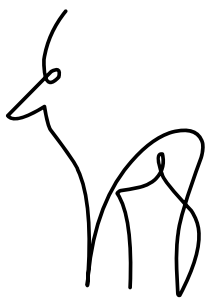
WHAT I DID WHEN I DIDN'T SEE A TIGER

JEYKUMARAN IFS
DIVYA BHARATHI IFS



To Every Life
that makes the Forests
Interesting

WHAT'S INSIDE

WHAT'S INSIDE

WHAT'S

INSIDE

Our sincere thanks to

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Why?

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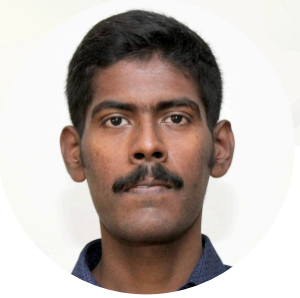
We rarely delve into information that is out there beyond traditional field guides.There is more to know than just the names of animals or birds.Every being in the forest raises curious questions about life itself. Here, we have attempted to answer some questions and add some.



JEYKUMARAN

‘What do you engineers have to do with forests and wildlife?’ is a silly joke in our space. When one stands before the wilderness, expertise dissolves. Academic boundaries blur when wonder takes over. Staring at a small deer and sinking into the thought of ‘How life works’ is a spiritual moment available to anyone — one need not be a biologist; one just has to be human and curious.

WHY SO SERIOUS?

A SLOTH BEAR ANGER

"Whenever great deeds are remembered in this jungle, one name will stand above all others- Baloo". That is how Baloo the bear is remembered by Bagheera, the panther in Kipling's 'Jungle Book'. Despite Disney's animations depicting Baloo close to the American Black bear, Kipling's description in the book and the geographical location in which the story is set in, it is the sloth bear that fits in Baloo's character.

The first thing that stands out when one encounters a sloth bear is its long claws and protruding snouts. In fact the word 'Sloth' got affixed to this bear because the animal was mistaken initially for a Sloth due to its long claws. It was only after detailed studies that the animal got recognized in the family of bears. Even their snouts are longer compared to other bears. All these are an adaptation for their special diet.

Though sloth bears devour fruits, their diet mainly consists of social insects such as ants and termites. Often termite mounds extend deep underground and might be as

strong as a concrete. This is where the claws come into play. Sloth bears can rip off these mounds with their powerful claws. Once they make way into these mounds and reach the insect colonies, their snouts take over. The protruding snout makes it easier for the Sloth bears to suck the insects. And sucking is no easy job.

Imagine putting your lips on a wide-mouthed bottle to suck water. You won't be able to because your small lips won' t close around the wide bottle and hence you will not be able to create enough suction. Sloth bears on the other hand have long lips which can close around the insect mound without leaving any gap. So when they suck, insects are drawn into their mouth. Evolution has also resulted in sloth bears having reduced front teeth unlike other bears, which help them suck more insects like a vacuum.

But wait. Wouldn't putting the snout into the mound risk the bear from inhaling dirt or insects? No. Sloth bears have mechanisms that actually allow them to close their nostrils completely while sucking.

Despite their cool eating tactics, one might feel that being a sloth bear isn't that cool. With an elaborate fur in such a warm tropical climate, surely sloth bears might be sweating, right? Not actually. Unlike their cousins in cooler temperate regions, sloth bears do not have under-coat beneath the fur. Hence the outer furs alone don't make them feel the heat. The elaborate furs are mainly to provide them protection from insect bites and also to help them exaggerate their size to intimidate predators like tiger.

Speaking of intimidation, one always remembers sloth bears for being aggressive. Why is that the case? As already mentioned, sloth bears have longer claws for digging through the termite mounds. These claws however come as an obstruction while climbing. Yes, a sloth bear has the ability to climb a tree, but it never resorts to tree climbing as a means of escape while facing its predator.

Okay, but why not run away from the predator? If you had observed a sloth bear walking, you might have noticed that it walks with a flat feet. The flat feet might allow the bear to run fast in a short burst but soon they tire out (Even in humans with flat feet, running is a challenge). With climbing and running off the table, sloth bears have the only option of being aggressive. That is why when they encounter a predator or any threat, they stand on their hind legs to exaggerate their body size (the white chest markings add to the intimidation) and also act aggressive to ward off the predator. What started as an adaptation for eating insects, has indeed made this being, a beast of the jungle!

