



2018
VOL 12 | ISSUE 4

current conservation

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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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This magazine is produced with support from:



ISSN 0974-0953

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Cover art **Upasana Agarwal**



Cover art **Antara Bhargava**

Conservation science has long been seen as the domain of trained professionals. At CC, we have long acknowledged the role of indigenous knowledge, and published a special issue on the topic in 2013. We engage with this issue by visiting a fascinating project in the Nilgiris, a collaboration between Keystone Foundation, a local NGO and Cornell University, USA. Steven Wolf et al. provide an overview of the project which attempts to integrate research and practice towards conservation and sustainable development. Their article is linked to seven research pieces (online only) written by seven pairs of student researchers including an undergraduate student from Cornell and a young Adivasi community member from the Nilgiris.

Our feature article in this issue takes on the contentious issue of cats. Not so much differences in musical tastes pertaining to Andrew Lloyd Weber's rendition of TS Elliot poems, but the dramatic impact that domestic cats have on biodiversity, and the opposition from cat fanatics to doing anything about it. We include an interview with George Schaller, one of the pioneers of wildlife biology and conservation. Talia Tamson gives us a glimpse into the use of cameras to study whale sharks. And in our creative rambling section, we have a poem delving into a researcher's tryst with turtles; and our columnists wonder what the Half-Earth movement might look like if it were an Avengers movie!

—**Kartik Shanker**

This issue of Current Conservation is all about the unexpected. The surprising. The unpredictable. It reminds us that however much we learn, the natural world can still bamboozle us. Perhaps that is what makes it so wonderful.

We have heard of the extinction crisis. Species are disappearing at a terrifying rate. This makes it all the more exciting when one is re-discovered - after 130 years! Dr Seshadri KS tells about his efforts to uncover the secrets of a frog re-found.

Meanwhile, our other story is also about a re-discovery. The re-discovery of a dinosaur, after decades of searching, in an entirely unexpected place. Join a search-expedition on a journey across the Australian outback, in search of a living fossil.

I hope you enjoy reading these stories as much as we have enjoyed researching them. Let's see if they are what you expect - I guess not...

—**Matthew Creasey**

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Slow Conservation

in the Nilgiris Field Learning Center: an integrative model of education, research, and practice

Author **Steven A. Wolf, Neema Kudva, Anita Varghese, Andrew Willford, Rebecca Stoltzfus, Snehlata Nath, and Pratim Roy**

Illustrator **Jobin Varughese**

Early attempts at environmental conservation, as represented in the environmentalism of the 1960s and early 1970s were shaped by deep ecology arguments for the intrinsic value of nature independent of social and economic utility to humans. These values combined with newly recognised ecological risks to produce so-called “fortress conservation”, strategies premised on excluding people and economic processes from protected areas dedicated to nature conservation. The shift away from this position began in the 1970s as public agencies, donors, activists, and researchers confronted socioeconomic, political, and ethical problems linked to displacement of local people in efforts to arrest deforestation, loss of biodiversity, unsustainable fishing and other resource-extraction practices. The strategies that began to emerge aim to achieve and consolidate conservation gains by promoting secure livelihoods that allow local people to shift away from ecologically unsustainable practices. While there is considerable heterogeneity under this big tent of sustainable development, the relationships between human-centered and nature-centered objectives remain substantially unclear.

We need new approaches to conservation, and we need to reflect critically on experiments underway. At the Nilgiris Field Learning Center (hereafter NFLC), in partnership with the indigenous communities, we cross boundaries of disciplines, cultures, languages, organisations, scales, and the worlds of theory and practice as we pursue our goals. This is a collaborative project of a mid-sized NGO, Keystone Foundation, based in Kotagiri, Nilgiris District, Tamil Nadu, and a large higher education institution, Cornell University, based in Ithaca, New York. Our collaboration aims to create an integrative model of education, research, and practice focused on issues of environmental conservation and sustainable development. The sprawling Nilgiri Biosphere Reserve (NBR)—a global ecological diversity

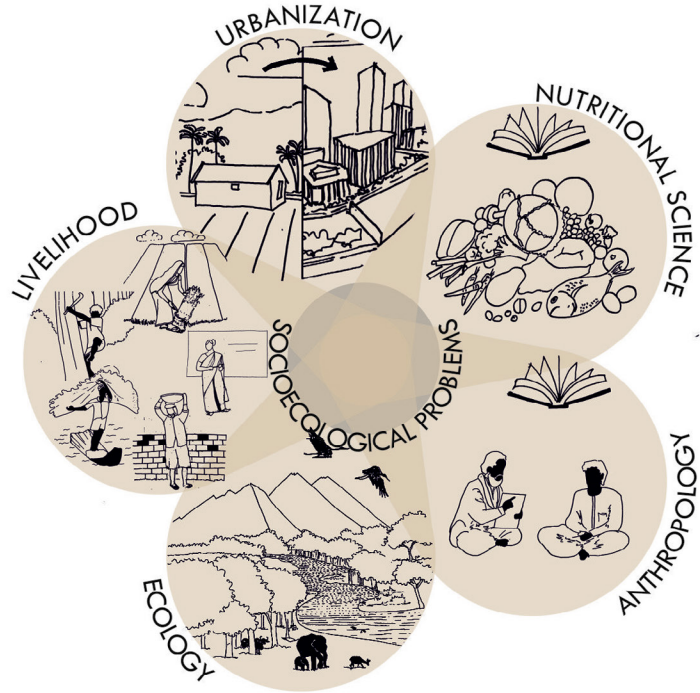
and endemism hotspot—provides an ideal setting for this experiment. It contains a broad range of landscapes from protected areas, wildlife sanctuaries and large tracts of reserve forests to thriving plantation and commercial agriculture, an active tourism industry and a real estate boom fuelled by India's economic growth that is reshaping urbanisation in the hills, including towns like Kotagiri. The NBR also contains a great diversity of cultures and communities including more than 30 adivasi (indigenous) groups who, at about 16 percent of the total NBR population of 1.2 million people, are among the region's poorest and most marginalised. The scale and complexity of challenges and changes we observe in the region provide an ideal setting to develop and test a new model of environmental conservation and sustainable development.

This article lays out a conceptual framework for this boundary pushing experiment. In the e-edition of Current Conservation, this article is linked to seven research briefs by pairs of NFLC student researchers— an undergraduate student from Cornell working with their partner, a young Adivasi community member from the Nilgiris. The NFLC research projects have been operating for more than 5 years. The briefs highlight aspects of the work students did over 15 weeks in spring 2017.

Connecting conservation to development: three approaches

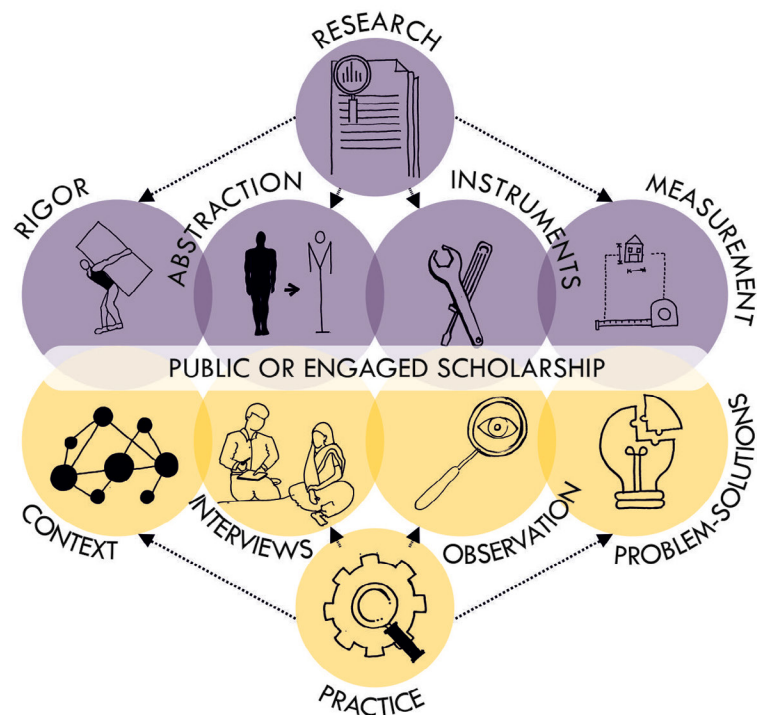
At the scale of the globe and within the Nilgiris, our analyses of biodiversity, forest health, water resources, waste production, and the human welfare implications of environmental change and economic development indicate the urgent need for both environmental conservation and sustainable development. By many measures, historical processes of ecosystem degradation are not just unchecked, they are accelerating. The

BINARIES STRUCTURING SUSTAINABLE DEVELOPMENT DEBATES AND OPPORTUNITIES. OUR TREATMENT HIGHLIGHTS TENSIONS AND COMPLEMENTARITIES.



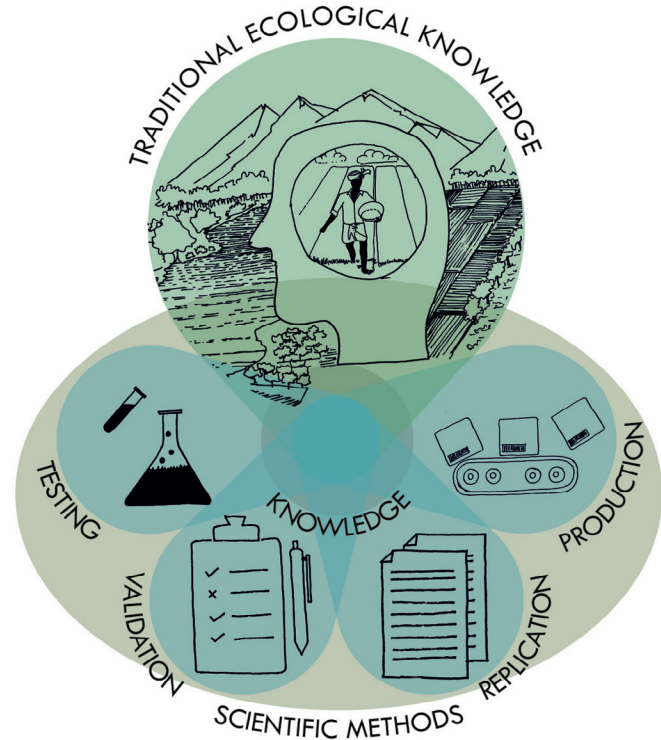
SCIENCE - TRADITIONAL ECOLOGICAL KNOWLEDGE

The NFLC recognizes existence and implications of different knowledge systems and works to address tensions and complementarities between them in the classroom and in research.



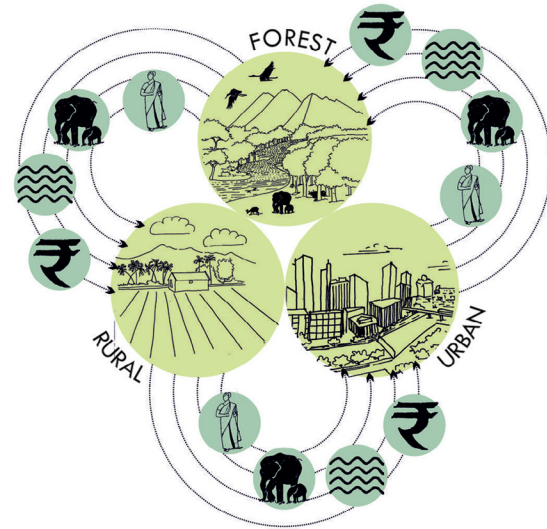
DISCIPLINARY-INTERDISCIPLINARY

Through engagement with complex socioecological problems in a specific region, the NFLC highlights the critical importance of interdisciplinary engagement through disciplinary strengths.



