple of Semba villages has shifted to rice from the various millets, wheat, buckwheat, maize and barley.

Semba's sarpanch is concerned about the future of his children, saying, "if there's a strike, a war in the future, and the rice stops coming from outside then [the children] should learn the practice of agriculture. Right now the rice comes from Siliguri, it's not grown here."

In a nutshell, the social-ecological system of Semba is faced with high vulnerability. Its diverse foods were lost as their sources diminished in one way or another and the communities have become increasingly dependent on government subsidies and external markets. The lost diversity is largely caused by the disintegration of subsistence farming, livestock grazing and forest foraging, that were all deeply connected to each other. These changes have probably come at the cost of nutritional decline in diets, as dietary diversity loss can reduce micronutrient adequacy. There is evidence that literacy has gone up and standard of living across Sikkim is better than the past. But has it come at the cost of long term resilience?

Why do colours on the palette matter?

Semba villages are not the only ones losing diversity and becoming dependent on far off sources. Parts of central India and Odisha have also come under the homogenous distribution systems, making a switch to a more rice-based diet and losing local varieties, respectively. The replacement of subsistence foods with imported market products causes a disconnect between diets and food sources. This depleting diversity of foods also results in a loss of knowledge that help to harvest or cultivate, produce and use them. With increasing droughts and resistance to disease in crops, several factors that govern marginal and small-scale farming communities need to be considered.



Keeping or providing options gives freedom of choice as well as the ability to fall back on substitutes when other options fail. It is like an ability to choose from a colourful palette and paint one’s own future in terms of food diversity and choice. Acknowledging the diversity of individual social-ecological systems should be a key consideration while creating policy.

Studying interactions across time and different geographical scales can greatly inform policy. Conservation of forests and economic development are not individual end goals. They are parts of a larger painting that can ensure Sikkim’s food security.

*Semba is a replacement for the original name to maintain the anonymity of interview participants for ethical reasons.

Further reading

Baudron, F., J. Y. Duriaux Chavarria, R. Remans, K. Yang, and T. Sunderland. 2017. Indirect contributions of forests to dietary diversity in Southern Ethiopia. Ecology and Society 22(2): 28

Maikhuri, R.K., K.S.Rao, & R.L. Semwal. 2001.Changing scenario of Himalayan agroecosystems: Loss of agrobiodiversity, an indicator of environmental change in Central Himalaya. India. The Environmentalist 21(1): 23-39

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Ladyfingers Co. is a communication design studio with a fun and sensitive approach, based in Bangalore, Mumbai and Kolkata. At their core, they believe in making communication relevant to context and culture.



Science for saiga conservation: interview with EJ Milner-Gulland

Author **Hari Sridhar** | Illustrator **Rohan Dahotre**



Q: I want to start by asking you about how you got interested in the saiga antelope.

Sure. I think for many scientists it’s just chance, how you get into a species and then you decide that you like it. I was starting my PhD on the ivory trade in elephants and also later on rhinos. When I was researching about rhino horn use in Chinese traditional medicine I found that the saiga antelope was associated with rhino horn often, it was in the same medicines and it was actually seen as a substitute, though it’s really a complement, not a substitute. That was exciting for me because my father is a professor of Russian arts, literature and history. He was translating Russian dissident poets and we had lots of Russian stuff in the house. He was going to Russia lots and so I was really interested in the Soviet Union. When I read that saigas from the Soviet Union were complements to rhino horn I thought this is my chance to go and visit the Soviet Union. So I put in a grant proposal , got the money and went to visit. I was a population modeller doing population models of elephant and rhino populations and the effect of trade. I thought I could do something similar for saigas. When I got there I just really loved it and I stayed!

Q: Do you remember your first sighting of the animal?

Yes, it was in Kazakhstan, in 1991 possibly; maybe 93. I had a bit of time, I was there for a month, and we went up on a survey. That year the calving was very far north, so we were starting to give up. We couldn’t see any saigas and we were also a bit late for the calving. I was thinking I had driven for 2 or 3 days in vain and that I was not going to see a saiga, when we saw a single baby saiga right on the tracks, sitting in the sand! Quite often, late calving subdominant females put them in the sand in order to keep them warm. So, on that trip I saw just one baby saiga on the road. I took a picture of and 25 years later, it is still my Skype icon. I’m very proud of that picture. It’s not the best picture but it was my first saiga.