ANTLERS

TREES THAT ARE SHED

In the breeding season, sporting of antlers by male Chital and Sambhar deer is a sight to watch. Antlers are supposed to have evolved with the evolution of fighting behaviour in deers. Earlier evolved deers like Barking deer sport small antlers and large canine teeth to display aggression. However with time, the deers began to develop bigger antlers in place of canines for aggression and also as a showpiece of their dominance to females. But what are these antlers made of?

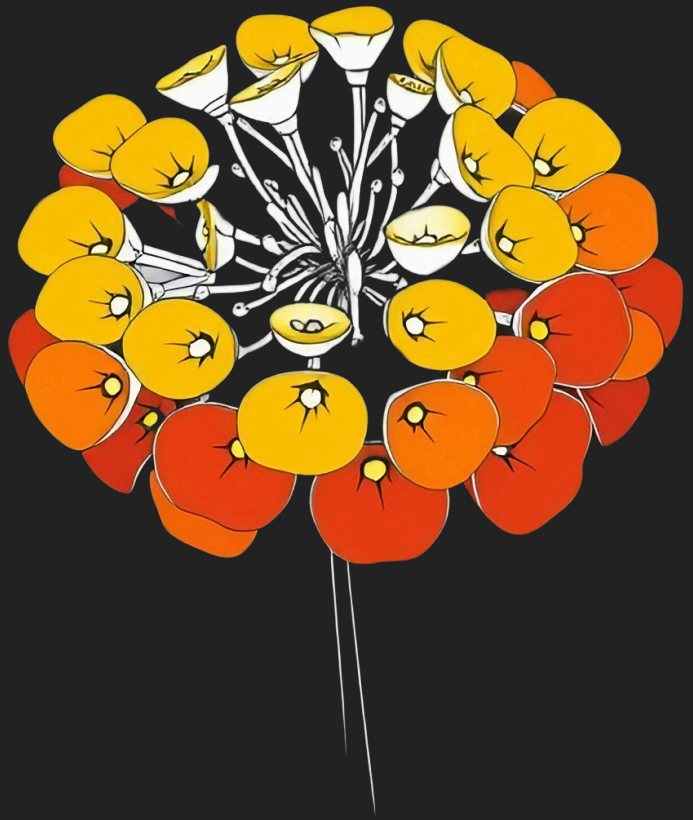
Antlers start as bony living tissues. Their initiation coincides with the secretion of testosterone in puberty and their annual cycle coincide with its levels. It works like this. In early summer when testosterone levels are low, the antlers begin to develop with a mushy velvet skin around it. This velvet skin allows

oxygen rich blood to reach the growing antlers. As testosterone reaches a peak during breeding, this velvet skin dies and the antlers calcify. The rubbing of antlers against trees by a Chital, is an effort to remove these dead velvet skin. At this stage the bony living tissues of the antler also dies producing an insensitive hard structure which the deers use as a weapon. After the breeding season, these antlers are shed by males and they start regrowing in the next year.

But it is as taxing for males to sprout bones out of their foreheads as it is for females to grow a baby in their wombs. The male body spares calcium from its skeletons to grow these antlers. In fact the deer depend on natural salt licks to supplement some of these calcium. But then, why undergo this painful process every year?

Firstly antlers must keep up in size in relation with the body size of male Chital/ Sambar to be useful at every stage of a deer's lifecycle. Hard antlers are however dead structures and cannot grow further. So without these periodic shedding and regeneration, the antlers cannot keep up with the growing body size of these deer species. Also keeping those antlers outside mating season could be a huge liability. The antlers are heavy and might entangle in branches. They also highly restrict the males movement among trees and bushes. And so, these antlers are shed!

What a waste of an year's effort, one might think. But no. These antlers (which are rich in calcium) are immediately fed by porcupines to grow their spines. So the next time you see a deer antler lying on a forest floor, just walk away for some porcupine might be eyeing its next meal.



FROM YELLOW TO RED

A LANTANA CAMARA STORY

Ask any forester and almost all of them would vouch for their year long battles with Lantana camara. But what do we know about Lantana other than the fact that it is an invasive species from the Americas that needs to be removed?

Let’s begin with the flower. One who has observed Lantana might have realized that some times the flowers are yellow, sometimes they are pink and sometimes red. Are these different varieties? No. The buds of lantana flowers start pink and as they open up they turn yellow. So what is happening? Yellow is the colour of the unpollinated flower of Lantana. Once the flower is pollinated (by thrip insects), the flowers slowly turn orange and then finally red. This is Lantana's way of telling the insects which flowers to focus on. Intelligent, right?