EDUCATION - RESEARCH - PRACTICE

We blur boundaries between education, research, practice in the structure of the curriculum, our pedagogy, and in our commitment to community-engaged action research. The composition of the student body, the teams of instructors, and the research groups reflects this commitment to linking students, scientists, development professionals, and community members.



RURAL - URBAN

We aim to analyze and engage landscapes that encompass many different land uses and very different levels of human population density. Through analysis of flows of water, people, capital, goods and services we blur the distinction between urban, rural and forest to better understand interrelations and dependencies.

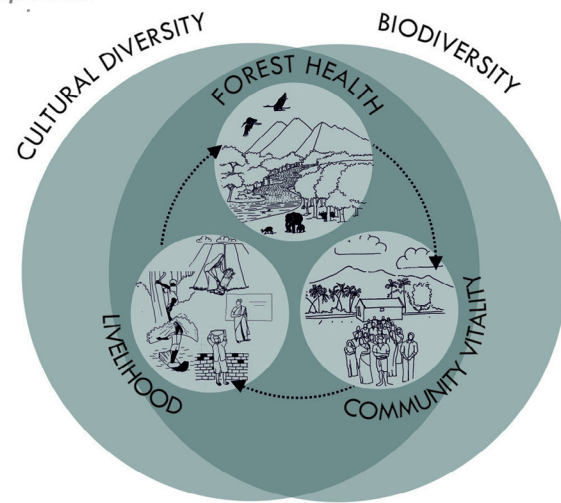
HEALTH OF THE BODY - HEALTH OF THE COMMUNITY

Our approach to health integrates considerations from the natural and social sciences, and we aim to address dynamics at the scales of microbes, families, villages and international relations. Health outcomes derive from connections across domains, scales and species.



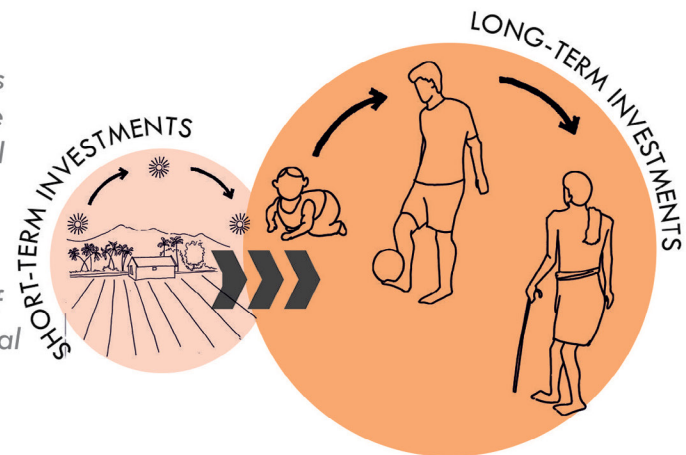
CULTURAL DIVERSITY - BIODIVERSITY

Working in a UNESCO designated NBR, we identify conservation of cultural and biological diversity as moral imperatives, even as we identify their connectedness and instrumental value. Promoting traditional livelihoods can advance forest health while forest health can enhance community vitality and resilience.



SHORT-TERM - LONG-TERM

Change at the NFLC is focused on different communities and takes into consideration varied temporal scales. The educational benefits shape the thinking and professional projects of the Adivasi and Cornell students in an immediate fashion, while impacts on Cornell and Keystone as organizations have started to unfold more recently and have a decadal perspective. At the scale of NBR and analogous large-scale, complex socioecological systems, the contributions of NFLC will play out over a longer time scale. This variation is part of our strategic planning.



Binary	Tensions & Opportunities	Wrestling tensions to the ground in the NFLC
disciplinary – interdisciplinary	Going beyond single academic disciplines is essential for addressing the complex nature of socioecological problems. At the same time disciplinary research can be very productive. Disciplines define problems differently, and use different methods. The friction interdisciplinary produces can be productive and points to the limitations of single perspectives.	By focusing on socioecological relations of a specific region in context—the NBR- we force interdisciplinarity. Each week of the curricular phase is structured along disciplinary topics e.g., ecology, livelihoods, urbanisation, anthropology, nutritional science. When we shift to the research phase, we build on an interdisciplinary perspective on the NBR.
science – traditional ecological knowledge	Knowledge produced through the scientific method, which includes testing, validation, replication of findings and production aimed at developing universally applicable findings has obvious value. However, context-specific assemblages of knowledge and practice though time allow us to understand processes and relations differently. Knowledge pluralism is an important principle and produces, ultimately, better and more valid guidance for planning and action.	At NFLC we emphasise knowledge pluralism by designing exercises that draw out scientific and traditional knowledge perspectives. During field work, projects vary on the extent to which they combine knowledge embedded in community understandings with knowledge generated using methods embedded in a scientific, disciplinary understanding. The nutrition project for instance brings together scientific and traditional knowledge through the use of ethnography and survey methods.
research – practice	Quantitative research methods emphasise rigor and abstraction, while qualitative and ethnographic methods avoid orthodox instruments and quantifiable measurements. In contrast, practice is mediated by context and the need for pragmatic problem-solving approaches. Emerging approaches to public or engaged scholarship blend research and practice in a way that moves us beyond the duality of basic and applied research.	We address the tension between research and practice driven approaches by forming researcher-practitioner pairs of educators. Each week in the curricular phase, and each research project carried out by student researcher is led by a Keystone staff member and a Cornell faculty member who collaborate on structuring their joint-teaching week and in mentoring students during field work.
rural-urban	Flows of people, animals, natural resources, and capital blur distinctions between rural and urban. Analysis and interventions focused at the scale of regions composed of both sparse and dense human settlements offers promise in understanding and addressing challenges posed by rapid socioeconomic and environmental change.	We focus on particular processes to understand the relations of forested, rural and urban systems within a region. Water resources, waste production and human-wildlife interactions represent important examples. To understand and engage negative human-wildlife interactions in urban areas, for instance, we need to understand the forces that change animal behaviour and drive them from forests into rural and urban areas.

Binary	Tensions & Opportunities	Wrestling tensions to the ground in the NFLC
health of the body – health of the community	Public health interventions have tended to focus upon the human body as the unit of intervention and analysis without paying sufficient attention to the mind-body relationship within a broader socioecological behavioural environment. This question is magnified in contexts of rapid social change within small-scale societies, living within, and adapting to, a rapidly shifting socioecological context.	Our approach to addressing health integrates considerations from the level of microbes to the level of national policies of food aid. We focus on understanding nutrition and health issues, for instance, by considering not just behaviours of individuals (mothers for example) but also the ways in which extended family and the community-supports shape interventions and individual decisions.
cultural diversity - biodiversity	While public and private organisations have traditionally identified with naturecentred or humancentred missions, there is now expanding recognition of interdependence between social and ecological diversity and wellbeing. Cultural diversity supports and is symbiotic with biodiversity, given the complex entanglement between cultural and ecological systems. Understanding and sustaining the one necessitates understanding and sustaining the other.	As reflected in the UNESCO Man and the Biosphere programme's designation of the Nilgiris as a special place, social and ecological diversity share a history and a future. Within NFLC we identify conservation of cultural and ecological as distinct moral imperatives, but we also identify their instrumental value. Promoting traditional livelihoods can contribute to forest health. Advancing forest health can advance community vitality and resilience.
short-term – longer term	Time horizons are critical when we seek to understand change – both with positive and detrimental socioecological outcomes. Time is also critical when we consider mentoring and leadership, as well as the relation between community organising and enactment of material change.	By focusing on a pedagogical approach that blurs binaries and boundaries, we focus on educating two groups of future practitioners and researchers. The outcomes of these on conservation and sustainable development will only begin to emerge some years into the future as our Adivasi students move into leadership positions in their communities, and as our American students shape their future careers and lives. Further, it will take some years to understand how the NFLC experiment changes the trajectory of the professional leaders engaged as well as The Keystone Foundation and Cornell University. From small acorns, mighty oaks grow.

cumulative effects of degradation and feedbacks between multiple stressors compound the conservation challenge. The results of existing efforts to mobilise public authority (government), private interests (markets), and collective solidarity (community) to advance conservation are very modest when examined against the scope of the challenge. Against this backdrop, there is a need to think critically, creatively, and pragmatically about conservation and to explore a range of alternatives. Any project of critique and potential reconstruction must encompass both means (i.e. techniques, strategies) and ends (i.e. objectives, goals) of conservation.

Here, we will discuss three popular conservation strategies to highlight interplay between environmental conservation and sustainable development: Payments for Ecosystems Services (PES), Integrated Conservation and Development Projects (ICDP), and the Biodiversity and Community Health initiative (BaCH).

Payments for Ecosystems Services (PES), schemes that provide financial incentives to secure a range of goods and services humans derive from nature, have emerged as a dominant way to talk about conservation. The PES paradigm is strictly anthropocentric. The mechanism and the justification for securing ecosystems lies in the functional value of nature in relation to human security, wellbeing and prosperity. Under the logic of PES, the beneficiaries of healthy ecosystems pay for their conservation. For example, downstream cities pay upstream forested communities to conserve water flows and the landscapes on which these flows depend. Over time, PES has become increasingly integrated with efforts to address poverty, and it is now standard practice to identify these initiatives as “pro-poor” conservation schemes.

Explicit engagement with the economics of conservation is also represented in Integrated Conservation and Development Projects (ICDP). Originating in the 1980s, ICDPs are biodiversity conservation programmes that involve an economic development component. By attending to material needs and livelihoods of local people, these projects seek to restructure linkages between the economic behaviours of local people and the integrity of ecosystems. For example, Keystone

Foundation, a core partner in the NFLC, advances livelihoods, enterprise, and environmental conservation through a programme of adding value and retail marketing of non-timber forest products including honey, resin, and spices.

Both PES and ICDP seek to align economic interests of local actors with environmental conservation objectives. These concepts are part of a larger set of ideas in which environmental conservation and socioeconomic wellbeing are pursued as interdependent and mutually reinforcing objectives under the overarching goal of sustainable development. Despite widespread agreement regarding the need for an integrated socioecological approach, we do not have fully developed models to guide investment, interventions and assessment. More importantly, case studies and reviews of PES and ICDP implementation have highlighted problems in terms of effectiveness, efficiency and equity. For example, these interventions often poorly reflect the interests and ambitions of local people, women in particular. Further, these efforts are difficult to sustain after the initial stream of investment from external funders comes to an end, and it is not clear that these place-based efforts can scale up to produce transformative change. Given the experience to date, we lack solid evidence that these models of an integrated approach can deliver ecological conservation and inclusive economic development at different scales and in a full range of contexts.

Our third example of pursuing integrated thinking is represented by the Biodiversity and Community Health (BaCH) initiative, a consortium of leading global organisations dedicated to achieving the goals of biodiversity conservation and food and health security. This group aims to “leverage ... ecosystems and biodiversity as well as knowledge, skills and capabilities of the populations living in close proximity to biological resources.” They place special emphasis on employing bioresources and traditional knowledge in development strategies that explicitly brings in a health and nutrition dimension into the environment-development binary. This expanded focus also opens up issues of community engagement and local control over natural resources in different ways, including highlighting the importance of long term strategies of education and building community awareness of environmental changes and challenges.