Q: Stepping back a bit, how did you decide to work on trade in elephants and rhinos for your PhD?

It was another bit of random chance. I was interested in conservation and population modelling. I turned up in my supervisor’s lab without a topic, but he had just been given a contract by CITES, the international wildlife trade body, to look at population dynamics of elephants, before their up-listing to Appendix 1. This was in 1988-89. He’d been asked to look at the effect of the ivory trade, the amount of trade that was going on at that moment, on the dynamics of elephant populations to see whether it was sustainable, and whether declines in elephant populations could be attributed to the ivory trade. He’d been given this consultancy, I turned up and he said, “well, why don’t you do it?” That’s how, in my very first few months in my PhD, I was providing input to one of the most important decisions that CITES has made. That was quite a baptism of fire for me, as a 21-year old. It was an amazing opportunity but also incredibly stressful, and made me realise immediately, from the first days of my PhD, how political conservation can be. I did my population model as best I could and



it was taken up and argued about by both sides, which made me not want to do anything related to ivory for a few years! This is another reason why I moved into rhinos and from that into saigas, but I was interested in the dynamics and sustainability of trade from that moment.

Q: Stepping back even further, where did your interest in conservation and population modelling come from?

I was always interested in conservation. I grew up in the countryside in Sussex, enjoyed nature and my parents were very good at telling me about plants and animals and that kind of thing. I was also very interested in theory, in behavioural ecology and evolution and all those theories as an undergraduate. My undergraduate in Oxford was on pure and applied biology, so it was some behavioural ecology and evolution, but also agriculture and forestry, which I found really interesting, that application of theory to practice. As I went through my undergraduate, I started to think that conservation biology, which was just starting then, really needed some of these more quantitative and theory-based techniques. The terms 'conservation biology' and 'biodiversity' were coined while I was an undergraduate, so it was a really fascinating time to be in this field. I wanted to do something applied, do something for nature and felt that all the things I'd been learning in theoretical biology, about game theory and about population modelling, was really useful for conservation. I was just really lucky to get into conservation at that time.

Q: What are your memories of doing field work at that time when you started? What were the challenges of doing field work in those places?

The first thing I did was to make a real effort to learn Russian. I was the only English person around so I had to speak Russian. I think it's really important for conservationists to speak the language of the people you're working with. In those days, Russian was the language of the whole region, less so now. I guess initially they felt I was very young and female and so they were very kind to me, then later I grew to know them and to be their friend and to work together with them, and then I started getting grant money to support our joint work. This was a really difficult time when the Soviet Union was collapsing and there was no money for science or conservation. My colleagues who had this very proud history of science, of many years of science being one of the top professions and very respected, suddenly they came to a point where there was no money for electricity and all their staff were leaving to be bus drivers or selling cakes on the street. You could make a better living as a bus driver than as a scientist! Their proud 70-year tradition of science was falling apart and in the lab where I was mostly working, I was the only one producing money because I was their only foreign collaborator. At that time I guess the relationship changed a little bit because, although I was still a young post-doctoral early career researcher, I was still the one who was leading these big projects. We had 10 years worth of big interdisciplinary international projects, with many partners, with money from the EU for the reconstruction of the Soviet Union, which I ran. I was very lucky that there was that money, and I became one of the senior members of the team I guess. They still think I'm a bit odd, particularly because I'm a vegetarian in Central Asia, but they are used to me and my students now, and I feel like we have a really strong collaborative relationship, even though nowadays, because of all the responsibilities I have back home I don't visit as much as I should. I feel like we've got nearly 30 years of shared history with the same people.

Q: You started by doing research mainly in biological sciences, then moved to also doing research in the social sciences and now you are also involved in many different aspects of conservation practice. What were the main challenges for you, as a biologist, in making these transitions?