Yes, but why yellow and not red as a signal? Insect eyes perceive red colour as black and hence generally avoid red flowers, so the unpollinated flowers are non-red (yellow in this case).

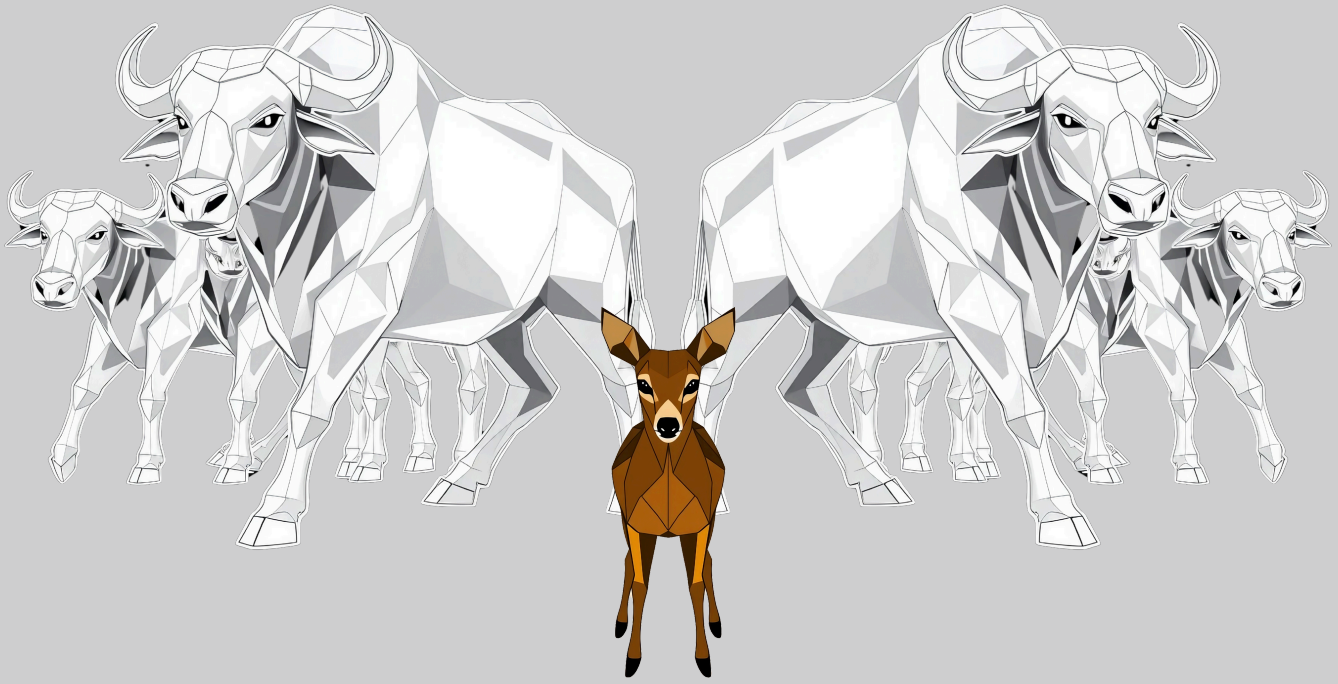
If this kind of efficient pollination was not enough, the flowers of a single plant produce more than 12000 seeds per year which makes the plants to spread profusely. And the seeds can germinate throughout the year as long as there is enough soil moisture. Once the seeds germinate they need intense light for faster growth. That is why in natural forests, Lantana presence is relatively less than in monoculture forest areas, as in the former, there are trees and plants occurring at various heights which limits the light falling on Lantana, if any. The dependence on light can be witnessed in the quadrangular arrangement of leaves too (leaves alternating at each node) to receive maximum sunlight, a feature we find in many other invasive species like Ran tulas (Hyptis sp), Eupatorium (Chromolaena sp) etc. No wonder many of our monoculture plantations find it hard to compete with Lantana.

CHOICES

HOW MUCH SHOULD I CARRY?

Imagine these two scenarios: A starling carrying insect prey for its chicks and a worker honey bee carrying nectar for the hive. The question before both these individuals is how much load to carry back to the nest or hive and there are two options. One could carry the load that maximizes the delivery at nest/hive or one could carry the load that is most efficient for the individual to carry interms of its energy expenditure. Experiments find that starlings aim to maximize the insects delivered to the nest, while worker honey bees try to maximize their energy efficiency, meaning honey bees are worried about the energy spent in carrying the load. Now why would species make different choices when the problem is the same- carrying a load to a destination?

