NATURE TRAIL

Chennai Young Naturalists' Network

FEB '23 | Volume 4, Issue 1

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Nature Trail is a free e-magazine published biannually by the Chennai Young Naturalists' Network that may be viewed on our website.

Our Mission - To reach a broad spectrum of readers and ignite curiosity towards the natural world, while also providing a platform for young naturalists to develop a variety of skill sets.

About the Editor: *Currently pursuing a BS-MS course in Biological Sciences at IISER Thiruvananthapuram, Smriti has been fascinated by the natural world from a young age, her love for wildlife sparked by family vacations spent on safari. An avid reader with a passion for writing and photography, she aspires to explore the fields of wildlife research and journalism*.

Dear Readers,

The idea that all lifeforms on earth are intrinsically woven together in a massive web is a concept most of us are familiar with, if only through the food web illustrated in elementary school science textbooks. But even as interest in the natural world gathers steam, this interest is often saturated with an answer to the question “What animal is that?”. The act of zooming out and looking at the animal in the context of its surroundings is not one that follows naturally.

Through this edition of Nature Trail, we encourage people to take the time to zoom out because beyond the seemingly simple food web lies a world of inter-being interactions. The articles in this edition shed light on some of these connections that have evolved in different ecosystems - marine, terrestrial, and strangest of all, the human gut.

We hope you enjoy the read. Until next time!

– Smriti Mahesh, Editor-in-Chief

About the
Chennai Young Naturalists' Network

The Chennai Young Naturalists' Network aims to create a platform for young naturalists to interact with peers interested in wildlife. The hope is to help them grow not only in aspects connected to observation in the field but also give them the opportunity to explore career options with ties to nature. We also aim to conduct outreach and educational events to help increase awareness and improve participation of the public in citizen science and other nature related activities.

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On Wood Wide Web

N Nitha Fathima

my rhizoids ate into the roots -

they were hungry. i gave them food in return for a cozy home.

in the darkness, i saw -

swirling molecules before a dense cloud of green

some whisked into nothingness, some oozing out of me.

i half-remember some names in the dark -

memory was never my strong suit, i was made to communicate, to nourish

i carry words from the tree i've made my home to the one a few yards away-

we look out for each other, you see? we're a community.

we hold spaces for our kith and kin, partake in

some kind of reciprocity -

we give and we take. we don’t remember names.

our memories are hazy –

they hover over the edge of our consciousness, existing in two worlds at once.

sometimes we don’t know, we just are.

supplying s&p ‘s, finding places to cozily be.

Nitha is an undergraduate student who is usually found obsessing over fungi, books, trees and art.

A Dance Against A Parasitic Wasp

Mahathi Narayanaswamy

The path to the cafeteria at my university has a row of Madras Thorn (*Pithecellobium dulce*) or *Kodukapuli*, as they are known in Tamil. Last December, a couple of months after I finally arrived at campus post COVID lockdowns and online classes, these plants were donned with caterpillars and chrysalides of the Three-spot Grass Yellow. Some branches were covered with chrysalis hanging off them almost as though they were the leaves of the plant, while some others had caterpillars that were fast defoliating them and yet others had eggs or individuals that were mating or laying eggs.

Dropping by the plants regularly to see the various stages of the Three-spot Grass Yellow's life cycle as well as the development of a handful of Black Rajah caterpillars on the plant drew my attention to a small wasp that would drop by the pupae on a regular basis. Browsing iNaturalist later led me to identify this wasp as belonging to the genus *Brachymeria*, a group of parasitic wasps.

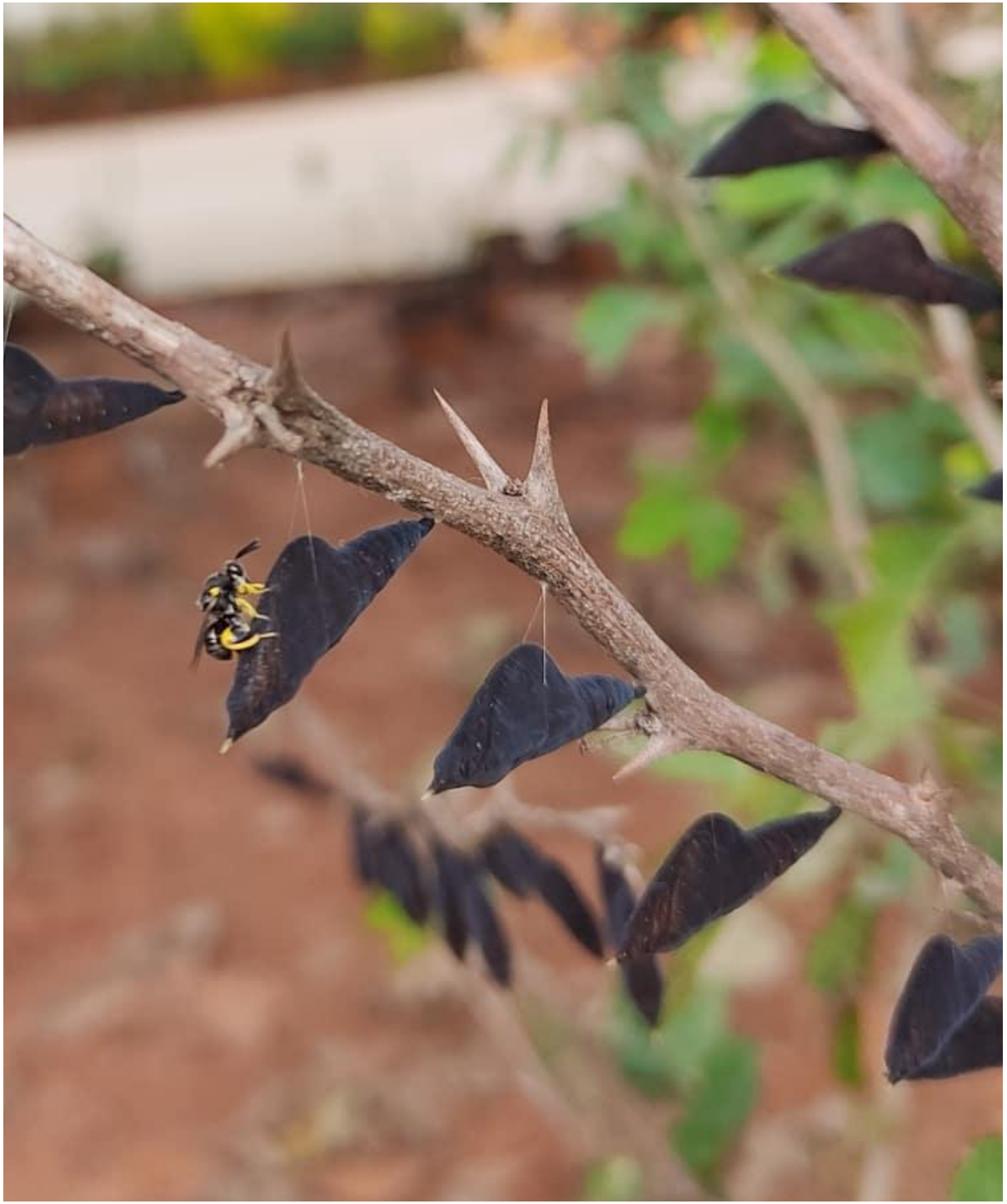
With parasitism being exciting on its own, the behavioural defence strategy adopted by the butterfly chrysalis was even more so. When the parasitoid wasp landed on a chrysalis, it wriggled fervently, preventing the wasp from depositing its egg in it. Observing this was exciting for me since I had never heard of such behaviour. This led me to read '*Antipredator strategies of* pupae: how to avoid predation in an immobile life stage?', a paper that talks about the various adaptations pupae are known to display to avoid predators and parasites.