These three integrated approaches to conservation highlight a range of binaries – considerations or categories that are traditionally set in an oppositional relationship. The ecology-economy binary receives the most attention, but we must also recognise other categories and boundaries (we list additional binaries that we identify as consequential in Infographic 1). Addressing these contrasting ideals and the relationships between them in specific places and contexts presents opportunities to relax tensions and to develop new ideas and practices. Through our work in the NFLC, we have developed curricula, community-engaged research projects, and ways of working that blur traditional boundaries and advance an encompassing integrated approach to conservation of people and nature. In advancing a next-generation approach to environmental conservation and sustainable development, we identify an opportunity to both broaden conversation and attract new actors, interests, legitimacy, and energy.

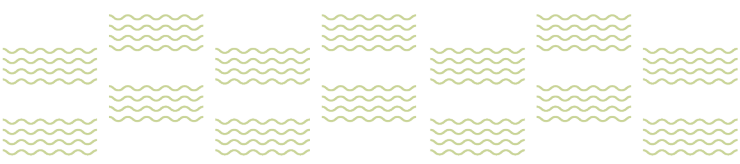
Radical collaboration: towards an ambitious integration for sustainability

The focus of the NFLC is sustainable development through radical collaborations. We pursue integration by focusing on blending and blurring categories identified in the figure above rather than by focusing on any one model that seeks integration across economy, ecology and health. The programme – which is bilingual – is premised on partnerships among Cornell University-based researchers-educators and undergraduate students from across disciplines, Keystone Foundation staff rooted in practice, and Adivasi students from the communities Keystone works with in the Nilgiris. Our ability to bring Adivasi students into these partnerships rests largely on collaboration with the Keystone Foundation and their relationships with 12 tribal groups, who make their livelihoods through a combination of strategies that include subsistence agriculture, growing small quantities of commercial crops like tea or coffee, wage labour in plantations and other regional industries, and gathering non-timber forest produce such as honey. The NFLC is intentionally structured around the expertise and experience of varied groups to integrate knowledge pluralism, experience, interdisciplinarity and diversity

into every learning interaction. By bringing university students from the global North to Kotagiri to live, study and conduct field research with tribal peers from the Nilgiris, we invite and structure cultural collisions that present opportunities for fundamental reflections on what constitutes valid knowledge, the fluidity of cultural norms, and the range of social and ecological interactions that structure opportunities and constraints to conservation.

The multidimensional conception of conservation represented by the NFLC is illustrated by the set of seven research briefs published by NFLC students in the online supplement to this issue of Current Conservation. The articles address forest governance, human-wildlife conflict, sanitation, water resource management, nutrition, health and healthcare in the Nilgiris Biosphere Reserve. In terms of research, the attention to ecological and socioeconomic concerns points to the integrated approach to analysis and development we seek to advance within the NFLC. In terms of pedagogy, bringing undergraduate research to publication – both Cornell and Keystone students’ – in a manner tightly linked to an educational programme is, itself, an example of crossing boundaries.

Are we succeeding in our efforts? Going by measures tracking learning outcomes for students in the short-term, yes. We track changes in student behaviour and attitudes as well as proficiency, skill and knowledge acquisition at the end of their 15 week programme in Kotagiri. The results, and the numbers of our Cornell students pursuing Honor’s Thesis when they return to Ithaca, make us cautiously optimistic that our curricular innovations are producing positive results for students interested in sustainable development. Our ability to recruit Cornell students to join the programme on a consistent basis remains an open question. The NFLC has a reputation on campus for being a rewarding but intense and demanding experience, and many students who seek to study abroad may be attracted to looser, less ambitious programmes. The Tribal Advisory Council convened by Keystone continues to support the programme enthusiastically, and the NGO partners at NFLC note two significant organisational impacts: they have moved into new programme areas in community health and human-wildlife interactions to further their



goals of eco-development. They are also able to partner with and absorb talented Adivasi students into their work, even as they note being stretched in ways they had not anticipated. Progress on the collaborative research projects between Cornell faculty and Keystone staff, however, remains uneven due to a number of reasons including lack of faculty and staff time, difficulties in raising money to support collaborative research embedded in communities, and the challenges of combining the norms of scientific research with the practical demands of delivering support to communities. Our successes at creating an integrative model of learning and action that blurs boundaries allows us to remain optimistic, even as we continue to experiment in efforts to combine our strengths to develop pragmatic responses to the challenges of ecological conservation and sustainable development in the Nilgiris.

We acknowledge the valuable contributions of reviewers and editors supporting Current Conservation, and we thank Anna Callahan and Brian Hutchinson for editorial assistance at Cornell University. We want to recognise contributions of Paige Wagar of Cornell University and Vijayan, a NFLC student who lives in the Sathyamangalam region.

Steven Wolf teaches and conducts research on political economy of environment at Cornell University. Together with his Finnish wife he is raising two kids and working hard to keep one eye on socioecological problems and the other one on opportunities for enchantment.

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Anita Varghese is deputy-director at Keystone Foundation and is trained in forest ecology. Her interests are in plant ecology, sustainable harvesting of forest products, endangered species, traditional ecological knowledge and forest management.

Andrew Willford is Professor of Anthropology at Cornell University. His research has focused on ethnic identity, the politics of development, and mental health in Malaysia and India. His publications include *Tamils and the Haunting of Justice: History and Recognition in Malaysia's Plantations* (2014)

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Snehlata Nath is one of the founder directors of Keystone Foundation and is trained in development economics. Her interests are in non-timber forest products, agrobiodiversity, indigenous people's issues, and community well-being. She works with several field based organisations across South and South East Asia on issues of forest-based livelihoods.

Pratim Roy is one of the founder directors of Keystone Foundation, and is trained in ecology and environmental diplomacy. He is interested in bees, water, wetlands, advocacy, and the politics of environmental change. His vision of a collaboration with Cornell University has resulted in the Nilgiris Field Learning Center.

Jobin Varghese is a PhD scholar at IISER-Tirupati, figuring out the 'hows' and 'wheres' of bird movements in Western Ghats. He illustrates to preserve his sanity.



feature

A Looming Cat-tastrophe

Author Caitlin Kight | Illustrator Upasana Agarwal

Deadly or dear?

What do you see when you look at a house cat? A cuddly, if sometimes roguish or aloof, companion? A skilled and efficient hunter? Perhaps a little bit of both?

Your answer to this question will place you on one side or the other of a growing divide—and billions of lives hang in the balance. These are the lives of the prey—small mammals, birds, reptiles, and even invertebrates—that domestic cats hunt, kill, and sometimes consume each year. They are also the lives of the cats themselves, whether they are mostly indoor pets taking only the occasional stroll outside, semi-feral animals receiving some human support while living in colonies, or completely feral felines dependent only on themselves.

For over a century, naturalists have worried about the potential impacts of domestic cats on native wildlife, and their fears have only grown as improvements in technology have allowed researchers to paint an ever more detailed picture of house cat hunting behaviour. Despite the increasingly damning evidence that our feline friends are slaughtering an unsustainable number of native animals, pro-cat advocates have repeatedly lobbied against efforts designed to protect wildlife by minimizing the ability of house cats to interact with these animals—even where this mitigation involves relatively gentle measures such as mandatory pet registration and cat curfews. Conversations about potential management solutions have been strained, even violent; in at least one case, the discussion led to death threats against researchers who pointed out the harm that cats can do.

Cats, then, are seen by some not only as more important than wildlife, but even more important than humans. How did we get here—and where should we go next?

The ecology of cats

It is hard to know exactly how many domestic cats exist in the world, but researchers estimate there are approximately 600 million, of which maybe a quarter are ferals—cats that are not deliberately supported in any way by humans. Feral individuals are, by necessity, free-roaming, but they are by no means the only domestic cats with an opportunity to explore the habitat and predate native wildlife. Many pet felines, such as the traditional 'barn cat', are only loosely affiliated with their owners, and may spend significant proportions of their time outdoors. Likewise, even the cats that spend the majority of their time indoors may be let outside occasionally. A recent study examining both rural and urban households in Australia revealed that only about a tenth of cat owners entirely restrict their pets to an indoor lifestyle. Although practices likely vary according to location and owner demographics, this figure can be used to estimate that approximately 405 million owned cats, plus 150 million feral cats—for a grand total of 555 million cats—are in a position to hunt and kill native wildlife globally.

Because we humans love our cats—and because we typically spend time with them when they're at their sweetest and most innocent—it's hard to admit that they are just as good, if not better, at killing as they are at cuddling.



While domestic cats are not native, many, if not most, of their prey items are, and this contrast is particularly galling to conservationists because it seems like a given that indigenous wildlife should be valued over a species that has been introduced. Many of the animals that cats hunt are not commonly thought of as particularly exciting or charismatic (think voles or skinks, for example), but they all play an important role in their local ecosystem. Reducing their numbers or removing them completely can, among other things, alter the dynamics of food webs, change the ways and extent to which diseases spread through populations, and influence habitat structure by impacting seed dispersal.

The negative impact of cats is particularly obvious on islands, where feline predation has wiped out endemic species (those not found elsewhere) or, at the very least, contributed to their status as ‘threatened’. Particularly well known is the example of the Lyall’s, or Stephens Island, wren, the focus of the first chapter of Pete Marra’s and Chris Santella’s book *Cat Wars* (reviewed elsewhere in this issue). Lyall’s wrens were ‘discovered’ after a free-ranging pet cat began bringing them home from hunting trips; shortly after the wren was identified as a new species, it was extinct. Although this species was already in a vulnerable position, experts agree that cats drove the final nail in its coffin—and this is not an isolated occurrence. More recently, for example, camera traps have captured footage of cats attacking and killing Hawaiian petrels (also known as ‘ua’u) at their burrows. This species is an endangered endemic that could easily suffer the same fate as the Lyall’s wren in the absence of some sort of intervention.

Island species—birds or otherwise—are especially vulnerable to cats for a variety of reasons. For one thing, many islands to which felines have been introduced do not have any similar native predators; this means that potential prey may not be naturally wary of cats or have sufficient defences or escape mechanisms (ground nesting, as seen in the Hawaiian petrel, is a huge risk factor). For another, resources on islands are finite, and therefore may support much lower numbers to begin with; a good feline hunter might work its way through an entire population fairly quickly, especially if (in the case of non-endemic species) it is not regularly replenished by new individuals from the mainland. Of course, the size of the cat population is also important to consider. Cats are quick breeders; a female reaches sexual maturity in as few as five months and can produce a new litter (of anywhere from two to five kittens) every four months or so. Before long, one or two cats can become a dozen, and a dozen can become a hundred. Even if each of those hunters only takes down a single wild animal a day, the cumulative effects would quickly become untenable, especially for populations that are small, isolated, and/or already struggling in the face of other threats such as chemical pollution or—as in the case of Lyall’s wren—habitat loss.

A growing catalogue of casualties

The effects of cat predation have been somewhat easier to observe and record on islands than on the mainland, where researchers have had to do a fair amount of extrapolating in order to estimate just exactly how many wild animals—and of which species—are being hunted by domestic cats each year. Although ornithologists have been sounding the alarm since at least the early 20th century, most formal studies of cat predation have been conducted only since the 1980s, as conservationists have become increasingly panicked.