We were very naive to start with. I told you I had 10 years of money from the EU. After that stopped we started to look for other money. I got some money from the Darwin Initiative which funded projects which integrate research and conservation. But around that time we also just started to find that we couldn't ignore the conservation issues anymore. We were doing ecological research, disease research, all sorts of things and we were finding it harder and harder to find saigas. The biologists who were out in the field were saying there was huge amounts of poaching, that the saigas are going. This was in the late 90s – early 2000s. It was getting harder and harder to do our research, but we also thought that if this is really true we can't just stand by. So I got the Darwin grant in 2003 with my colleagues to do research on what was going on with the poaching. And the answer was really worrying. Also, when this money stream came to an end I wanted to keep our network going and I wanted it to start working more on conservation issues. In 2006, I happened to be asked by the Wildlife Conservation Network (WCN) in the US if I would like to apply for our program to join that network. The whole thing again just came together nicely - funding was running out, we were starting to work on conservation issues, we were seeing serious issues, and we were asked if we would like to join WCN as a conservation organisation. We didn't have a conservation organisation so we made one. It was basically the science network that I built up over 10 years but starting to work on conservation issues, and then, over time, we've moved that into a collaborative network doing all sorts of conservation. From the beginning we wanted it to be a network that brought a range of state actors together. The other thing that was happening was that people internationally were getting concerned about saigas because of our work and others who were saying that there was a problem. But I felt there was a huge disconnect between all the talk that was happening internationally, in the UN conventions and IUCN, and the huge experience that my colleagues had on the ground. This was not reaching those people because they didn't speak Russian and they hadn't worked with them. So I thought why can't we have some network that would allow some of this huge expertise to be translated up so that the people who are making decisions internationally that were directly affecting the saigas had access to the expertise from the science on the ground. One priority for the network was to make that connection between global and local much more explicit so that there was a way that the information was channelling in both directions.

Q: Looking back at all your research on saigas and the conservation work you have done, what aspects of your research do you think have been most useful in conservation decision making?

That is an interesting question because my very first piece of research, on the ivory trade, was a fundamental contributor to a landmark decision (to uplist the elephant to CITES Appendix 1). That was very strange to me. But most of the early saiga work we did didn't really play any role in decision making. I think it was only when the Convention on Migratory Species decided to have an MOU and an action plan for saigas in 2006 that science started feeding in. That action plan was informed by the best science from all the different actors in the range states. My organisation, the SCA (Saiga Conservation Alliance), is one of the coordinators for that MOU. We collect all the science that's been done, all the evidence available, and we put it into an action plan and an overview report, which are then discussed and signed off by the range states, and form the basis for the next 5 years of action. So for the saigas, I feel the governments are taking the science relatively seriously, some more than others, and are acting upon it and commissioning more science as well, some more than others. For the saiga there is a fair representation of science in decision making.



“The terms ‘conservation biology’ and ‘biodiversity’ were coined while I was an undergraduate, so it was a really fascinating time to be in this field. I wanted to do something applied, do something for nature and felt that all the things I’d been learning in theoretical biology, about game theory and about population modelling, was really useful for conservation. I was just really lucky to get into conservation at that time.”

Q: In the talk yesterday you mentioned your paper in Oryx in 2001 (Oryx 35(4): 340-345) which you said was influential in the saiga being listed as critically endangered.

Yes, that's right. That was a collation of data collected by government agencies in different countries. Like I said yesterday, it was only through publishing that evidence in a peer-reviewed publication in English did it get the seal of approval which meant it could then be used in the red listing. I think with the red list and other kinds of large-scale international prioritisations, peer-reviewed papers are powerful because they give the seal of scientific approval to information that can then be used in conservation. That information was already there, but it was helpful to have the scientific paper.

Q: You spoke about how you were initially sceptical about big international conventions but after being part of one such exercise you feel differently about them. Can you say a little more about that?