With December just weeks away as I pen this article, I am excited as I hope to witness this phenomenon again. Nevertheless, Kodukapuli is also popular with several other insects, particularly with the spiders on campus. Next time you come across the plant, do check it out to see what you find!

Mahathi Narayanaswamy is 3rd year B.Sc Physics student at Azim Premji University, Bangalore. She has a keen interest in Birds, Butterflies and Moths.

Three-spot Grass Yellow and its eggs

Leaves with dozens of camouflaged caterpillars feeding on them



A Brachymeria Wasp on a pupae with the background branches being strung with pupae

A gallery of pupae.

A Black Rajah caterpillar

Mistaken Mistletoes: Parasites or Symbiotes?

Akhila S

"A young lady caught under the mistletoe could not refuse to give a kiss." Fourteen-year-old me might have scoffed at this line while thumbing through an old copy of 'The Old Farmer's Almanac', but my whimsical self knew of mistletoes only by the legend it bore: that kissing under a mistletoe was supposed to increase one's chances of marriage.

I later re-encountered the flower in a Norse mythology book: the goddess Figg had lost her son Baldur to an arrow made of mistletoe, and following her curse urging the mistletoe to 'kiss' (read: kill) anyone who passed under it, the mistletoe was no longer used to make weapons.

But I digress. However ridiculous I found these tales, I must admit I never was curious to observe the plant or the flower itself, that was until I watched episode 4 of The Green Planet: Desert Worlds. It was quite a shock to hear Attenborough's regal voice say 'poo': he was talking about "parasites in the poo", while referring to the very same mistletoe.

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Cacti protect their water stores with their spines. The desert mistletoe gets hold of this aqueous treasure; it falls on the spines as seeds in mockingbird droppings, and grows long tentacles that enter the cactus, bursting into a bouquet of red flowers after growing inside the cactus. A typical parasite, one might think. But think back to the vectors of the seeds themselves: the mockingbirds. These birds feed on the seeds, ending up with many sticky leftovers all over themselves or in their droppings. By wiping the seeds off on branches of shrubs or trees while cleaning themselves–or in the case of the cacti, through their feces–they are duped into finding new hosts for the mistletoe. Birds get food; plants get hosts. It seemed to me a perfect example of symbiosis.

Researchers have continued to study the mistletoe as an obligate hemiparasite, which is absolutely right. It is obligate, since it won't survive without its host, and it is hemiparasitic, since it can photosynthesise too. And

Cactus - Simran Singh

even though they're parasitic, since they cause very little damage to commercial plants as compared to root parasites, these aerial parasites have received very little attention from researchers. But why has the symbiotic role of mistletoe with their vectors been completely ignored? "Mistletoes are unique among vector-borne parasites because they maintain a mutualistic interaction with their vectors." (Martínez del Rio et al., 1996). Indeed, most other parasites maintain a negative or neutral relationship with their vectors. Another interesting fact here is that other vectors are themselves parasites (think: mosquitoes and ticks), but the birds that disperse mistletoe seeds have a commensal relationship with the host plants.

The mutualism between the birds and the mistletoe can have two major consequences that have also been backed by observational evidence: an already-parasitized host will have more bird visitors than non-parasitized hosts; and, since birds will frequent mistletoe-infected sites more, seed deposition will be proportionate to mistletoe infection. Birds can also better the interactions between mistletoes and their hosts, for example, if the host trees provide a reward such as fleshy fruits that are available at the same time as the mistletoe fruits (Carlo and Aukema 2005; Okubamichael et al. 2011). As

Mourning Dove - Vikas Madhav Nagarajan

such, the vectors can also influence host specificity and host switching of the parasitic plant. And of course, mistletoes in turn will have a huge impact on bird communities, the direct influence being through the abundance of fruit and nectar.
Mistletoes are thus very interesting biotic components: they scourge through their host plants but are also kind benefactors to their bird mutualists. In addition, they may also influence the fertility of the host plant's competitors and other members of the community. Although Dobson et al, 1994 and associated references have given a lot of attention to plant parasites and their contribution to community
composition, we know too little about the mistletoe's contributions in the same vein.