One of the reasons so many scientists have revisited this issue is that the tallies of cat-caused casualties are staggeringly high, causing researchers and the public alike to ask, ‘could that be right?’. Yet, no matter who performs the study or what region is examined, the results say the same thing: free-ranging cats kill astronomical numbers of wildlife. One of the earliest systematic analyses calculated that just in the rural portion of the US state of Wisconsin, there were approximately 1.4–2 million domestic cats that were, collectively, responsible for the deaths of some 7.8 million birds each year. More recently, a study conducted in the UK estimated that some 9 million British cats preyed on anywhere

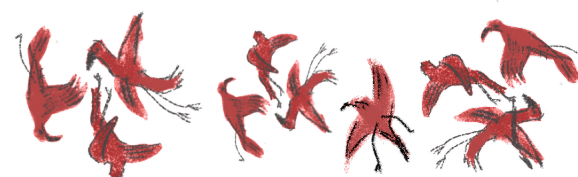
from 52–63 million mammals, 25–29 million birds, and 4–6 million reptiles annually. Just this year, researchers found that Australian cats preyed on approximately 466 million reptiles annually – in addition to the 377 million birds they’d previously been found to kill.

Over the past several years, scientists have made use of a wider range of techniques, including trail cameras, cameras affixed to cats’ collars, GPS tracking, dissection of scat samples and dead felines, and analysis of footprint patterns, just to name a few. All evidence suggests that if the resulting tallies are incorrect, it is only because they are too conservative and actually underestimate the damage that domestic cats are doing each year. This indicates that we can be pretty confident in saying that annual cat kills are well into the tens, if not hundreds, of billions. Cats are known to have contributed to at least 8% of all reptile, bird, and mammal extinctions and approximately 10% of the population declines of all critically endangered animals in these three groups.

Medical consequences

Predation is not the only negative effect of free-ranging cats. While they are out and about in the habitat, domestic felines are exposed to a range of diseases that they can spread to each other, to wildlife, and to humans. Examples include fleas, ear mites, hookworms, roundworms, rabies, avian flu, feline leukaemia, and toxoplasmosis—the last of which can be particularly devastating in pregnant women, and has recently been linked to, among a host of other more flu-like symptoms, a range of behavioural and psychological problems. When infected cats defecate outdoors, the microorganisms they are voiding can enter the water, which not only reduces water quality and places a greater burden on the sanitation process, but also puts wildlife in harm’s way. For example, Hawaiian monk seals exposed to runoff contaminated by cat waste suffer a higher incidence of infection by the protozoan that causes toxoplasmosis—leading to their deaths.

As if it weren’t bad enough that humans and wildlife can contract diseases that are at best unpleasant and are at worst deadly, the cats themselves also suffer. Free-ranging cats have been found to carry higher parasite loads and be infected by more communicable diseases than indoor-only cats. This is one of several reasons why outdoor cats are not only less healthy, but also have shorter lifespans than their indoor counterparts. Truly feral cats may only live a few years (assuming they make it past kittenhood, which most do not) and barn





cats may only last a couple years longer; on the other hand, fully indoor cats—protected from hazards such as cars, bad weather, fights with wild animals and other cats defending territories, and the vast majority of diseases—may live well over two decades.

The difficulty of ferals

This discrepancy in lifespan and quality of life is one of the main points that has been emphasised by the activists who argue against allowing cats to roam freely throughout the habitat. Though their message often falls on deaf ears, these crusaders repeatedly point out that we are not really doing felines that big of a favour by granting them their ‘freedom’. The truth is that the vast majority of wild domestic cats lead lives that most cat owners would be heartbroken to imagine for their beloved pets. This is particularly true of ferals, which have the most difficult lives of all, as evidenced by their thin bodies, torn ears, ragged fur, and scarred faces. Whether they live in rural or urban environments, feral cats have to work hard to obtain and defend every scrap of food and sheltered sleeping spot.

Some ferals are looked after (at least partially) by caretakers who devote significant amounts of money, time, and effort to caring for the cats. Some eventually open cat sanctuaries, large-scale rescue operations that remove feral cats from colonies and relocate them to facilities offering safety and regular care in perpetuity. Cat sanctuaries sound like a perfect solution until you factor in the huge expense required, as well as the incredible amount of space that would be needed to accommodate every feral cat currently in existence.

Another appealing alternative is trap-neuter-release, which aims to curtail the growth of existing colonies and more free-ranging feral populations by rendering the cats unable to create kittens. Unfortunately, this method fails to reduce either the cats’ hunting of native wildlife or their ability to spread disease. Further, it assumes that new feral cats won’t appear through other means – by running away from home, for example, or by the all-too-common occurrence of being abandoned by owners that no longer want a pet.

In Australia, where feral cat populations have had a devastating effect on rural wildlife in particular, officials have taken more drastic steps. After years of not just permitting, but also encouraging, hunters to kill feral felines, the government has more recently begun using tailored poisons that target cats and euthanise them quickly and painlessly. Both techniques have drawn backlash from animal lovers who consider

Although the exact origins of the human-cat relationship are unknown, a series of genetic analyses over the past few years, coupled with archaeological data, have helped scientists narrow down the window during which cat domestication occurred.

House cats (*Felis silvestris catus*) are descended from wildcats (*Felis silvestris*), which can be split into five distinct subspecies that inhabit different geographical regions. By comparing the DNA of domestic felines with that of their wild cousins, researchers have shown that the domestication process began approximately 10,000 years ago and involved *Felis silvestris lybica*, the African or Near Eastern wildcat. True to its name, this species inhabits (and also inhabited, at the time of domestication) northern Africa and the Levant, or Fertile Crescent region.

It was in the latter part of its range that the wildcat probably took the first steps that would lead to its eventual entronement in the human home. During the Neolithic period, the increasing human mastery of agriculture led to more permanent settlements, complete with grain stores and trash heaps. As they do today, these features attracted rodents, and rodents attracted cats.

To anyone familiar with the feline disposition, it probably does not come as a surprise that experts think that cats, in deciding to tolerate our proximity in order to have easier access to mice and the occasional scrap, essentially chose to domesticate themselves. The genetic evidence suggests that this process took hundreds, if not thousands, of years. Archaeologists found a 9,500-year-old gravesite in Cypress containing a cat alongside its human, and Egyptian art from approximately 3,600 years ago clearly depicts cats that are not just near homes but living within them as a part of the family.

However, this should not be taken to mean that the domestication process was ‘complete’ by this time. Both genetic and archaeological evidence suggest that cats spread outwards from the Fertile Crescent as people did, following the same routes as migrants and trade goods—perhaps as beloved pets that were deliberately transported, perhaps as hitchhikers, but more likely a bit of both. In more remote areas, such as the Far East, isolated pockets of immigrant cats interbred in seclusion, driving the development of unique physical traits (picture Siamese and Burmese cats) not observed in pet felines elsewhere. That said, most domestic cats looked remarkably similar to their striped, or ‘mackerel’-patterned, wildcat forbears until the late Middle Ages, when the ‘blotched’, or ‘tabby’ pelage emerged. Fur characteristics—such as colour, patterning, and length—are some of the only traits, aside from (depending on the cat) friendliness to humans, that obviously differ between wild and domestic cats.

these methods inhumane. However, conservationists suggested these measures not just for the purpose of preserving wildlife, but also to bring a humane end to the feral cats' hardscrabble lives. Although animal welfare is of critical importance to people on both sides of the debate, there are different views of which animals should be prioritised, and how those species can best be managed compassionately and responsibly.

Australian scientists have also investigated support for additional measures such as mandatory registration of pet cats, cat curfews, and outright bans on domestic felines in habitats that are home to sensitive wildlife. Support for these varies according to the demographics of the people being surveyed—gender and location were particularly influential features—but are, overall, surprisingly high. These methods could possibly gain traction in other countries, as well, though, as many researchers have noted, Australians have a more pragmatic and proactive response to wildlife management than is currently found elsewhere.

Seeking a solution

Because we humans love our cats—and because we typically spend time with them when they're at their sweetest and most innocent—it's hard to admit that they are just as good, if not better, at killing as they are at cuddling. When we hear their plaintive meows as they look longingly out the door, it can be extremely difficult to refrain from letting them out. However, the research overwhelmingly shows that we should not turn that knob and let them loose—not if we value our wildlife, or our felines' health, or our own. Instead, we should invest in toys, cat-scratchers, climbing towers, a leash to take them on walks, even 'cacios' (fully enclosed patios that allow cats to be 'outside' without being able to range far and wide). And if, for some reason, we cannot continue to live with our pets, we should never simply release them into the wild; those that manage to survive by fending for themselves will likely live short, unpleasant lives during which they kill native wildlife.

It's more difficult to decide what to do about the cats that are already living wild under their own auspices. Trapping them all would take significant time and effort, and while euthanising them may be kinder in the long run, it will never be an attractive option even for the most conservation-minded of people. More governments may begin to follow the Australian model and pursue this option, but places like the UK and the US aren't yet ready to take this step. There, researchers are threatened and smeared simply for discussing the facts and requesting a dialogue; in the UK, even the Royal Society for the Protection of Birds (RSPB) refuses to publicly admit that cats are a problem, despite ample evidence to the contrary.

Maybe the first step, then, is simply to establish civil discourse—to move beyond suspicion and insults and emotions and instead focus on the cold, hard data. Perhaps then, key stakeholders could finally meet at the table and agree that we need to do something. Once they have achieved that, they would be on firmer footing for having the much more challenging conversation about what, exactly, should be done to avert the 'cat-astrophe' before it is too late.

Caitlin Kight is an educator, communicator, and scientist. She is the author of the natural history book *Flamingo* and tweets as @specialagentCK.

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The Life and Times of an intrepid biologist:

An interview with George Schaller

Author **Vrushal Pendharkar** | Illustrator **Maanvi Gupta**

Q). What are your most striking memories from your time in Kanha?

My wife Kay, two very young sons, and I lived for over a year in Kanha at the edge of a beautiful maidan in a bungalow which the government of Madhya Pradesh had generously allowed us to use. There we could observe chital, blackbuck, gaur and other species, and at times a tiger passed by our bungalow. I had learned to recognize the resident tigers individually by the stripe pattern on their face, and every meeting with an old 'friend' added data and pleasure to the project.

Q). How and why did you decide to work in India?

I had completed a mountain gorilla project in the Congo. The Johns Hopkins Center for Medical Research and Training, based in Baltimore and Calcutta, had an ecological unit which they asked me to join, and from late 1963 to 1965 we moved to India. Having read many shikar books about India, I was eager to actually study the actual lives of the various species.

Q). Could you share a couple of your experiences that have left an imprint on you from your time in the field?

Animals tend to be shy because people have made them afraid. I treasure experiences in which animals accept my presence without fear. Meeting a mountain gorilla group day after day, the animals accepted me to such an extent that I could sleep near them while they were on their nests at night and one day a female climbed a tree, which I had ascended to observe them better, to sit beside me on a branch. Earlier this year, I was in Argentina where on a ranch a group of capybara, the world's largest rodents, an animal weighing 100 pounds, surrounded me within touching distance as I reclined among them. Such instances lift the spirit.

Q). Was conservation always the motivation for your research or did it come about later in life?