The answer lies in their lifespan. Worker honey bees live for a shorter time (several days) and it is found that harder a honey bee worked, the shorter it lived. So by keeping an eye on energy expenditure, a honey bee tends to extend its lifespan and thus contribute more nectar overall to the colony. Such a calculation on lifespan might not be needed for a starling which lives for several years. Or is it the urge of a parent, that makes one throw away such self-centred calculations? Keep thinking.



HERD/SOLITARY?

THE GENIUS OF GROUP SIZES

Anyone moving across forests might have noticed that species like Gaurs are in groups while Barking deer are often solitary. Have you wondered why? Let's start from basics. Smaller bodied mammals like Barking deer have relatively larger surface area (in relation to their volume) exposed and hence they lose a lot of heat. So to maintain their body heat, they generally are metabolically more active. Such an active animal needs high quality food like shoots and berries right? Barking deers prefer these high quality foods but such food material are scarce and scattered in their distribution. So small sized species generally have to live a solitary existence. If they were in groups, imagine the resource competition they would have to face.

Now think about Gaur. Their thermal losses are relatively low and hence they donot have the need to be metabolically active. This allows them to survive even on poor quality food. But because of their size, a larger quantity needs to be consumed. Such resources are often patchy in distribution but abundant wherever they occur (say grasslands). With such food preferences, there is no point in being solitary too. Living in larger groups help to identify such patches and once found, all can feed without any competition. In fact such open areas make solitary existence vulnerable to predation. So it is an added advantage to move in groups. But do these group sizes have an influence on mating choices?

Indeed.Think of the barking deer again. As both male and female are solitary, it makes even more sense to live in pairs (monogamy) and defend a territory to protect the scarce resources they depend on. A male barking deer might not be able to mate with multiple solitary females, as it means needing to defend larger territories.

But take the case of the group living Gaurs. Group dynamics automatically brings in a system of dominance hierarchy among males. And naturally, the dominant male at the top, tries to monopolise a harem of females which is what happens in Gaur (Polygyny). Now who would have thought that size and food choices have a bearing on not just group size but even matrimonial relationships?

PACK SIZE

THE MAGIC NUMBER ?

Group living animals never fail to arouse one's curiosity. Take the case of Asiatic wild dogs (referred commonly as dholes). Depending on the forest you are in, the number of individuals in a pack could be 3 or 6 or even 15. But how do these numbers get decided? One might think an optimal group size of dholes is the minimum number of individuals needed to hunt down a prey like Sambhar. Lesser than this would mean the prey could not be hunted and more than this would mean less share in food that each dhole would get. Pretty straightforward right? But doesn't work in real world.

Many a time in nature, the pack sizes are larger than this optimal size because some dholes don’t mind getting lesser benefits than others as long as the benefits of being in a pack are more than choosing to stay alone. So the pack sizes continue to grow till it becomes costlier for individual dholes to join the pack than living alone. But how does this benefit sharing dynamics between dholes operate?

Take the case of sex ratio in a dhole pack. Generally in carnivores the females are more than males in a group (as in lions) or even at a population level (as in Tigers). But in dholes the number of males is more than females. This is because there is a delayed dispersal of males from the pack. The dominant female generally has less reproductive capacity with age and hence the dominant male after few seasons of mating, moves out in search of better females.

This opens up breeding opportunities for sub adult males who may mate with the dominant female despite her reduced reproductive capacity. This option costs less than having to find a pack where they have to be accepted and allowed to mate. Hence these subordinate males don't disperse and the packs have more males than females. Even when dominant male is around, these subordinate males are tolerated when they approach breeding females, as they help the dominant dhole in pup care and in cooperative hunting. There is even more to these group sizes.

The size of a dhole pack also depends on the densities of other predators like tigers in the landscape. In areas of higher tiger densities, the prey availablity is reduced due to competition and the pressure of tiger predating on dhole litters is high. This forces dholes to reduce their pack size. In fact, unlike any other wild animal in dog family (like Wolves, Jackals), dental arrangement of dholes are uniquely evolved to allow for more efficient tearing of the meat of prey, which helps them to quickly finish the prey and escape before it is stolen by larger predators around. Such is the pressure of other predators on dholes.

However in areas of lower tiger densities, these pressures are removed and hence dholes are found to occur in larger pack sizes and in fact are known to suppress the recovery in population of dominant predators like tigers. Phew! Group sizes are not mere numbers.