Martínez del Rio et al., 1996, summed it up best: 'Mistletoes are parasitic plants that exhibit a metapopulation structure, and whose seeds are dispersed by mutualistic avian seed-dispersers'. So yes, mistletoes are both parasites and symbiotes.

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The "History of Ecological Studies, Part 52: Symbiosis Studies" by Frank N. Egerton (2015) states, "Parasitism was the first symbiotic relationship recognized." (Ha.)

In Surindar Paracer and Vernon Ahmadjian's book "Symbiosis", the authors define symbiosis as an umbrella term that comprises any persistent relationship between two organisms, thus including commensalism, mutualism and parasitism as symbiotic interactions. By this definition, predation (and its comprising 'competition') can also be

called symbiotic, since they too are persistent interactions between species. One of the most basic symbiotic relationships is animals eating plants and the animal waste ending up as fertilizer for the plants. Another such
interaction so basic is the human maintenance of domesticated animals. Both these relationships are so fundamental and existed before even the concept of 'symbiosis' that we usually do not study them under symbiosis.

Similarly, before 'symbiosis' was conceptualized, there were many instances of ecological texts referring to the mistletoe as a special entity. Theophrastus, Aristotle's successor as the head of the Lycaeum, wrote about the growth of the plant but did not call it a parasite; Albert Magnus' description of the plant was said to be a landmark by Ainsworth et al (1981) and Paracer et al (2000); even Darwin (1859) noted the dependency of mistletoes on insects for pollination and birds for seed dispersal. Throughout the years, the definition of symbiosis itself went through a multitude of changes: from including only two-way mutualistic relationships, to many researchers attributing any instances of evolving together as symbiotic. To quote Gregory Dimijan, author of "Evolving together: the biology of symbiosis, part 1":

"The definition of symbiosis is not universally agreed upon; in this review, it will be considered in its broadest sense, encompassing associations varying widely in intimacy and types of interaction. Symbioses can be mutualistic (all partners benefiting), commensalistic (one benefiting and the others unharmed), or parasitic, although many symbiotic associations are complex or poorly understood and do not fit neatly into 1 category. A continuum can be envisioned that spans a dynamic bridge from antagonism to cooperation."

Prof. Paul Portier had another perspective, novel during his time: that of bacteria being symbionts of all multicellular organisms. This idea never actually made it through (due to obvious lack of observational/experimental evidence, save, for instance, the gut microbiomes), but it inspired Maurice Caullery to come up with his own perspective which was summed up by ecology historian Jan Sapp as: *"Caullery's aims were to rid accounts of teleology and anthropomorphism; to show that all cases of mutualistic symbiosis could be accounted for in terms of individual life struggle, domination, and control; and to show that no natural distinction could be made between parasitism, mutualism, and commensalism."*

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And there you have it. The mistletoe is not just an infamous site for kissing but also a significant locus for battling ecological concepts: symbiosis at the center of parasitism. Stanley Jr., in his very influential paper "Photosymbiosis and the Evolution of Modern Coral Reefs", stated: "Symbiosis is the most relevant and enduring biological theme in the history of our planet." Considering the broad range of this single word, I can't help but agree.

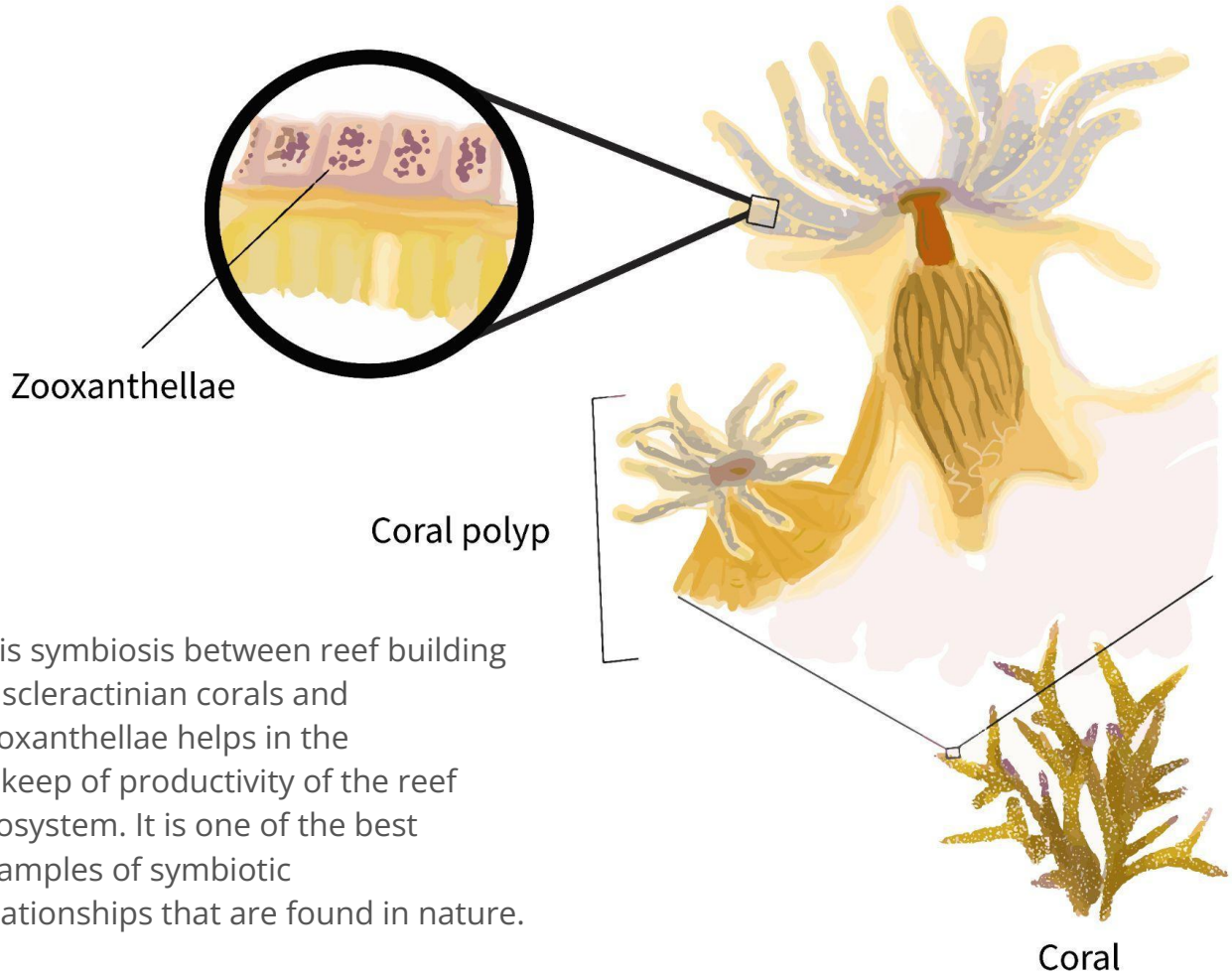
Akhila is a 3rd year undergraduate biology student at IISER Trivandrum. When she's not hyping about the F1 weekend or strumming on her guitar, you can find her reading up on everything from chaos theory to chess endgames and space missions to AI.