I enjoy watching animals, to delve into their lives. My early studies on gorillas, tigers, and lions were mostly in national parks where they and their habitats were fairly well protected. But even in the 1960s, I became well aware of the conflicting demands of conservation, development, and the livelihood of local people. In recent decades, I have focused more on species and conservation issues both inside and outside of reserves, on whole landscapes. Solid scientific information is essential to protect and manage a species or area on a long-term basis. Without good information, government departments may act out of ignorance or political expediency pass regulations and laws which actually harm the environment. One of my aims in recent years has been to offer data to governments on specific issues that may help them in making decisions.



Q). I am sure there isn't one solution but what would be your blueprint for conservation?

Mahatma Gandhi had two precepts that need to be in every blueprint for conservation:

- a) "There is enough in the world for everyone's need but not enough for everyone's greed."
- b) "You have to be the change you want to see in the world."

The world's religious community has been surprisingly negligent in promoting conservation. Every imam, minister, monk, and other should constantly emphasise that the ecological crisis is a moral issue, that all species have a right to exist, that the earth has limits which are being reached. The religion which is most explicit about conservation is Buddhism: "Kindness to all living beings is the true religion." The Bhagavad Gita says "conserve or perish", the Quran notes "Allah loveth not wasters"; the philosopher Lao Tzu wrote in the 5th Century BCE that "the world is a sacred vessel not made to be altered by man." And then there is the ominous statement in Genesis of the Christian Bible: "...replenish the earth and subdue it, and have dominion...over every living thing that moveth upon the earth." The various faiths best become partners and vigorously promote the survival of humanity and all living beings on this small and fragile planet. There is a constant battle between Shiva the destroyer and Vishnu the preserver. It is up to the vision and heart of every person to decide who will win. Equally negligent in promoting conservation have been the media, the newspapers, magazines, radio, TV, or social network. The average Indian newspaper has several pages of cricket but no news about the environment. Worldwide, newspapers say little about the environment, whether we talk of small-town newspapers or the New York Times. Every newspaper, for example, should have at least one page daily on the environment, both good and bad news, to raise awareness about the beauty of the land and its problems and to arouse compassion and respect for animals and plants. The word 'ecology' comes from Greek and means the study of our home, not just our surroundings but our inner home, our thinking, expectations, and habits. These must change. The public needs to be more aware about its natural and cultural heritage and not be seduced by proclamations of endless growth, by GDP (which does not measure destruction and the death of nature), as currently promoted in India and the USA. Those who vote must think of the future.

Q). Problems of hunting/poaching are often linked to issues of food security or livelihoods/ sustenance. How do you think developing countries should look at this issue?

Some illegal hunting is simply to make money by a few individuals or organized gangs. A good example is the killing of tigers in India for the trade in traditional medicines, especially to China. It's a matter of law enforcement at all levels, yet in country after country—Cambodia, Laos, Vietnam, Myanmar—the flaming beauty of the tiger has vanished or will soon do so. The days of when the Maharaja of Surguja could brag about having killed 1150 tigers are gone, but India now has fewer than 2000, and with carelessness it could lose those as well. And then there is the mass-killing of the Tibetan antelope or chiru on the Tibetan Plateau in China to which India contributed for years by processing the fine wool of the animal to weave the ultra-fine shahtoosh shawls in Kashmir. The wool of some 300,000 chiru was for years illegally imported into India since the 1980s and knowingly processed before anything was done to halt it. The trade continues at a reduced rate. In the Amazon rainforest in Brazil where I have, in the recent years been working, some

indigenous tribes kill wildlife to eat because there is little other protein. But they, as well as settlers and some missionaries, sell the meat and hides in town to make money, and this makes any management of wildlife resources on a sustained basis impossible. Actually in working with communities one can, as has been shown, regulate hunting and make it sustainable. There are options in offering income, such as paying local people to patrol and protect the land from intruders, local handicraft industry, resettlements with jobs and so forth, depending on the local situation. Whatever is done, government departments, NGOs, scientists, and communities need to collaborate to find solutions. Ultimately, however, no matter what the laws or implementations, it is the communities who will determine their tomorrow by truly working together to protect and manage the health of their land, and in a peaceful manner confront any issue that threatens their environment such as an unnecessary road, dam, timber operation, or other.

Q). How is it to work with different governments? Are politicians/bureaucrats the same across cultures/countries?

Politicians and bureaucrats are much the same everywhere, much concerned about retaining power and not making what might be considered a wrong decision. Few at the highest level of government have great interest in or concern for the environment—Indira Gandhi was an exception—but I have usually found officials in almost every of the 30 or so countries where I have done fieldwork who cared and were supportive. A new generation or two has had ecological training in India, at the Wildlife Institute of India in Dehradun and the Centre of Wildlife Studies at the National Centre of Biological Sciences in Bangalore, or at overseas universities. This has created a core of dedicated and knowledgeable conservationists of great benefit to India. When I visited, for example, the Kaziranga and Pakke national parks in 2017, I was much impressed by the directors and their staffs who not only conduct research but also involve the surrounding communities in conservation, as well as providing them with benefits in the form of a percentage of the park entrance fees paid by tourists. China, where I have worked annually since 1980, has made tremendous progress, training many conservation biologists in the country and abroad, setting up protected areas, and creating management plans for critical areas to reduce ecological impact in cooperation with communities.

One reason I return to countries like India, China, and Brazil year after year is because I see much progress and receive good cooperation. I go into the field with local biologists and graduate students so that we can learn from each other. My main goal, now as always, has been to help the country if possible by collecting information that in some way can be of use to conservation.

Q). When it comes to policy or laws, a country like India has some of the best legal frameworks but dismal implementation. How do you think this affects conservation/protection and what should be rectified?

Governments at all levels everywhere have to decide if they want an environmentally healthy future for their people. An excuse always is a lack of money. But it's a matter of how the available money is spent, the environment being usually of low priority. The public needs to be educated, and that's a job of schools, churches, and other such institutions-- and the media. And then the public must pressure government to change, amend, or implement the laws for the future benefit of everyone, not just corporations and other 'big businesses'

which are all too successful in buying what they want from politicians and bureaucrats. Easier said than done! But be aware of what is happening. Brazil, for instance, is planning to build 304 dams on the rivers of the eastern Amazon, development that will have a huge impact on everything from climate to new roads, settlers, destruction of forests, and others. Of these, 46 dams have already been built. Responses to these plans have been surprisingly muted.

Q). What, according to you, are the most pressing concerns of our times?

The most pressing concern of our times is keeping the earth alive. There is population growth (India's has tripled in the past 50 years or so); pollution (look at the Ganges); fresh water shortages (already a problem in India's northwest); species extinction (cheetah, Javan rhino in India); climate change. Is India planning for the last-named?

Its protected areas are small, and only about 5% of the country has such protection, far less than many other countries some of which have 15% or more. Any water conservation measures planned, any connectivity between critical habitats proposed to enable species to move as nature becomes warmer and more fragmented?

Q). Where do you see the world headed to in the next 50 years?

In the last 50 years we have used up more of the planet's resources than in all previous history. We tend to forget three matters:

Every personal act is also an ecological act with an impact on the environment, whether we drink a cup of tea or send an email. Everything in nature is connected and interrelated, indicating that we can not address anything in isolation. Everything we make, buy, need, and use comes from nature, and at the rate at which we are continuing to destroy things mindlessly makes me wonder if there is intelligent life on earth. So we best not plan the future as in the past, and it's certainly ours to improve or lose all.

Vrushal Pendharkar is a science freelancer. He sometimes writes about food and culture. When not doing that he likes to bird and bake.

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 turtle and I

Author **Madhuri Ramesh and Kartik Shanker**
Illustrator **Sagar Saple**

I wandered lonely 'pon the shore
A windy night with restless seas,
When all at once I saw a score,
A swarm of nesting olive ridleys
Upon the beach, beneath the moon
A lumbering, bumbering turtle typhoon

Whose turtles these are I think I know
I thought they were in Gahirmatha though;
They won't mind me standing here
And watching them nest ungainly and slow...

I tagged a turtle with great care,
It swam away, I know not where;
For so effortlessly it glided,
All its tracks were elided.
Long, long afterward, on a beach
Someone found it, once more within reach.
Upon reading the tag, she wrote to me:
'Tis the turtle that has the measure of the sea.

How do I study thee? Let me count the ways
I track thee to the depth and breadth and height
My telemetry can reach, when you dive out of sight
For the ends of science across the bays.
I follow thee through almost every twist in the maze,
Data columns to be filled in by months and by days
A fierce need, by moon and torch-light
I obsess over thee, and for authorship will fight.

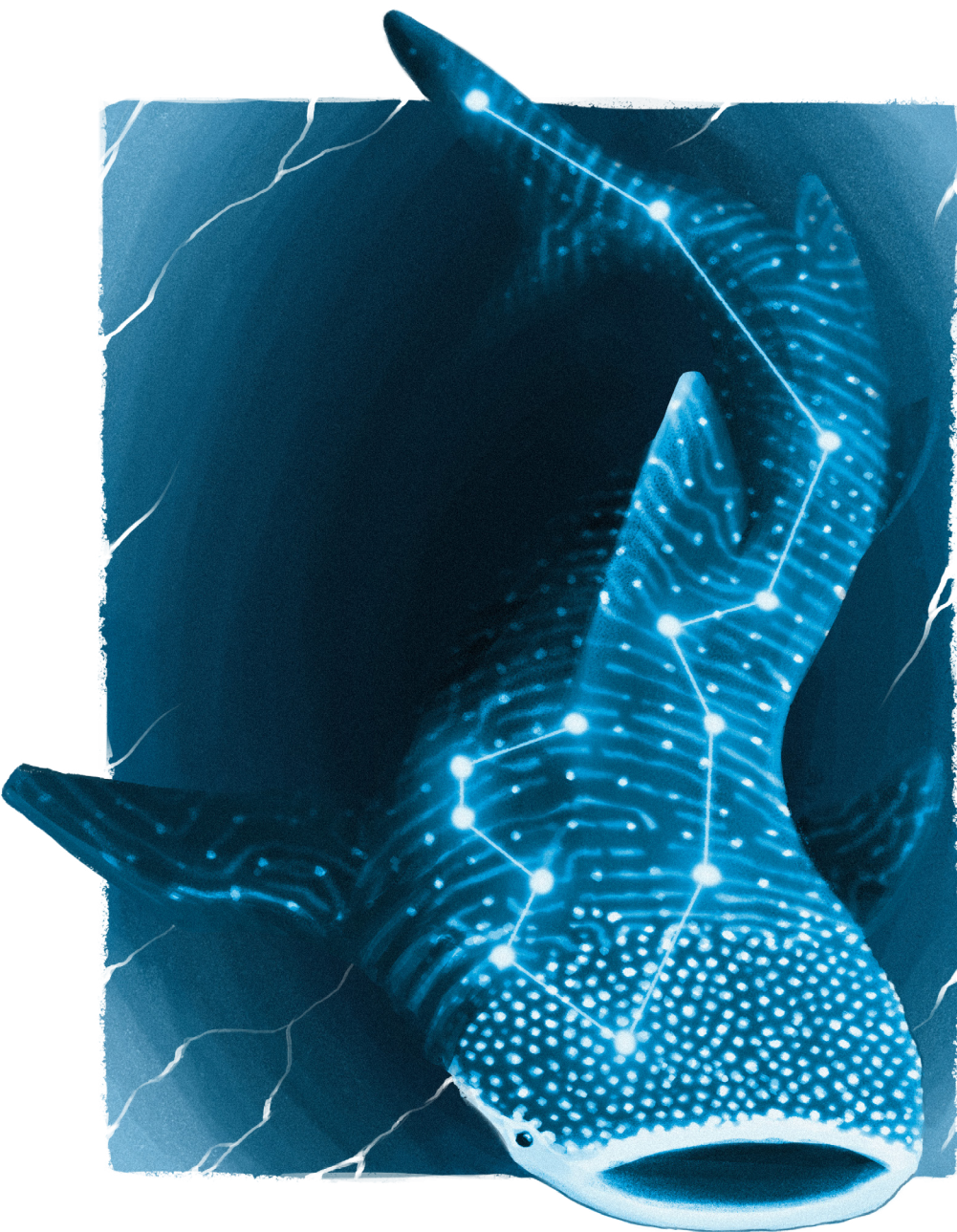
Tonight I can write the saddest lines
Write, for example, "The dogs entered the hatchery
And now my paper on TSD has receded into the distance."
The turtles no longer come ashore and nest.
Tonight I can write the saddest lines.
I watched them every night, and sometimes they watched me too.
Through the months, I collected their eggs carefully, gently
I counted them repeatedly under the starry skies.
They watched me sometimes, and I watched them too.
How could one have foreseen the eggs were all destined to die.