Yes, so that was the Convention on Migratory Species (CMS) MOU on saiga conservation. Its success is partly because the saiga community is relatively small. We all know each other, have been working together for years, and so we could get together in a room and produce an action plan that could be adopted by a U. N. Convention. What I found remarkable was that governments take UN conventions so seriously. The fact that it had a seal of approval from the CMS, which the range states had signed up to, meant that they did take their reporting seriously. I guess the fact that the saiga is not an

internationally contentious species also contributed. It's a species where the range states themselves are making and implementing policy and there's not a lot of interference from outside. Therefore the community of saiga researchers have a big input. When you get to the big international conferences like CITES, you get huge wrangling when there's large amounts of money involved or there's a lot of public sentiment involved, like in the case of elephants. It's very different in those cases, and I think it can be very frustrating and very, very political. But I haven't found the saiga MOU to be very political. So maybe it's a difference between these different species.

Q: Now that you have taken on this additional role as a conservation practitioner, I'm sure you occasionally find yourself in situations where you're asked to provide your opinion on matters on which you might not have the backing of solid empirical evidence. How do you deal with such situations? Do you find such situations uncomfortable?

No. I think you have to be very clear that the empirical evidence isn't there. I'm happy to give my opinion, but if my opinion is that the data are uncertain that is what I will say. I'll give my opinion in as much as what the evidence is telling me and if the evidence is not telling me anything then that's what I will say.



Q: From the point of view of conservation, are there certain areas of research that you think are key in the near future?

Yes. My group has done quite a lot of research on the social side - attitudes to saiga, saiga consumption, poaching behaviour and things like that. But we haven't done much in recent years, partly because I've been really busy elsewhere, but partly also because there's less interest from the government on the cultural/social side. That kind of work is less likely to get into policy because they're more interested in what they see as hard empirical facts. I was disheartened about the lack of engagement that governments had with research using social science methods to understand poaching.

Q: It's now 28 years since you started working on saigas. If you now look back is there anything you wish you had done differently in your research and conservation work?

I guess you always look back and think you could have navigated some situation differently. When you are learning and growing you don't always navigate diplomacy and politics as best you can, but I always try to act with integrity and sincerity, and I always hung in there and didn't just walk away. Even when we had difficult times we got through it together as a group. I wish I was doing more research on saigas rather than more of the NGO stuff. But that's the way of the world I guess. You trade off one thing with another.

I guess the other thing I would say is that because I was running a Masters in Conservation Science and training young conservation scientists, I felt it was really important that I had a hands-on understanding of what it's like to run an NGO, to be a small NGO that's actually active in conservation. I think it's very easy as a professor to get more and more distant from the real world and start teaching your students in a very conceptual way. This saiga conservation work is really important in grounding me in the real world.

Q: At the conference you conducted a workshop on "conservation optimism"? Can you tell us a little about what you mean by conservation optimism and why you think it is important?

It's mainly about looking forward and thinking that we can address the big problems that we have in the world, which are huge problems. And that we - conservation professionals, the general public, governments, businesses, all of us - can make a difference. And the way to do that is perhaps not to start with a huge problem. Like when you write a PhD thesis, if you sit at a desk and say you've got to write 100,000 words in three years time, that seems the most enormous task. But if you think, okay well, I'm going to break it down into bite-sized bits of work that together, in three years time, will add up to a big thesis, then it's more achievable. Similarly for conservation, if we think about all the little victories we have and learn from them, and also learn positively from failure, then we can add those up into something that makes a difference. Of course you need to have the top-down stuff as well but the bottom-up is crucial. We can't solve everything with an international treaty, we have to have the grass roots work as well. Conservation optimism is trying to create a support network, bring together and highlight those grassroots efforts, and help them improve. There are many young people around the world who want to help, different sectors who might want to help, NGOs around the world

who might want to help. Can we bring them together and help them work together? The hope is that the burnout you experience as an individual conservationist, thinking that everything is hopeless and why should you carry on, can hopefully be relieved by being part of a wider group of people. There's a lot of talk at the moment in wider global conservation about the fact that we're coming to a biodiversity super year in 2020, when lots of CBD targets are going to be re-negotiated. There's a lot of discussion about how we can change the public's mind and governments' mind so that the general public of the world starts to see conservation as something that they can get behind, which then allows the governments to make the radical change that we need. One contribution towards that is trying to amplify these voices from around the world. That's the bigger mission for conservation optimism.