Corals and Micro-algae

Shreya Mehra

Corals are marine organisms that are essential for the sustenance of marine biodiversity.
These corals are dependent on micro-algae, that exist in a symbiotic relationship with them for their survival.

Stony corals owe their success as reef-builders to their symbiosis with dinoflagellate algae of the genus *Symbiodinium* (*Zooxanthellae*). The coral consists of coral polyps in which *Zooxanthellae* exist. *Zooxanthellae* are single-celled organisms known as *dinoflagellates*. These creatures are photosynthetic and produce oxygen, glucose and amino acids. The coral polyps provide the algae with carbon dioxide for photosynthesis. Symbiosis between *Zooxanthellae* and corals is vital for nutrient recycling, which is crucial for maintaining the productivity of corals. *Zooxanthellae* supply nutrients to the coral to produce calcium carbonate, proteins and carbohydrates.



This symbiosis between reef building or scleractinian corals and zooxanthellae helps in the upkeep of productivity of the reef ecosystem. It is one of the best examples of symbiotic relationships that are found in nature.

The illustration represents this symbiotic relationship.

Shreya Mehra has completed her masters in environment and development and loves creating species illustrations.

Illustration by Shreya

Corals and Communities

Nanditha Ram Satagopan

Corals are wonders of nature that have inhabited our blue planet for more than 400 million years, according to fossilized records. Different species of coral thrive all across the vertical ocean column, in all shapes and sizes - brackets, sea fans, tubes and branches. Reef-building corals grow in shallow waters where there is more sunlight and their propagating rates are higher than those of other types of corals. These corals are symbiotic in nature, sharing a unique relationship with algae known as zooxanthellae, which belong to the group dinoflagellates. Corals are made of millions of tiny structures called Polyps, which are very similar to sea anemone. Polyps contain these tiny algae (zooxanthellae) inside their tissues. They photosynthesize during the day and produce nutrients that are transferred to the coral's cells. In mutual reciprocity, coral polyps excrete ammonium: a Nitrogen-rich compound used by the algae for nutrition. The polyps have a circular mouth surrounded by tentacles with stinging cells called nematocysts, which come alive at night and are used to capture prey. The symbiosis between the polyps and algae also facilitates the reef-building nature of corals, as the algae produce calcium carbonate, forming hard coral skeletons that grow into reefs. They are also more productive since they derive food from both the symbiotic algae and the predatory polyps. Some of these reefs grow so large that they can be viewed from space!

Almost 25% of marine life relies on coral reefs, which is why the reefs are often referred to as the 'Rainforests of the Ocean'. Looking beyond the intra-symbiotic relationships, they also have inter-symbiotic relationships with other creatures and corallivores (organisms that consume corals) which depend on them for survival. Parrotfish bite off and graze on the algae growing on top of corals to increase their productivity, sharks roam reef beds and control fish populations and there exist different crabs and lobsters that defend corals from predators.

Unfortunately due to rising sea temperatures, corals experience a phenomenon called bleaching where the polyps expel the microalgae living inside their tissue as a stress response. Due to this, they are deprived of their food source and ultimately perish, transforming vibrant reefs into white skeletal expanses of dead corals. They also face the threat of damage due to large vessels, water pollution, ocean acidification and overfishing. To preserve these vital ecosystems, coral reefs are officially protected in India under the CRZ-1 category of the Coastal Regulation Zone notification. India is home to coral reefs that adorn the Lakshadweep Islands, Andaman and Nicobar Islands, Gulf of Kutch (Gujarat) and Gulf of Mannar (Tamil Nadu). Since corals support huge populations of fish, fishing communities all over the globe depend on coral reefs, directly and indirectly. Pieces of coral are a common sight in fishing bycatches by the Chennai coast. Painted Rock Lobsters, Parrot Fish, Butterfly Fish, Green Sea Turtles, Moray Eels and Sponge Crabs are just a few of the species that need corals to thrive in

Sea-Whip - Rohith Srinivasan

Indian waters. In Tamil Nadu, fisherfolk call the coral reefs *Pavala Paarai*. They bring with them generations of knowledge and years of interacting with the ocean and have mental maps of the sea bed and the treasures it possesses. Just like the symbiotic relationship of corals, communities- both aquatic and terrestrial - depend on these magnificent substrates of life for their survival.