Somewhere I have never travelled, dived beyond
An unimaginable depth, your flippers move in silence:
In your most mundane movements are things which enthrall me
Or which I cannot fathom because my text books fail me.
Your slightest shift will easily confuse me
Though my mind is closed by science, as a clam's
You bewilder always slowly, subtly as an underwater current
(tugging, pulling, carrying) a little hatchling.

Madhuri Ramesh and Kartik Shanker

The authors are biologists who believe poetry sounds better with a smattering of turtle-speak. They would also like to thank the original poets for inspiration: Byron, Noyes, Eliot, Tennyson and Keats for 'Turtle Song' (Issue 11.2); Wordsworth, Frost, Longfellow, Cummings, Barrett Browning and Neruda for this poem.

Vidyasagar Saple is a graphic designer and visual artist based in Mumbai. His dual life allows him to work with a variety of creative fields and constantly explore different mediums. Recent projects include an animated short film for World Monument Fund, branding for a car company and a wall mural.



How cameras are helping whale shark conservation

Author **Talia N Tamason** Illustrator **Adwait Pawar**

Conservation policy depends on biological, ecological and demographic data of a threatened species, which in this case is complicated since little is known about the whale shark to enact worldwide conservation laws. Reliable existing data does not currently exist on whale sharks, which threatens their worldwide conservation status.



Figure 1. Photo-identification of a female whale shark on her right flank

#	SIZE	SEX	PHOTO	MARKING
1	29 ft	Unknown	sarah 2	
2	29 ft	m	sarah 3	
3	28 ft	F	vin 2	boat scars
4	120 ft	—	T1	
5	25 ft	F	sarah 5	
6	26 ft	—	sarah 6	Δ cut on top of C-fin
7	24 ft	M	J1	small cutmark in front of D.F.
8	14 ft	—	S10	pale pink mark on mouth injury?
9	15 ft	F	VM/L Fin Meg	

Figure 2. Photograph of the rough data chart recorded on the boat

In the summer of 2016, I volunteered with a small group of fellow field researchers to collect conservation data on whale sharks in Baja California, Mexico. Our conservation data was collected with cameras, waterproof slates for documentation of data, and measuring tape to measure the length of the whale sharks we encountered. All of our cameras varied in style and price, from a GoPro to a cell phone inside a protective underwater sleeve. We each used our own underwater camera to capture photo-identifications of various whale sharks in the Sea of Cortez. Once a whale shark was spotted near our small fishing boat, a few of us would slowly enter the water and swim towards it. Submissions of photo-identifications have to remain raw images and cannot be zoomed, cropped, edited, or altered in anyway, since it affects the integrity of the data. To capture Figure 1 accurately, I had to swim closely and calmly alongside the whale shark while steadying my camera to record an effective photo-identification. While two of us photographed the shark, another researcher would swim underneath the whale shark to record its sex. We quickly measured the length of that whale shark with measuring tape or against the length of the fishing boat and reassembled on the boat to record our data onto the slate. As Figure 2 highlights, the data collected consisted of sex, length and

any identifiable markings. If a whale shark had noticeable identifiable markings, such as a boat injury to the dorsal fin as seen in Figure 3, this was also photographed as data. Once back on land, we uploaded our data onto a computer and submitted it to Wildbook for Whale Sharks.

Whale sharks (*Rhincodon typus*) are the largest fish in the world, estimated to reach lengths between 35 - 55 feet. The whale shark is a pelagic, migratory species that is found worldwide in tropical waters. They are filter feeders, which means as they swim they suck in water through their large, 5 foot wide mouth and filter out plankton. Whale sharks have around 300 tiny teeth within their mouth, but the purpose of their teeth is still a mystery. The whale shark gives birth to live young, although the average number of pups born in one litter is still relatively unknown. There is little to no information on key aspects of whale shark biology, such as breeding habitats, lifespan, reproductive/growth rates, basic behavior and pup survival rates. Recently, the International Union for Conservation of Nature, IUCN, Red List of Threatened Animals has updated the whale shark conservation status from vulnerable to endangered. Conservation policy depends on biological, ecological and demographic data of a threatened species, which in this case is complicated since little is known

about the whale shark to enact worldwide conservation laws. Reliable existing data does not currently exist on whale sharks, which threatens their worldwide conservation status. To protect the whale shark, more data is currently being collected through the use of cameras.

Cameras capture more than daily moments in our life, they also have emerged as an innovative and important tool in the field of conservation. Cameras are being utilised to capture photo-identifications of whale sharks. Photo-identification is a form of mark-recapture and is used to record an individual animal's natural markings.

Photo-identification only tags the animal by photographing it, not physically restraining and marking it. Photo-identification is also a permanent method since the whale shark's pattern will never change. Mark-recapture studies are possible when an animal can be physically marked and then recaptured and identified, later in the future. This process produces sufficient data that can be used to estimate a species survival rate, migratory pattern and demographic data. Unfortunately, conventional tagging of whale sharks has been relatively unsuccessful. Whale sharks are an optimal species for photo-identification tagging since they are difficult to mark-recapture due to the physical tags falling easily off of them. Whale sharks have their own unique spot patterns behind their gills, similar to a human's fingerprints, and these are the natural markings that are used for photo-identification. In the beginning, the number of photographs for photo-

identifications of whale sharks was fairly small and the photographs of their patterns were only matched by trained professionals through the naked eye. But, as photo-identification photographs from research studies increased across the globe, Australia, Belize, Mexico, and Africa, the number of photographs exceeded the number of "reliable eyes" that could match the patterns. Photo-identification has proven to be an effective application in the conservation management of wildlife population demographics. The largest strength of photo-identification is that it allows researchers to track and monitor wildlife without physically catching and tagging the animal. Even with the slightest form of temporary marking, the process of physically catching an animal can affect the animal's behaviour.

Pattern-matching Algorithm Software System Wildbook for Whale Sharks is a public photo-identification library on whale sharks where people upload their photo-identification photographs. This website boasts a software system that has been developed from an algorithm originally designed for astronomy for star pattern recognition, see Figure 4, to recognise the unique patterns of individual whale shark markings.

A collaboration between whale shark biologists, Ben Norman and Jason Holmberg, and NASA astrophysicists Zaven Arzoumanian and Ed Groth, who created specialised algorithms for the Hubble Space Telescope, created a pattern-matching algorithm software system that compares two lists of coordinates (x, y) that identifies individual points to form a geometric pattern within the spots of the whale shark pattern.

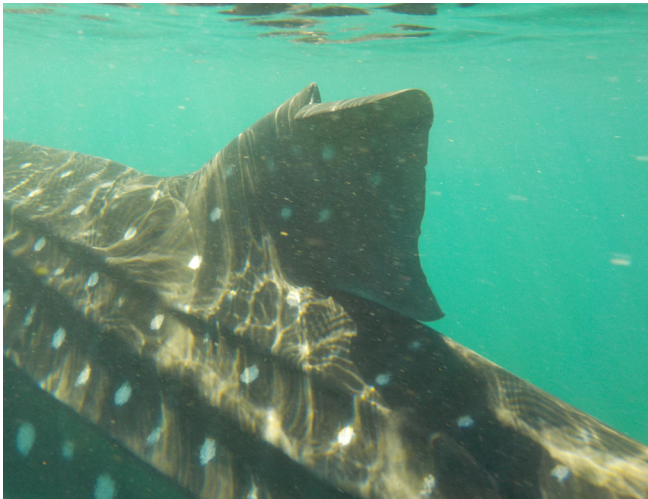


Figure 3. Photograph of an injured dorsal fin

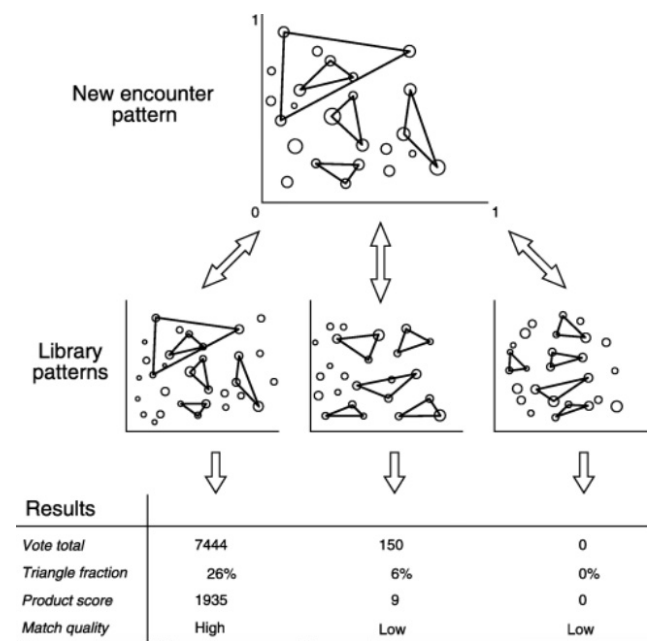


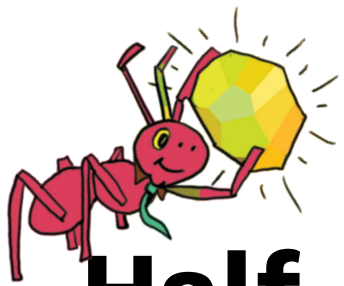
Figure 4. Astronomical pattern comparison algorithm example (from Arzoumanian, Z., Holmberg, J. & Norman, B., 2005).



(I edited this photograph to highlight the spot patterns of the whale shark)

Talia Nicole Tamason has studied and participated in conservation research in Mexico, Australia, Costa Rica, Namibia and Thailand. She currently resides in Chicago, IL as an educator.