Q: In another interview you compared conservation to other social movements, for example the movement for gay rights, and said that very often it might seem like there's no progress being made, like pushing against a dead weight, but then change happens suddenly and dramatically...

That came from a paper that I read about changes in socially liberal policies in US states that had a lovely graph, in which you see nothing, nothing, nothing or very, very slow progress and then all the states suddenly adopt the legislation. I think there's been some literature about tipping points in social change making similar points. Another example is what we have just seen with plastics. We saw NGOs banging on about it for many years without much success and then a sudden switch. It was interesting because, if you looked at the popular media it was pottering on and pottering on, but as soon as it became something the public wanted, in the U.K. at least, the government stepped into legislate. It became easy for them to legislate because the public mood had changed. That is why I think there's a lot of hope for conservation and cause for optimism.

Hari Sridhar is a post-doctoral researcher at the Centre for Ecological Sciences, Indian Institute of Science, and his primary research interest is heterospecific sociality. In addition to research, Hari teaches community ecology and ornithology at different institutes and conducts interviews on topics related to the making of science.

Rohan Dahotre is a nature and wildlife enthusiast who loves exploring the wild. He feels illustration is a very strong medium in communicating our thoughts with society and continues spreading animal awareness through his illustrations.



A city-girl field ecologist

Author **Anusha Shankar** | Illustrator **Maanvi Kapur**

Ecology is sometimes thought of as a bourgeois profession; one that only the middle class and above can have the luxury of seriously considering as a career. And this might well be true. Maybe 'saving the world' is a luxury for those who can afford it. Many ecologists indeed feel passionate about what we do because at some level we are thinking about the Earth's well-being. And there is always an acknowledgement that this profession isn't about making money - you won't make money. It takes near-impossible resolve to keep this mindset if you are penniless. But I never could quite put my finger on why I could earn 10 times as much driving a truck than I ever would as an ecologist with over 10 years of post-high school education. I realised one day when I was in the field that it's for two main reasons: we have curiously explored the little secrets that make animals work the way they do, and tried to uncover new knowledge of how animals interact with their environments. And we often get to do this by exploring places most others don't get to see. This professional curiosity in often remote places cultivates an awe for the natural world.

It's far from glamorous once you get down to it – you might literally wade through cow dung or get swarmed by 100 ticks at once (itch for months), get deported, and go to other insane lengths to see these things (some, or all, of these might have been my real-life experiences). But at the end of it all, I don't just get to see the Milky Way light a path through the universe. I see the Milky Way in Arizona at 2am after my shift watching a wild hummingbird sleep.

I followed gibbons in the forests of Northeast India, watched a king cobra devouring a rat snake in the wild, and studied nesting hornbills, in the Western Ghats of India. I held transparent butterflies and woke up, for months, to a cloud forest valley bathed in clouds in Ecuador. I saw penguins near the equator in the Galapagos, and blue-footed boobies. The majestic Swiss Alps in the snowy warmth of the spring; the breath-taking Himalayas, their dizzying heights leaving me literally breathless. The caressing, windy, confusing, warmth of the high Andes, with its bluer-than-blue skies. This has been my past 10 years – a self-proclaimed city girl.





How lucky am I? This is not altruism – I am selfish. I want to continue to be able to see these things. This profession satiates my curiosity, and quenches my need to experience the Earth as it should be – less polluted. This Earth is marvelous. Its diversity moves me to tears. I am amazed by it. How much you can see and learn if you stop and observe the world around you!

Many ecologists enter the profession because they want to get away from people. But to be successful in the field, you come to realise that the key lies in the opposite, in working well with other people. There is no way we can save our wild places simply by roaming them; we need to reach across disciplines and work with people to solve the problems humans have created. We must lead by example to continue having the chance to experience our wilderness. One way is to have compassionate conversations with others who think differently from us. To gently bring up questions about our lifestyles. How much stuff do we actually need to own and use? How much plastic and oil and land and fish and clothes and straws... at what cost? What do you or I, or all of us, really need, to be content? How much is enough?