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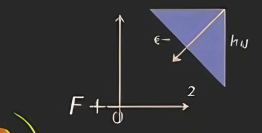

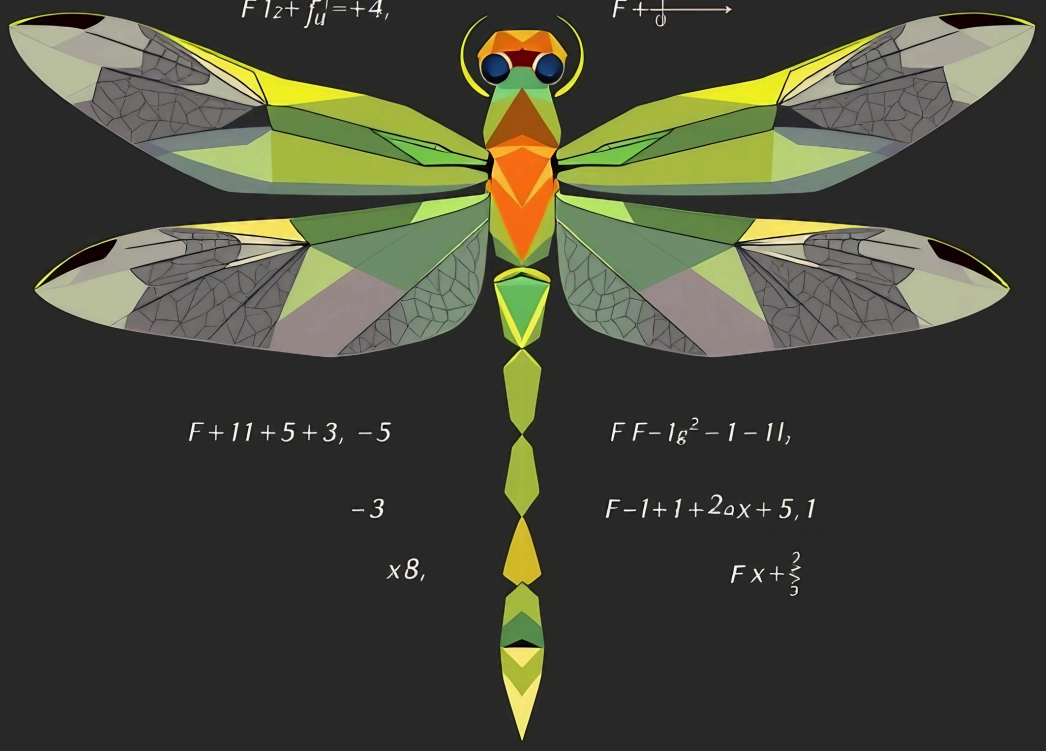

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MOTION CAMOUFLAGE

WHEN A DRAGONFLY CHOOSES TO CHASE

Who is the successful hunter of Indian forests? Tiger? But tigers have a successful hunting rate of only 7%. Leopards? Nah, they also fall somewhere in the same range. It is the Dragonflies that are deadly when it comes to hunting. Visualize this. If a tiger manages to catch a prey 7 times in 100 attempts, a dragonfly catches its prey 97 times in 100 attempts. Phew, that's some feat. But how does a tiny dragonfly manages this? By motion camouflage.

Dragonflies don't just chase the prey like a carnivore but use a technique called motion camouflage to conceal themselves while chasing. Through out the chase, atleast from a prey's point of view, the chasing dragonfly remains stationary until it suddenly appears near it and finishes it off. Let me explain.

Imagine that you are a prey on a train looking out of a window. Objects near the train (like a house) appear to move fast. Objects that are far away (like a mountain) from a train appear to move slow or even stationary. This is because of the angle at which you see these objects. Objects near the train move (relatively) at a larger angle and far off objects at a smaller angle. So if a dragonfly moves in the same angle as a distant mountain(a stationary object) it might seem to you that the dragonfly is also stationary. But the dragonfly takes it a step further, it moves in such an angle (a complex mathematical function of the angle of the mountain) that it keeps moving towards you but still appears stationary. Only its size keeps getting larger. Before you even realise , it's in the position to catch you. Confusing? Think about solving these complex mathematical equations inside the little brain of dragonflies. So much for human intelligence!