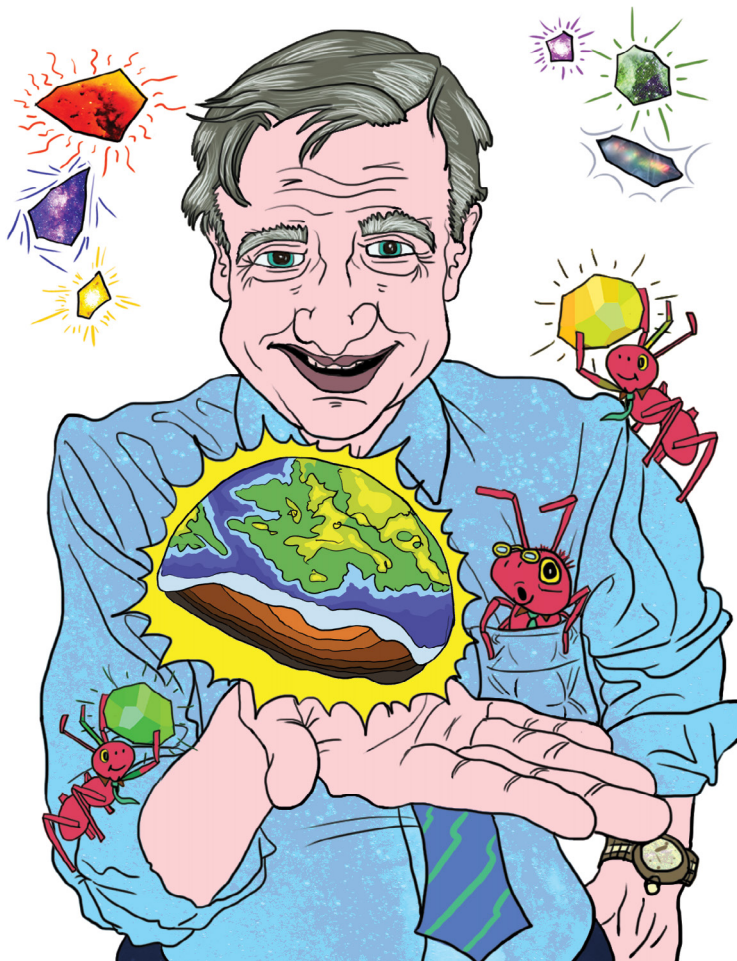
Adwait Pawar is an artist and illustrator based out of Bangalore who is passionate about wildlife, travelling and storytelling. He tries to combine the three as often as he can.



Half-Earth is Half-Hearted

Make way for Thanos and The Half-Universe

Author *Kartel Shockington* | Illustrator *Amit Kaikini*



Megademophobia – fear of overpopulation – has a lot to answer for. Malthus is serious enough, Ehrlich almost as bad. But now there is new problem: Marvel's Infinity Wars. This film spectacularly unites multiple comic book heroes in an orgy of destruction which culminates in the annihilation of precisely half of the people in the Universe (including many of the weirdly abled protagonists). And all this because the Bad-guy-in-chief, Thanos, fears that overpopulation causes too much suffering.

But is this the first time this idea has been circulated? A few years ago, EO Wilson, one of the most prominent biologists of the 20th century, and an evangelist for conservation, came up with the idea of Half-Earth: the notion that half of earth was to be set aside for nature. This is based on the principle that humans are not part of nature, and that for the Earth to be able to preserve its biodiversity and sustain itself, humans had to be removed from one entire half of it.

Despite the similarity of these ideas, we don't think that the Marvel script writers are half-earthers, or that Wilson is a secret Avengers

fan (unless of course of Antman). The filmmakers and conservationists are no doubt independent, original thinkers. No one has copied anyone else.

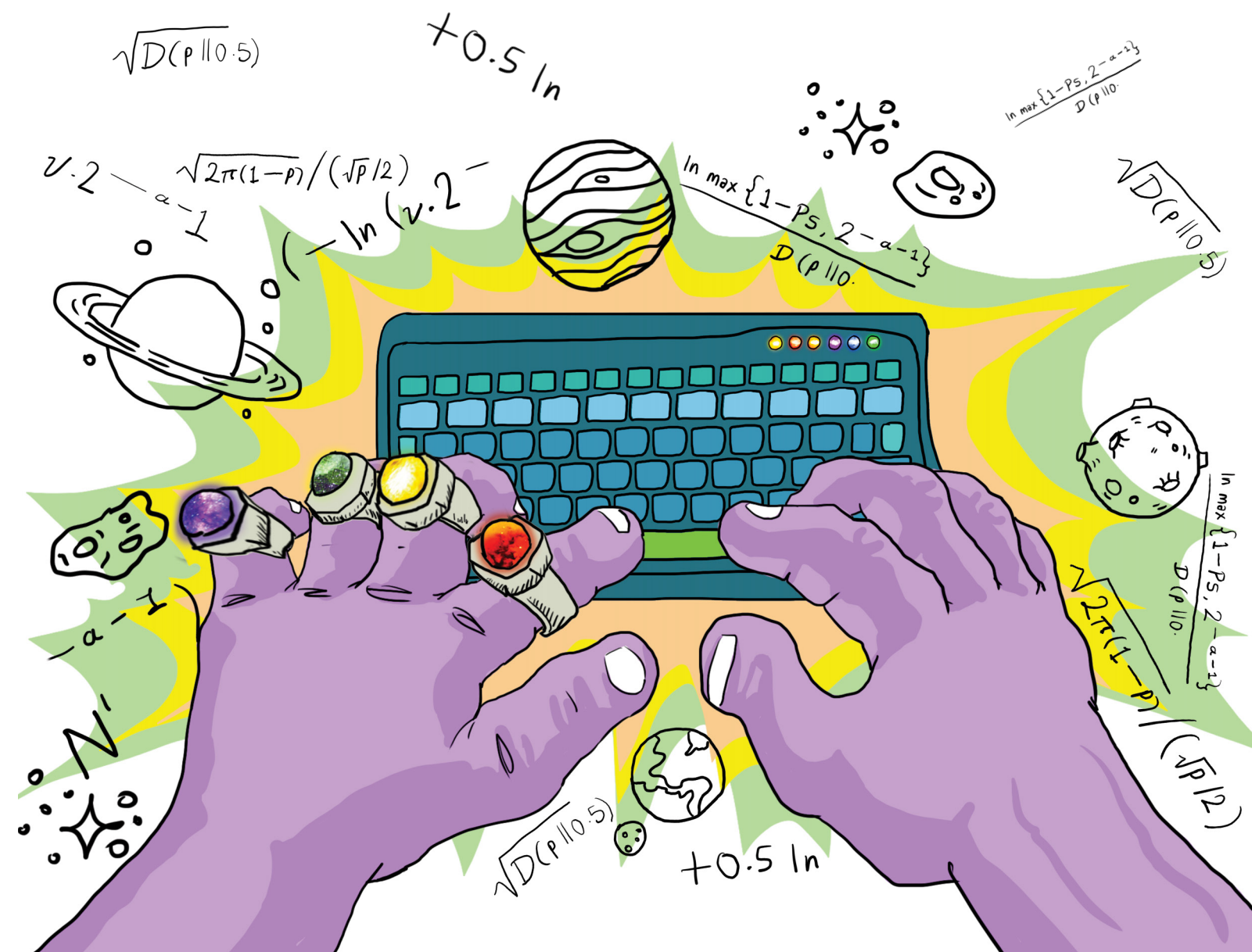
But our views are not so important here. We understand that an irate Half-Earther has been pressing the Half-Earth movement to sue Marvel comics for plagiarism. This is, of course, absurd. First, there is no plagiarism. Second, never pick a fight with Thanos. So we would like the Half-Earth movement to distance itself from such foolishness, and release the following statement:

The Half-Earth movement would like publicly to disassociate itself from any resemblance or comparison with the Marvel film Infinity Wars. Thanos' evil plot to destroy half of all human life, and our own cunning plan, have nothing in common. They share no affinity. Any sane observer could tell that one of these plans is a complete fantasy. It is socially (not to say politically) illiterate. It disregards the

lived fabric of our lives and the role of people in creating life around us. It is only possible to conceive with new advances in computer modelling. No prizes for guessing which one that is.

Just to underline the point further we would like to point out a few of the balmier elements of Thanos' plan compared to our own. Thanos

vapourised a random half of the universe. Our plan will deliberately target the places where poorer people live. It is cheaper to move them. It is politically safer to leave the rich alone. Thanos only appeared to have human interests at heart when he abolished half of life. Our plan is not about people. It will make life better for the richer half of humanity, but, more importantly, it will also



make sure that these people can continue to enjoy the best ecosystem services and the biodiversity that their wealth deserves. Also, Thanos was utterly uncompromising. We are vague and ambiguous when it comes to what sort of life will be possible in the half where people are not around.

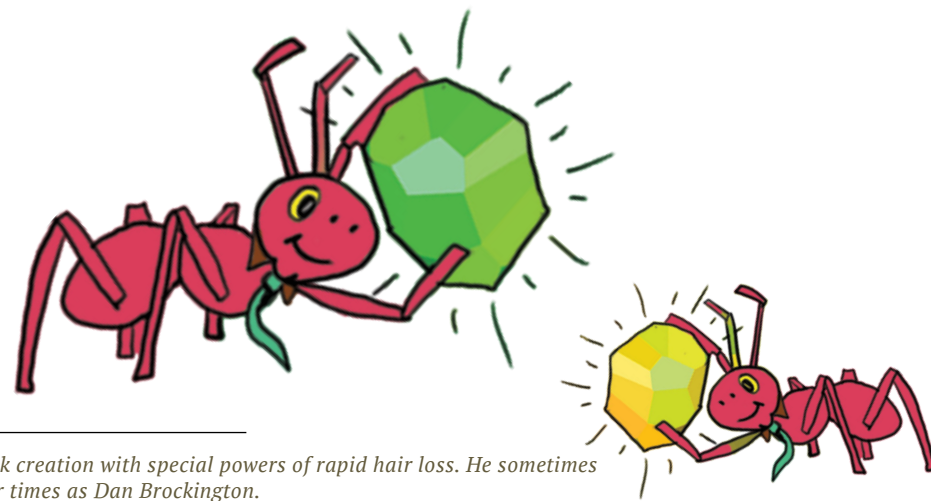
So there is no similarity whatsoever between

Thanos' evil plan for domination and our own hopes to clear the land of people who get in the way of our understanding of nature.

To avoid all possibility of doubt we would also like to point out that none of us cheered at the end of Infinity Wars. We have not named any of our offspring or pets 'Thanos' in appreciation of his achievements. Nor

do we gain any succour from news that an intergalactic message has been intercepted from one Zaphod Beeblebrox to Thanos indicating that, due to a clerical error, the wrong half was destroyed and would he accept a further 25% reduction of life in the Universe, at discounted rates?

We hope that this press release will erase all possibility of confusion and allow the rest of us to get on with the business that matters – halving all known cases of megademophobia.



Kartel Shockington is failed comic book creation with special powers of rapid hair loss. He sometimes appears as Kartik Shanker, and at other times as Dan Brockington.

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THE REDISCOVERY OF AN ANTIQUE THE DINOSAUR ANT

Words **Matthew Creasey** and Pictures **Sreeja Basu**

The searing heat of the Australian outback evaporated into the night and a chill descended, sinking deep into the hollows between the mallee trees which surrounded the impromptu camp. Bob Taylor had itchy feet. Not because of his desert boots (although perhaps that too), but because he was itching to begin his search. In a way it had been over 40 years in the offing and this unplanned delay was trying on the nerves. What he sought was out there, somewhere, in the darkness.