I know this is cliché, but our Earth really is the only one of its kind that we know of. On one rock in the universe we know of, there are giraffes, blue whales, giant smelly flowers, microscopic and indestructible tardigrades, some ten thousand flying, feathered, colourful things we call birds. There are green leafy things that don't move (much) and act like our planet's lungs. This concept, of our blue-green planet, continues to astound me. I want its diversity to continue existing, for my selfish current self, and for the future. There are over seven billion of us humans, and I am sure we can come up with ways to make it happen if we put our heads together. Let us open our minds, work with engineers and architects, painters and children, to keep our disappearing diversity from slipping away.

Thank you,
A city-dwelling forest lover

Anusha Shankar is a National Geographic Explorer and a post-doctoral Fellow at the University of Alaska, Fairbanks. For her PhD from Stony Brook University, New York, she studied how American and Ecuadorian hummingbirds manage their limited energy.

Maanvi Kapur is a lover of good design and all things illustration. Fine Art was a part of her life from an early age and she received formal training in painting and sculpture. Her true love lies in illustration, and that means anything from portraits to nature to still life.

THE SACRED CONCH

Mystery and embodiment in Palk Strait

Author **Michael Adams** | Illustrator **Ipsa Jain**

*I am the last born and I have a long following/
Everything and everyone is my elder/
I move through the relatives in my green leaves/
I eat canoes and drink inlets...*

(from Maori writer Hinemoana Baker's 2008 poem *Last Born*)

At the beginning of the Bhagavad Gita, seven war conches are named as their owners sound them at the start of the climactic Kurukshetra battle. War conches are shankha, the sacred or divine conch that is used in Hindu and Buddhist ritual, and in sacred ceremonies in different saltwater cultures around the world. There is a three to four thousand year tradition of diving to collect shankha from the waters of India and Sri Lanka, including Palk Strait.

The conch seems an unlikely candidate to reach the level of reverence it does in India, Sri Lanka and other cultures. In scientific terms, it is a large marine gastropod, a big sea snail. They are predators, feeding on other marine invertebrates and especially species of sand-living worms. The specific animal revered as shankha is *Turbinella pyrum* in Latin. It lives on sandy sea bottoms, and is common and restricted to the southern coasts of India, parts of Sri Lanka and the Andaman and Nicobar Islands. In its living form it is not obviously attractive, the shell being covered by a dark brown mantle of soft tissue. Once processed, it is a shining white symbol of the divine.

On these coasts on both sides of Palk Strait, the material properties of the living environment of land and ocean continue to be reshaped into the built form of local human beach communities. From the land, palmyra and coconut trunks, stalks and leaves become furniture, fences, roof framing, thatch, fishing boats, paddles, bailers, shade covers, walls. From the sea, sand becomes concrete, shells become lime, coral becomes construction blocks. Local artisans have specially woven the roof thatch on our buildings in both India and Sri Lanka. There are no nails or synthetic materials, and room dimensions are determined by the bearing capacity of palm beams.

But these places are not held in the past. Threaded through these continuities, the persistent materials of modernism are rethought and repurposed, as well as discarded. Polystyrene packing becomes boat hulls, worn fishing nets become all kinds of containers and wrapping, plastic bottles become fishing floats, old clothes become flags and markers. All these same things line the tidemark on beaches. Every turtle skeleton I find is entangled in indestructible nylon net.

Underwater, the experience changes daily and hourly. The sand is rippled by the tide, pitted and tracked by the activities of hosts of small invertebrates. Tiny fish speed through the mid and upper levels in dense and tightly choreographed shoals. Jellyfish with two metre streams of stinging tentacles drift silently. The calligraphy of tiny lives marked in the sand is layered over with dead and living animals and plants. The hard calcium carbonate of shells, exoskeletons, bones and claws persists while the soft flesh, mantle, muscle and organs are consumed by predator and detritivore.