SENTINEL

NOTHING UNDER MY WATCH

One of the first species a beginner bird watcher gets comfortable with spotting is a Jungle babbler. Often found in groups, these are one of the commonest birds in our surroundings. However when one begins to observe these birds, one notices that when the group is foraging on ground, there is often a single bird perched at a nearby bush or a branch, which keeps scanning the area. Such individuals are known as 'sentinels' whose role is to scan for predators and alert the group which is foraging. At first sight, it might appear as an altruistic act as the birds have prioritised the welfare of group over their need to feed on ground. But there is more to it than what meets the eye.

Sentinel behaviours in babblers and even in meerkats (the 'Timon' character in Lion king) often result from selfish actions. It is often the satiated bird that goes for sentinel duty. Acting as a sentinel benefits the individual itself as it detects the predator first and hence gets the first chance to escape. Also when it gets hungry, another satiated bird in the group will take over the sentinel duty, allowing it to start foraging on ground. Each individual in the group is just simply choosing the best option for itself, which ends up benefitting the group.

But how do the birds on ground who are busy foraging, know there is someone watching their backs? Is there an evolutionary blind trust? No. The sentinels are observed to give vocalizations (referred as a watchman's song), which announces the rest of the birds that there is someone doing their duty and they can eat in peace. Babblers are one of the most successful birds as this sense of duty keeps on going. One wonders if there is something here that humans can learn.

BEYOND THE HOP

INSIDE A HARE'S HEAD

A night Safari in the forests of Central India is never complete without sighting a hare hopping around on the roads. This hopping around is possible because their hind legs are much longer than their front legs, giving them the ability to generate enough push on the ground. But doesn't all this jumping around cause a lot of shock to their skull, especially when landing? Yes, but hares have something interesting inside their heads.

Visualise a snake that gulps prey way bigger than its size. This is possible because of a skull which is not attached to the upper jaw (often referred as a 'moving skull'). Snakes move their skull to create space, thus allowing their mouth to widely open for gulping. Mammals in contrast, have skull bones which do not move and remain fixed to the upper jaws. This is mainly to inflict stronger bites on prey and for better chewing. Unlike reptiles, this also helps create enough suction for suckling milk from their lactating mothers at a young age. However, the only mammal which has a moving skull is the hare. It is hypothesized that this moving skull helps absorb the shock on the hare's braincase when it jumps. But then, a moving skull creates a different problem- Chewing! Hares can't chew properly with a moving skull and upper jaw. Then how do they digest plant fibres?

To absorb maximum nutrition, digestive systems of herbivores must ferment fibrous plant materials. Deer have special pouches in stomach for fermenting these fibres before they enter their digestive tracts. Others like horses have long digestive tracts which provide enough time for fermentation to happen and nutrition to be absorbed. But, think about a hare. Being small and fast as their main survival strategy, having systems such as above will add a lot to their body weight which they can't afford. Clearly, hares had to come up with a different strategy to digest these plant materials. So, what did they do?

They started feeding on their faeces (known as coprophagy), or that is what people observing hares initially thought. But reality is more nuanced. Faeces are materials discarded out of anus as wastes. But in hares, in addition to faeces, there is a nutritional product which is sent out through anus (which is what was mistaken as faeces). It works like this.

As we already saw, for fibrous plant materials to be digested, they need to be fermented and then nutrient absorption happens in intestines. This is the case in deers where fermenting chamber occurs before the intestinal tract. But in hares the fermenting chamber occurs after the intestines, as a result of which there is no nutrient absorption. Isn’t this a waste of effort then? Yes, but that is why once the plant material is fermented, it is clumped into a wet, sticky ball and is exited out of the anus and is fed again by the hares. This is known as Cecophagy, which is what is mistaken as hares feeding on their faeces (coprophagy). This way the hares manage to get their nutrition.

But if movable skulls and cecophagy weren't quirky enough, hares differ from many of the mammals in reproduction as well. If you remember, many female mammals have an ovulation cycle and fertilisation will be successful only when a male mates with the female during ovulation. Any mating outside this period will not result in conception. However, in hares, the ovulation of female is induced- meaning egg is produced in the female body only after being stimulated by mating. This means a male hare can mate with a female anytime without having to wait for the female to reach ovulation phase. Now what can explain that? We do not know, but induced ovulation makes sense in mammals which are widely dispersed and where encounters are less frequent, which is the case in hares.

But what is more interesting is, think from the view point of a female hare. In many other species, females have to judge the reproductive fitness of a male before choosing to mate. The choices might not be the best every time. But in female hares, ovulation happens only when stimulated by mating- meaning she conceives only when the 'fittest of the male' who can stimulate her, mates. Now that is a bar a male hare can't just fake with colourful plumage or large horns!