Nanditha is a Master of Environmental Management student at Duke University concentrating in Ecosystem Science and Conservation. Her interests in the natural world span from biodiversity protection to habitat conservation. When not chasing sunsets, she can be seen photographing the environment around her.

Lauridromia dehaani, a Sponge Crab - Balakrishnan Ram

Following Your Gut: Endosymbiosis and the "Great Abdominal Brain"

Madhumitha Rajagopal

In the medical circles of 19th-century England, there were few doctors more celebrated professionally—and more striking in personality—than John Abernethy. Born in London, Abernethy became the assistant surgeon at St. Bartholomew's Hospital in 1787, at which time he began to give lectures on anatomy. Famously no-nonsense and blunt with his patients, Abernerthy was nevertheless a brilliant and charismatic lecturer—his talks, peppered with amusing tales and vivid descriptions, attracted such a devoted crowd that a lecture theatre was even built at the hospital (leading to the establishment of St. Bartholomew's medical school). As a physician, however, Abernethy was marked by his fascination with a single part of the body: the gut. He was convinced that a number of complaints, including depression and fatigue, could all be traced back to digestive problems—in other words, that there was an essential connection between the gut and the mind.

Abernethy may have been unusually passionate about this topic, but he was hardly alone in his ideas—from morality to hysteria, the gut has been implicated in the mind's activities for the last 300 years. In Victorian times, many doctors held that drinking too much tea could cause indigestion, irritability, hallucinations, and hysterical fits. Two of today's most famous food products—Kellogg's cereal and graham crackers—were both originally created to combat sinfulness (both Dr. John Harvey Kellogg and Reverend Sylvester Graham believed that a diet of foods without meat or fat, such as cornflakes or crackers, would help people to control their desires). Even today, in speech, we often refer to having "gut feelings", associating our gut (and gut-related discomfort) with our emotional experiences.

Though not all of these historical beliefs are accurate, the idea that there is a link between the gut and the brain is far from fanciful. This gut-brain axis is a rapidly emerging field of research, and many of its most groundbreaking discoveries are centered around a group of unimaginably small creatures—microbes—and the biological phenomenon of endosymbiosis. In endosymbiosis, one organism (the symbiont) lives inside another organism (the host) and the two have a symbiotic relationship. Gut microbes are one of the most widespread examples of endosymbiosis that exist in nature.

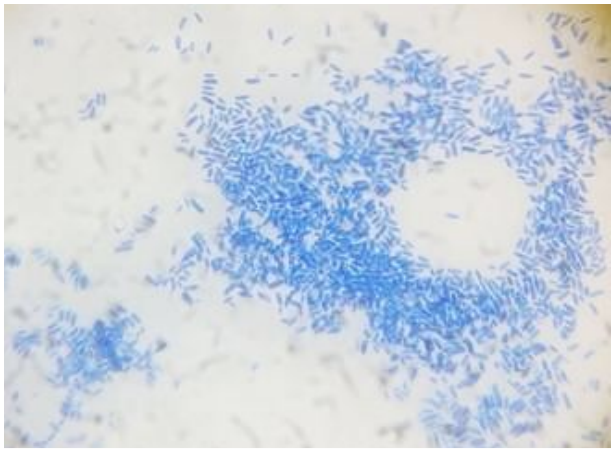
They are involved in a number of their host's bodily functions, including digestion and immune responses. Investigations of the gut-brain axis, however, have led to the startling discovery that gut microbes can influence one other essential aspect of an organism: its behavior. Through a variety of mechanisms, including altering neurotransmitter and hormone levels in their hosts, gut microbes have far-reaching impacts across a multitude of species—a finding that is changing our understanding of ecology.

In bees, gut microbes shape both memory and social behavior. Bees with a greater number of the microbe species Lactobacillus apis in their gut have better memories. In general, bees lacking a population of gut microbes (germ-free bees) do not socialize with (or exchange information with) their fellow bees as they normally would. In fact, researchers found that germ-free bees had brains with altered levels of chemicals involved in taste, smell, vision, and memory. Instead of forming specialized relationships and taking up roles that involve only a certain task (such as foraging for food), germ-free bees treat their fellow bees more equally. For bees, whose survival is rooted in social organization, an alteration in gut microbes could thus have disastrous consequences — disrupted social processes and a lack of specialized roles would leave them unable to cooperate effectively for the good of the hive.

In flies, gut microbes have been shown to affect another social behavior: mate choice. In her famous 1989 experiment, Diane Dodd raised groups of the fruit fly Drosophila pseudoobscura on two different mediums (starch and maltose). After several generations, starch-raised flies showed a mating bias toward starch-raised flies and maltose-raised flies showed a mating bias toward maltose-raised flies. A similar experiment, conducted decades later, had almost the same outcome. This time, scientists reared groups of the fruit fly, *Drosophila melanogaster,* on either molasses or starch, and once again flies raised on the same medium preferred mating with each other. Since this mating preference disappeared after flies were given antibiotics and reappeared when they ate food containing bacteria from certain mediums, the researchers concluded that gut microbes were responsible for this behavior. However, it's worth noting that the results of such experiments have varied and should be examined on a case-by-case basis.

Interestingly, gut microbes appear to change the levels of chemicals present on the flies' outer shells—chemicals that determine the flies' smells and therefore their attractiveness to potential mates. In this case, gut microbes could be a missing link in the story of evolution. If two populations already have barriers to reproduction between them (such as physical distance), having different diets—and thus different gut microbes—would make them even less likely to mate, accelerating their division into different species.