Like all species, shankha are both eater and eaten. They hunt for the polychaete tube worms in the sand while divers, stingrays and other predators hunt for them. The divers that hunt shankha now are varied in skill levels and access to equipment. Many approaches are used: breath-hold with various equipment, scuba, scuba variants, hookah, and likely more than this as cheap innovation is applied to technologies to get divers underwater. These are all dangerous to different degrees.

The shankha is collected alive, but cannot live out of water, and likely dies while still on the boat. This is the beginning of the shankha's journey into ritual. The large muscle comprising much of its body is kept for food by some divers, the elements of the living animal diffusing into the muscles of the living diver. The shell is processed into the ceremonial instrument, and its opercula ground into fixative for incense.

The calcium carbonate of the shankha's exterior shell is shaped inside as a perfect receptacle for its strange yet familiar body. As humans, as vertebrate mammals, we carry the calcium carbonate of our skeletons inside, our bodies vulnerably open to the world, just our brain protected inside bone. When we die, both shankha and humans, the bone or shell parts of our bodies





persist after the detritivores have finished with our flesh. Everything living survives through the deaths of others, who are all our/their relatives, close or more distant – we all eat our relatives, evolutionarily speaking, sometimes distant (molluscs, plants) and sometimes closer (mammals). Our interspecies interdependence is based not just in the biology of food but in the biology of evolutionary reproduction: both eating and sex. It is no accident that we recognise that the warm involuted whorls of the shankha reflect the human birth passage, and that both conches and oysters are aphrodisiacs in many cultures. The reproductive processes of all species are implicated and reflected in our own, including the lowly molluscs. Eating oysters increases dopamine that boosts libido, and their high levels of zinc are important for testosterone levels in both men and women. The creative generation of life on Earth endlessly recycles the available constituents on the planet, from the elements to the forms.

More than five hundred million years ago, an impossibly long time to imagine, we shared a common evolutionary ancestor with marine molluscs: our bodies are composed of the same elements, we come from the same ancient World Ocean. Humans do not just share the building blocks of our bodies, but the patterns of composition that put them together. We share this kinship with shankha and everything else living on the planet, as well as innumerable now extinct species, and they share that kinship with us.

For the shankha itself, it lives in a world we can hardly know, the sentient context of Palk Strait. Hindu belief depicts the very rare reverse turning shell, the dakshinavarti shankha, as reverently attended by hundreds of normal spiralled shells on the sea floor. Have human eyes seen this?

For shankha divers there are tactile engagements with the living animal in its underwater world, they earn their connection through skill, effort and knowledge. For people who purchase shankha as an emblem of luck and prosperity, the shining shell functions as a mnemonic, a reminder to embrace and also to transcend the mundane. For the ordained users of shankha in Buddhist and Hindu ritual, and in saltwater cultures around the world, they put the polished shell to their mouths, its shining form an embodiment of the sacred, and its sound calling the divine into presence. The shankha connects us to the universe of the ocean, and the ocean connects us to the origins of all life.

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Humming with Energy

Words **Anusha Shankar** and Pictures **Roshini Pochont**



In June 2015, I went to Ecuador for seven months, to study hummingbirds. The place I worked in, at an elevation of 3000m, was called El Gullan (pronounced el guyaan), after a flowering plant found in that area.

For the first two months I saw rainbows almost every day. El Gullan is on top of a plateau, with a view of a never-ending valley. The vegetation is mostly scrub, rather than dense tropical forest, as you might imagine in Ecuador. A river trickled past, almost dry because it was an El Nino year and the rains were really whacky. There was lots of wind.

On a typical day, my field assistants and I would wake up at 4:30 - 5:00 in the morning, have a little coffee and something to eat and set out to open the mist nets, long lines of very thin nets, strung between poles. So thin are they that birds do not see them, and flying through, get caught. Every 20 minutes one of us would go see if any birds were in the nets. Other birds were simply released, but if a hummingbird was caught we would take it out, put a metal ring with a unique ID number on its leg, measure the length of its wing, leg and bill, and take photos. Sometimes we would collect its pee for analysis and let it go!