GREEN SECRETS

DO PLANTS DIE OF OLD AGE?

Coming from the animal kingdom, we humans are always worried if we could last for 100 years. But in the plant kingdom, it is very common to find a thousand year old tree. In fact the oldest tree in the world is about 5000 years old. How are trees able to last this long?

Don't they just die? They do, not of old age but only by external factors like storm, disease or non availability of nutrients. In fact, trees do not age the same way we from the animal kingdom do.

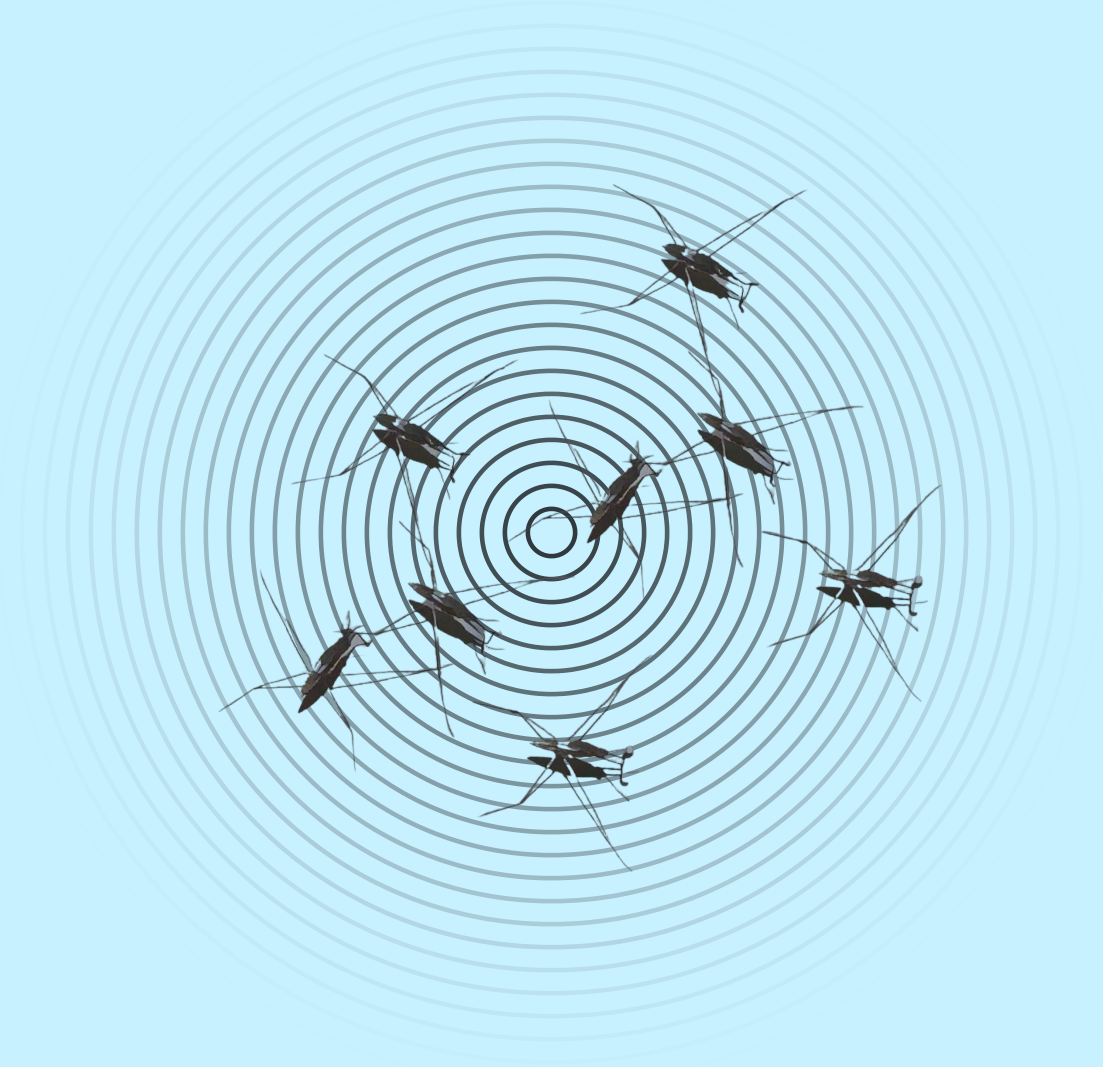
One can think of ageing as cells losing their ability to divide and multiply. And that is what happens in animals - their cells stop multiplying or become very inefficient in the dividing process after certain years. And eventually the animals die.