The impact of gut microbes on behavior is hardly exclusive to insects. Among mammals, the gut microbes of mice have been well-studied. Germ-free mice are more anxious, and therefore more antisocial, than mice with healthy gut microbe populations. Germ-free mice have higher levels of corticosterone (a stress hormone) than normal mice, indicating that gut microbes have an important part to play in the regulation of this hormone—a finding that could be extrapolated to humans and other mammals in the future. Research about gut microbes, including the studies



Lactobacillus - Nishanth M. Arvind

detailed above, have hard-hitting implications for our interactions with the environment. The use of pesticides, for example, could disrupt the gut microbe populations of bees, fish, and other creatures. This may not kill them outright, but would alter their social and cognitive processes and make it impossible for them to live normal lives. This hidden danger is especially important in light of the fact that many pesticides are marketed as "safe for wildlife", "bee-safe", "pet-safe", or the like—labels that are appealing for consumers, but may not be entirely true.

In the future, microbe-focused research has the potential to be at the forefront of our knowledge about not only animal (and human) behavior, but animal conservation and welfare. Far from being a negligible part of both general biology and ecology, gut microbes have proven themselves to be powerful determinants of the behaviors—and therefore fates—of entire species. After all, as far back as 200 years ago, physicians termed the gut the "great abdominal brain". They may well have been right.

Madhumitha is a gap year student based in Chennai.

In Conversation with Dr. Madhuri Ramesh

Aditya Ramakrishnan and Smriti Mahesh

***Dr. Madhuri Ramesh** works on nature-society relations in coastal spaces and is interested in inclusive, interdisciplinary approaches to conservation and sustainability. She began by studying the ecology of rare reptiles but with field experience, became interested in political ecology. Hence her recent work weaves together strands from the natural and social sciences, as well as the humanities. Her research has spanned diverse landscapes ranging from hill forests in the Western Ghats to arid grasslands in the Thar desert and densely inhabited islands in the Bay of Bengal. She has also taught in a school, worked as a copy editor and managed projects in a commune. All of these experiences have enriched her worldview and research practices.*

Nature Trail editors ***Aditya Ramakrishnan*** and ***Smriti Mahesh*** had the opportunity to speak to Madhuri about her work and her views on nature-society relations in India. Turn over for the interview!

Could you tell us a little about yourself? A lot of your work involves environmental and social sciences and human-nature interactions- how did you get into this particular field of study?

I did my undergraduate studies in Zoology from Stella Maris and used to volunteer at the Madras Crocodile Bank. Because of these, I gradually began to develop an interest in research. At roughly the same time, I was also a part of the Students' Sea Turtle Conservation Network (SSTCN). For my Masters, I attended the Salim Ali School of Ecology in Pondicherry and worked for many years before doing my PhD from the Ashoka Trust for Research in Ecology and the Environment (ATREE) in Bangalore.

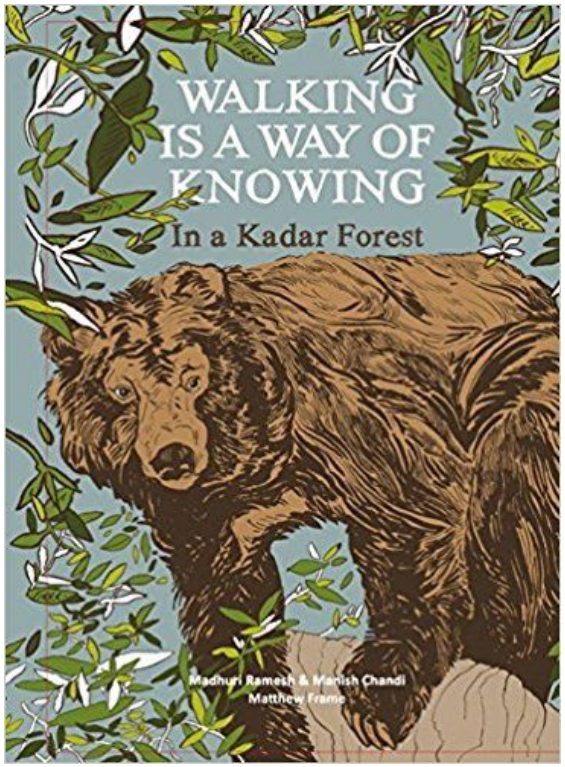
In the beginning, I was only interested in reptile conservation. But things changed when I did my first field study, on the Travancore Tortoise in the Anamalai Tiger Reserve. I had an amazing local guide, Ganesan, who was a Kadar. He was very knowledgeable and got me interested in the human dimensions of conservation, the importance of local knowledge and more generally, anthropology. This was a major shift for me.

You have co-authored two books related to the Kadar tribe. Could you tell us a little about your experience with them? How important is it to imbibe subaltern/ marginalised perspectives on the environment into wildlife conservation?

Writing both books was an incredibly rich experience for my co-author, Manish Chandi, and I. We had discussed the stories for a long time before actually getting down to writing them. Our interactions with the Kadar community had made a lasting impression on both of us; so much so that we thought back to what they had taught us about the forest even fifteen years after we had worked with them.

We wrote those books because we felt that the knowledge the Kadars possessed was invaluable and that other people could also learn from them. We chose to write it as a popular book because we felt that very few people would read it as a scientific paper. Also, it was much more fun to write it as a book and we felt that we'd be able to attract a larger audience and showcase the community's own voice much better.

It's important to bring in the perspectives of people who are traditionally marginalised and I think we've come a long way since the times people used to dismiss local knowledge. There have been some serious efforts to be more inclusive since I completed my Masters. But as always, there's a long way to go.



You've done a lot of work with coastal ecosystems. Do you think they get the attention they need? How do you think one can get more involved with them?

Like arid grasslands, coastal ecosystems often tend to be overlooked since people are only fascinated by the more glamorous ecosystems. So no, I don't think they get the attention they need. To remedy this, I feel that young people living in coastal cities should seriously spend more time understanding such ecosystems and the perspectives of the people who live and work in them. Simple things like nature walks (which are normally done in forests) that take you through coastal ecosystems would really help.