We would keep the nets open until around 10.30. By then the birds would be having some down time, and we were able to take some rest too. Our afternoons largely centred around delicious food. Breakfasts of scrambled eggs, omelettes, bread, cereal and juice. Then some time to enter our data

onto a computer, discuss our work and read journal papers, before lunch. With a multinational team, lunches could be as colourful and varied as the hummingbirds. Sometimes I would make something Indian – perhaps a sabji with local vegetables, one guy loved to cook Chinese stir fry, or we would have Ecuadorian food, which is typically rice and beans, sometimes with meat. And whatever the food we'd always have local fruit juice to drink. It's a very Ecuadorian thing to have juice with every meal. Sometimes tomato de arbole – a 'tree tomato', sometimes maracuya, sometimes granadia, all fruits I had never eaten before.

After lunch we would have some time to laze in the sun. Daily temperatures ranged from 0° – 40° C! We would sit outside and bask like lizards on the grass or a bench. Then from 4:00 - 6:30 in the evening we would go out again, hoping to catch a single hummingbird for a 'torpor experiment'. Hummingbirds are able to go into torpor, a state where they shut off their metabolism and lower their body temperature, to get through a period when they are not feeding. We are usually taught that some animals





like reptiles are cold-blooded and others like mammals and birds are warm-blooded. These hummingbirds can be both. We wanted to measure how much energy the bird uses during this torpor period. The night was split into two shifts and somebody would check the bird every hour. We found that almost all species of hummingbird use torpor to save energy at night. The longer a hummingbird uses torpor for, the more energy it saves. We also discovered that rather than just being asleep or being in torpor (which are different things), they can also do all kinds of things in between. Hummingbirds are very flexible in how they use their energy!

What a contrast my life in Ecuador was from my life back in my university in the US. In Stony Brook, I wake up by 9:00am, go to the lab by 10:00am, stay until about 7:00 or 8:00pm, head home and am asleep by midnight. All day, I sit at a computer crunching numbers, writing reports, reading papers and meeting people. My room at the university doesn't even have a window so I have no idea if it is sunny or cloudy, day or night!

I do what I do to understand how animals interact with their environment, and specifically to see how hummingbirds manage their energy needs. During the day, they get energy from the food they eat. But if they do not eat for about two hours, they can die. So they need to be very careful about how they use their energy. Flying and hovering uses up energy really fast, so to do this they need to eat a lot. At night, meanwhile, they can use torpor, to save enough energy to go and find more food in the morning. We are learning that hummingbirds have some really interesting strategies to balance their energetic needs. This has wider implications, because hummingbirds are important pollinators of plants, so understanding how they survive in different environments will help us to predict how they, and their food plants, will fare should the environment change.



Fun Facts

Unlike most other birds that just poop, hummingbirds pee. A LOT. They need to do this because they drink so much nectar, or sugar water from flowers 2 to 3 times their weight every day.

Hummingbirds use up energy so quickly that if an average human used energy as fast as they do, the human would need to eat 600 packets of potato chips a day to survive (when they would normally need about 15).

Hummingbirds are the only birds in the world that can fly backwards, in addition to flying forwards and hovering in one place. Their wings are structured very differently from other birds, allowing them to hover by moving them in a figure-8 pattern.

Hummingbird wings can beat as fast as 80 times a second. Their hearts can beat more than 1000 times a minute. Your heart normally beats about 70 times a minute.

Time must seem very different to hummingbirds, compared to us. Their bodies (especially their heart, wings, and lungs) work so fast that their brains have to send signals for their wings to move backwards when the wings are only just starting to move forwards.

Anusha Shankar is a National Geographic Explorer and a post-doctoral Fellow at the University of Alaska, Fairbanks. For her PhD from Stony Brook University, New York, she studied how American and Ecuadorian hummingbirds manage their limited energy.

Roshini Pochont After realising that her love for words and images could converge in illustration, Roshini made the jump from literature and journalism to study graphic design at the National Institute of Design. She is an illustrator and visual designer with a love for picture books, beautiful imagery, vintage ephemera, and all things handmade.



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