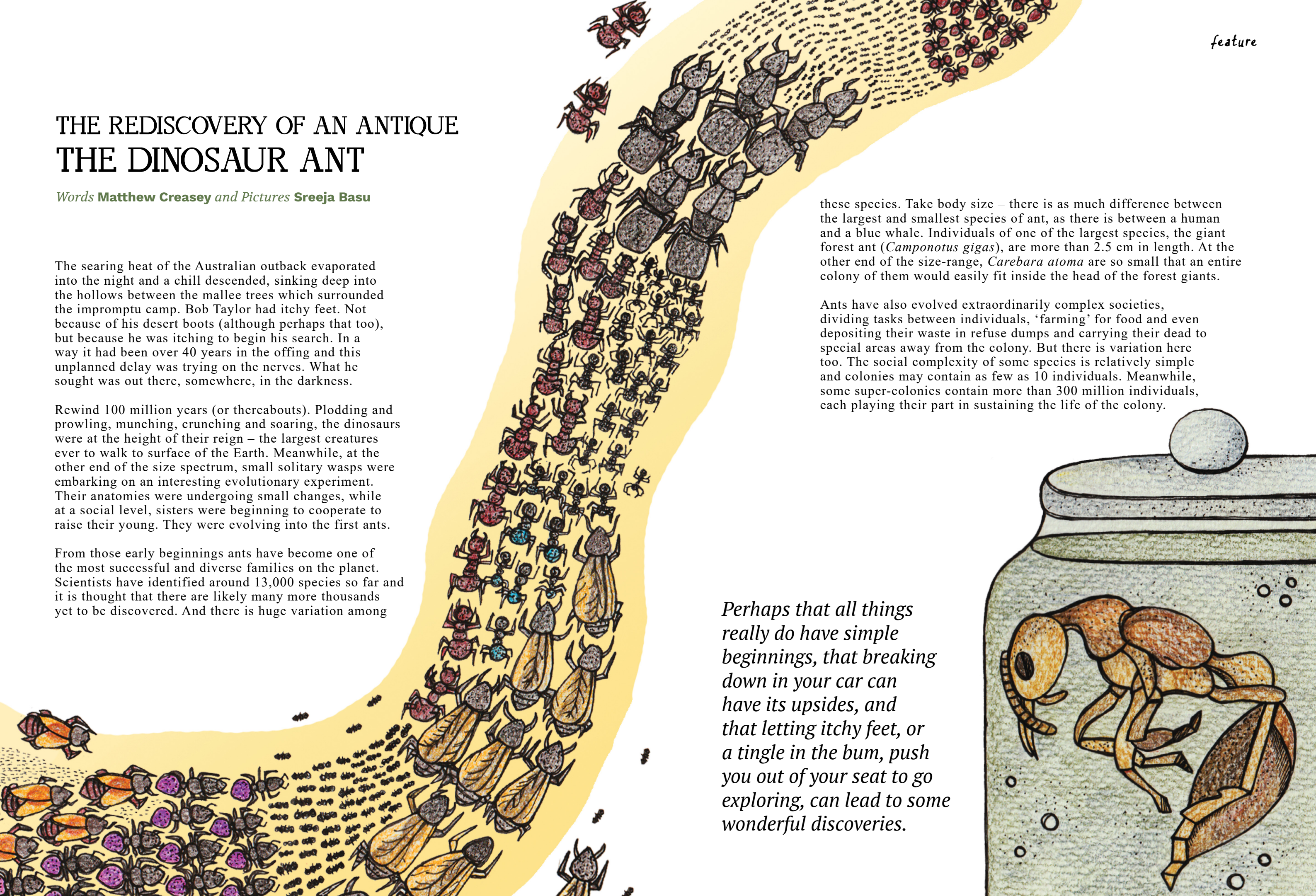
Rewind 100 million years (or thereabouts). Plodding and prowling, munching, crunching and soaring, the dinosaurs were at the height of their reign – the largest creatures ever to walk to surface of the Earth. Meanwhile, at the other end of the size spectrum, small solitary wasps were embarking on an interesting evolutionary experiment. Their anatomies were undergoing small changes, while at a social level, sisters were beginning to cooperate to raise their young. They were evolving into the first ants.

From those early beginnings ants have become one of the most successful and diverse families on the planet. Scientists have identified around 13,000 species so far and it is thought that there are likely many more thousands yet to be discovered. And there is huge variation among

these species. Take body size – there is as much difference between the largest and smallest species of ant, as there is between a human and a blue whale. Individuals of one of the largest species, the giant forest ant (*Camponotus gigas*), are more than 2.5 cm in length. At the other end of the size-range, *Carebara atoma* are so small that an entire colony of them would easily fit inside the head of the forest giants.

Ants have also evolved extraordinarily complex societies, dividing tasks between individuals, ‘farming’ for food and even depositing their waste in refuse dumps and carrying their dead to special areas away from the colony. But there is variation here too. The social complexity of some species is relatively simple and colonies may contain as few as 10 individuals. Meanwhile, some super-colonies contain more than 300 million individuals, each playing their part in sustaining the life of the colony.

Perhaps that all things really do have simple beginnings, that breaking down in your car can have its upsides, and that letting itchy feet, or a tingle in the bum, push you out of your seat to go exploring, can lead to some wonderful discoveries.



But how did such variation and complexity evolve? In biology, it is commonly assumed that complexity must have evolved from simple beginnings. So in the case of ants, it would be predicted that the first species would have relatively small colonies and simple social systems. However, actually showing this is difficult – how do you study species that were around during the time of the dinosaurs? The answer is - find a ‘Dinosaur Ant’...

So back we go to Bob Taylor and his itchy feet. It is 1977 and Professor Taylor, an Australian myrmecologist (ant researcher), was embarking on just such a search – a Dinosaur Ant hunt.

Back in 1931 an expedition across the deserts of Western Australia had brought back two specimens of a previously unknown ant species. These were pickled in alcohol and given to the National Museum of Victoria in Melbourne. Named *Nothomyrmecia macrops*, there they sat for years, before a leading ant specialist finally recognised their importance. Their bodies suggested that they might come from a species very similar to the very first ants. If a living colony could be found, they could be studied and we might learn more about the origins of the multitude of species living today. A number of expeditions went back to the original discovery site, but all failed to find anything. Eventually, rediscovering the Dinosaur Ant became the Holy Grail of myrmecology and Professor Taylor, then chief curator of the Australian National Insect Collection, made it his mission to find The Grail.

An expedition was organised, which would drive from Taylor’s base in Canberra in the far East of Australia, over 3000 kilometres to the original site where the Dinosaur Ant specimens had been found, near Esperance



in Western Australia. However, with over a thousand kilometres still to travel, problems with the vehicles forced the expedition to make camp in an area of bush close to the small town of Poochera. After darkness fell, Bob decided to take a stroll and after only 20 paces, let out a yell (his language of course must be excused – he was very excited, and very Australian!). “The bloody bastard’s here! I’ve got the Notho-bloody-myrmecia”. He had found a Nothomyrmecia worker, wandering up a tree trunk, only yards from where the trucks had broken down. Over subsequent years, it was found that Nothomyrmecia did indeed have small colonies, and a form of sociality much simpler than that seen in many modern species. It seemed that this truly was the Dinosaur Ant – a missing link back to the very first ants to roam the Earth, 100 million years ago. So what can we learn from this? Perhaps that all things really do have simple beginnings, that breaking down in your car can have its upsides, and that letting itchy feet, or a tingle in the bum, push you out of your seat to go exploring, can lead to some wonderful discoveries.

Further Reading

Holldobler, B. and E.O. Wilson. 1994. Journey to the Ants: a story of scientific exploration. Cambridge, MA: Harvard University Press.

Jaisson, P., D. Fresneau, W. R. and A. Lenoir. 1992. Social organization....macrops. Insectes Sociaux 39(4): 425-438.

Li Vigni, I. 2014. PhD Thesis: Interactions between ants and diaspores of flowering plants (myrmecochory) in Sicily (Southern Italy): an important ecosystem function of the Mediterranean basin.

Orr, A. G. and J. K. Charles. 1994. Foraging in the giant forest ant, *Camponotus gigas* (Smith) (Hymenoptera: Formicidae): evidence for temporal and spatial specialization in foraging activity. *Journal of Natural History* 28(4): 861-872.

Taylor, R.W. 1978. Nothomyrmecia macrops: a living-fossil ant rediscovered. *Science*. 201, 979-985.

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A NIGHT IN THE LIFE OF A FROG AND A FROG BIOLOGIST



Funnily, a day in the life of a batrachologist (one who studies frogs) actually begins at night. With the sun going down, the forest is shrouded in darkness and becomes an orchestra of sounds. It was on one such cold night, during the monsoon of 2011, that I encountered a fascinating sight which posed several questions in my mind. I got out of the vehicle and walked along a small trail beside a fast flowing stream, in the remote forests of the Kalakad Mundanthurai Tiger Reserve (KMTR), in Tamil Nadu, India. My headlamp threw a thin beam which sliced through the dark and illuminated the path. I was joined by my colleagues Prashanth M.B. and Dr. Ganesh T. Together we were hoping to spot a species of frog which I had seen in that area: a green frog with golden marks actually inside the eye. This frog, known by the scientific name *Raorchestes chalazodes*, was a re-discovery, not seen in this region for 130 years!

Perhaps the reason it had been ‘lost’ was because of its amazing camouflage. Or perhaps it was something to do with its behaviour. That fateful night I finally spotted the green frog and quickly turned off my light so as not to disturb it. In the dark I got my camera ready and turned the light back on. And behold! The frog was squeezing itself into a stalk of bamboo. It took little over a minute to squiggle into the narrow hole and I and my colleagues were spellbound by the sight. Then the frog began to call from inside. Among frogs, males produce a sound to attract a female. We assumed that the frog must be breeding inside the bamboo. I carefully split open the bamboo and found the male frog sitting with the eggs. Then we found another and yet another such male inside the bamboo clump and all of them were with eggs.



Soon, it was time for dinner. The air was getting cooler by that hour and so was our food. We sat down on the road, took out our packed dinner, comprising cold idly and sambar. As we ate we heard noises in a tree nearby and when we pointed the torch in that direction, we saw a pair of glowing eyes. Excited, we went closer and saw a rare flying squirrel. These squirrels are the size of a cat and glide from one tree to another. While working at night, we often encountered a diversity of wildlife. Some nights we would see large-scaled pit vipers, brown palm civets, mouse deer, leopards or elephants. We would also often startle sleeping birds. Birds do not sleep in nests, but on branches, curling up like a fluffy ball.

I spent the next three years studying the behaviour of *Raorchestes chalazodes*. But how does one observe the behaviour of frogs that breed inside bamboo, without cutting it open? Well, I used an endoscope - a small camera attached to a long wire and a screen. Every night for 6 - 8 months, my colleague Vignesh and I would insert the endoscope into the bamboo clump and observe the frogs' behaviour, without harming them. Having worked all night, we would return to base on an old motor bike, get a good breakfast and sleep until the evening, when our day would start all over again!

So for a batrachologist, the day actually starts at night. And out of the darkness, some extraordinary things can be uncovered.

Seshadri recently completed his PhD from the National University of Singapore. He is currently the Research Director at the Agumbe Rainforest Research Station in India.

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