Your work is extremely interdisciplinary in nature. As a scholar, do you think the perspectives of the environmental social sciences are adequately accounted for in how ecology as a discipline is practised?

Actually, I believe that these days, the social sciences get a lot of attention and that it is actually ecology which is getting marginalised. Today, even geographers talk a lot about more-than-human geography and you have anthropologists conducting multi-species ethnographies. No doubt these are interesting trends that help the social sciences engage with ecological ideas. However, I'm a bit concerned that they don't spend enough time on ecology itself. In a way, they're inventing afresh what has been known in ecology for a long time. What we need right now is a mutual exchange. It's not just ecology as a discipline that needs to engage with the social sciences. The reverse must also happen.

On a shore walk in Chennai- Smriti Mahesh

The theme for this edition is symbiosis and you've done a lot of work on nature-society relations. For a layman, what does nature-society relations really mean and how do you study them?

Nature-society relations can be used as a huge umbrella term for a range of questions. It could be something as basic as the air we breathe, what it tells us about the environment around us, how we maintain or degrade it, how we relate to other organisms and what our responsibility to other species is. It could also extend to more philosophical questions, like ones about whether man is just another animal and whether all human concerns can be extended to animals. Nature- society relations is an extremely relevant domain and it covers a huge range of interests.

As a beginner, is there any literature that you could suggest to learn more about nature-society relations?

There are various sources I could recommend depending on whether people want to learn about cultural,

physical or economic relations. As a start, I'd suggest people read popular magazines like Current Conservation since they write a lot about nature-society relations without any jargon. Even if you don't read much you'll be able to learn a lot from the illustrations!

With respect to jargon, what is your opinion on how science is communicated to the larger public today?

I think we definitely need to communicate science to a wider audience. There's only a tiny fraction of science that gets written up in a way that the public can read. I think it needs to be written better and can't be limited to doomsday stories all the time. Science communication needs to be a lot more nuanced as well. For many, the best way to capture public attention seems to be by reducing an issue into a black and white debate, which may not necessarily be accurate. We also need to start writing in regional languages and using a variety of mediums and formats such as podcasts, plays and so on. Not everything has to be written.

When we translate from English to regional languages, or even the other way round, there might be some content that gets lost. How does one compensate for such loss of content?

I feel that there is always a loss of content when people communicate with each other, even if both of them are speaking the same language. It's not like I can always convey exactly how I feel to another person, nor will they always be able to understand what I say the way I meant it. So there is some level of error that we live with. In fact, I think it can even be fun to experiment with languages. For instance, I don't see why we can't use common scientific terms, like PCR test or genetics, in articles in regional languages too. Why don't we use a mix of languages while writing popular articles? They're sure to attract young people's attention and introduce them to science in an accessible way. I'm not a language purist in that sense. I believe we should adapt it to suit our goals and use it as an instrument rather than take it as the rule. Its whole function, after all, is to reach the person we are communicating with.

The solution to a lot of issues has been to demarcate human-free conservation spaces or protected areas which are considered 'pristine wilderness'. In your opinion, is this an adequate solution and could you explain it through your understanding and study of nature-society relations?

First of all, I think this idea of pristine wilderness is a massive myth and many people have written well-researched scientific papers that talk about how this just comes from a very poor understanding of history. Most areas we think of as wilderness, starting with the Amazon rainforest, have been shaped by humans for a long time. Demarcating conservation spaces is not a good solution because of the socio-economic costs they impose on the poor and there isn't enough evidence to prove that such a conservation approach even works. This model has been around for a long time but we don't have enough evaluation studies that have examined how protected areas (PAs) have performed, say, fifty years after they were created. There simply isn't enough data.

This model also assumes that animals are obedient and do what we expect them to, even though the reality is that they don't. For example, marine turtles don't respect the boundaries of marine protected areas (PAs)- they go wherever they want based on ocean currents, temperatures and the availability of food. They end up spending quite a bit of time outside the PAs that were created for them. Similarly, the Spiny-tailed lizard, a species I studied in Rajasthan, is mentioned on almost every signboard in the Desert National Park. In reality, they are found mainly outside the national park. This is because grazing is not allowed within the park and Spiny-tailed Lizards require really short grass cover. So even though they were found within the park at one time, most colonies had later moved out. These are just a few ecological examples of how the fortress conservation model doesn't work very well. Apart from these, there are massive human rights and justice issues associated with them as well.

Protected areas are often associated with ecotourism, but do you think the mainstream approach to ecotourism is sustainable and can it be a helpful model for environment conservation in the long run?

Eco-tourism is a relatively new sector in india. Earlier, most parts of the world, including the US, just had ordinary tourism to protected areas or nature-based tourism. Concerns about sustainability and the impact of tourism on the environment came up recently and these are really what differentiate eco-tourism from simply visiting a natural landscape. I think like any new sector, it has serious teething problems and academic literature has been quick to criticise it as just another form of capitalism. I believe the reality is that it is a source of livelihood for many communities in remote underdeveloped areas and rather than completely rejecting it, we should think about ways to improve it and help local communities maximise their benefits from it. So I suppose you can say I'm on the fence about eco-tourism, although my views on the subject are not popular in academia.

Olive Ridley Turtle returning to the sea after nesting- Yuvan Aves

Have you ever experienced any trouble working in ecology and environment as a woman?

I believe you have the same gender-related problems in the city as you do in the field and that there is no sharp difference. Generally, women anywhere in India have safety issues and social difficulties that follow them into the field. People question women's abilities to do any task that's seen as challenging or 'macho' and the same attitudes are present in forests or coastal landscapes.

Do you have any advice for people who are interested in the environment but are not inclined

to pursue it via a career in the sciences? How can such people get themselves involved in ecology?

First of all, I think there's more to ecology and conservation than just research. So if you don't want to study science, you could always contribute through film, theatre, art, literature and so on. These contributions are really necessary and courses which help pursue them are good options. For example, the Asian College of Journalism used to have special modules on environmental journalism. Things like that are interesting since we don't have many people doing popular science writing or environmental journalism. You also have really good online magazines like the Bastion run by people from different backgrounds which cover a lot of important ecological and developmental debates. One of my friends from Chennai, Saravana Kumar, makes excellent wildlife films. He does have a background in the wildlife sciences but chose to make films instead. Similarly, another friend, Vena Kapoor, has a background in commerce but does a lot of work in environmental education now. So yeah, there's a lot you can do!

The Lilliputian Symbiosis

Samarth Jain

Not all symbiotic relationships are as intriguing and unique as lichen (fungal-algal association) or as easily observable as herbivores and oxpeckers (insect-eating birds), where certain bird species feed on the ticks and lice present on the skin of herbivores. There are many others that fall between these two. A few even occur around us and may still go unseen.
If you love gardening or even just observing the plant-life around you, you are likely to have seen tiny insects attached to the soft green stem or under the leaf surface of a plant. They come in a wide array of colours: from off-white and yellow to shades of green and brown. Well, if you are yet to guess, I am referring to 'Aphids'.

Aphids or 'plant lice' are small soft-bodied sap-sucking insects, which means that they feed on the sap that they extract from soft green parts of a plant. These insects are among the most destructive insect insect pests of plants, especially in temperate regions like our country. The sap is actually the watery fluid in plants which is found in the cell's vacuoles. This phloem sap consists primarily of sugars, hormones, and mineral elements dissolved in water. The sap in plants is somewhat equivalent to blood in our body since both work to transport food and nutrients from one body part to another.
Aphids feed on this sap and thus reduce the amount of this nutritious

fluid reaching the plant's cells resulting in weakness. In addition to weakening the plant by sucking its sap, they act as vectors for plant viruses and disfigure ornamental plants with deposits of their excreta, which harbour the subsequent growth of sooty moulds. Aphids must consume large quantities of plant sap to gain adequate nutrition only to then excrete equally large quantities of waste, called honeydew.

Honeydew is a sugar-rich sticky liquid, secreted by aphids and some scaly insects which also feed on plant sap. When the aphid's mouthpart penetrates a plant's phloem, the sugary, high-pressure liquid is forced out of the anus of the aphid. This honeydew serves as a good food source for a few insects and one insect, in particular that has probably grown to like it the most is ants.

Although aphids are menacing for plants, they are very susceptible to being predated by larger insects like ladybugs and wasps. Since aphids need protection and ants need sugary food, these two insects form a well-documented symbiotic relationship, which means they benefit mutually from their working relationship. Aphids produce sugary food for the ants, which in exchange, care for and protect the aphids from predators and parasites. Ants take their turns around the aphids to collect the sugary honeydew. Some ant species can be so hungry for honeydew, that they stroke aphids with their antennae, stimulating them to release honeydew, a process referred to as 'milking'. Some aphid species have lost the ability to excrete waste on their own and depend entirely on caretaker ants to milk them.

Not only that, these ants actually look after these aphids, technically rearing them for their honeydew.
Aphid-herding ants make sure aphids stay well-fed and safe from weather and predators. When the host plant is depleted of nutrients, the ants carry their aphids to a new food source. If predatory insects attempt to harm the aphids, the ants will defend them aggressively. Some ants even go so far as to destroy the eggs of known aphid predators like ladybugs.

Some species of ants continue to care for aphids during winter. They carry the aphid eggs to their nests, store them where temperatures and humidity are optimal, and move them as required when conditions in the nest change. In spring, when the aphids hatch, the ants carry them to a host plant to feed.

While it appears the ants are generous caretakers of aphids, ants are more concerned about maintaining their steady supplies of honeydew than anything else. Aphids are almost always wingless, but certain environmental conditions will trigger them to develop wings. If the aphid population becomes too dense, or food sources decline, aphids can grow wings to fly to a new

Oleander Aphids - Yuvan Aves

location with better food sources. Ants, however, do not look favourably upon losing their food source. Ants have even been observed to prevent aphids from dispersing by tearing their wings off before they can become airborne. There is also some evidence that ants force aphids to ingest certain chemicals (semiochemicals) that prevent them from developing wings in the first place.

Moreover, according to studies and research on this relationship, it turns out that the ant-tended aphids were subject to higher parasitism by hymenopteran parasitoids. The net result over the experimental period was found that in reality, the presence of ants decreased aphid colony productivity, measured by the number of winged summer migrants produced from the colonised host plants. This implies that aphids do not always benefit from the presence of ants, but under some conditions may even pay a cost in the form of reduced dispersal.

To conclude, this might be looked at as an example of defensive mutualism in which a species gets protection by providing nourishment in return. Ants have been seen to have this mutualistic relationship with other insects and certain species of caterpillars which are able to secrete honeydew. Ants might not be the best partners since they are actually just interested in the aphid honeydew and not in their wellness but nobody does anything without seeing their profit these days There is a lot going around us, a lot of things to explore and ponder about. Even the smallest of insects have a story to tell.

Samarth Jain is currently pursuing an undergraduate course in Zoology. He has always been fascinated by the various creatures that inhabit the earth. He looks forward to a career in wildlife management and research.

Ants tending to Aphids on Milkweed - Mahathi Narayanaswamy

PHOTO GALLERY

We at YNN are happy to share a few carefully curated images showcasing symbiosis in nature taken by our talented young members. Enjoy!

Ants tending to Aphids - Nikkitha Teresa

Pollination - Smriti Mahesh

Lichen - Balakrishnan Ram

Commensalism between Cattle egrets and Grazing Cattle - Mahathi Narayanaswamy

Terns fish in the wake of a fishing boat in Chilika Lake - Smriti Mahesh