Wait a minute. Plants also have cells, so don’t their cells stop dividing? No. In addition to normal cells, plants have something called a meristematic region. This region has undifferentiated cells that can continuously divide and differentiate into various plant tissues. There is a meristem in the tip of a plant which allows it to grow vertically.There is also a meristem in the trunk of the tree which continuously produces newer tissues which we see as the ever enlarging stem of the tree. In fact it is because of the meristem that trees can regrow their leaves or branches even when they are cut.

So why didn’t animals develop this meristem during the course of evolution? We can only guess, but here are some probable explanations- First, it relates to how they obtain energy (food). The inability to produce their own food meant animals had to move to hunt, and it wouldn’t help if their body sizes kept growing. Imagine a jackal the size of an elephant trying to chase a hare.

Second, relates to the complexity of the system. A moving animal requires a lot of complex parts working together to either hunt or escape. If some parts kept growing while others didn't, it could mess up how everything worked together. In addition to this, having to do complex tasks means that animal cells have to divide and grow to form specialised cells like brain cells or muscle cells. As cells specialize, they often lose the ability to divide or change into other types of cells. It's like a worker becoming so good at one job that they can't easily switch to another.

So, is being stationary and having the ability to produce their own food the secret to plants' longevity?



RIPPLES

WHEN WATER STRIDER WOOES

When you walk near small streams or water puddles in forest areas, you might find some swift moving spider like insects on the surface of water. These are known as water striders and they are not just floating in water, they have an unusual ability to walk on water which is the closest in the natural world we have to what Christ does in Bible. But how do these water striders do that?

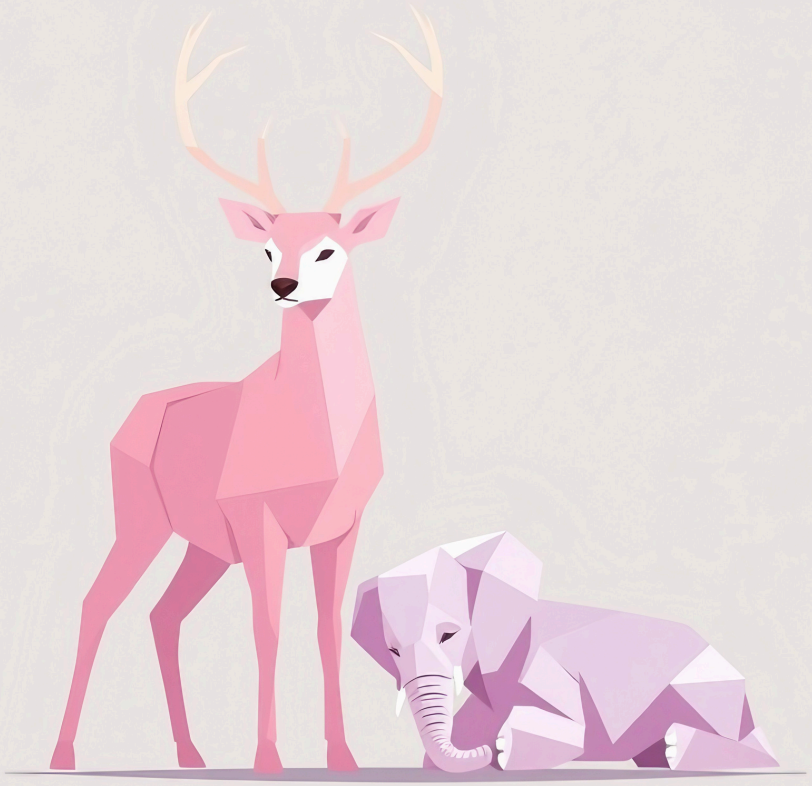
The legs of a water strider are long and slender, allowing the weight of the water strider to be distributed over a large surface area. There are also thousands of microscopic hairs on the surface of these legs which repel water. Even when striders are submerged in water by sudden water inflows, these hairs trap air bubbles to give them buoyancy to raise them back to the water surface. If walking on water is not enough, these striders fascinate even more by the way they communicate.

Water striders produce ripples in water surfaces in different frequencies and each has a story to tell : a 25 Hz water ripple as a repel signal, a 10 Hz ripple as an alarm signal and a 3 Hz ripple as a courtship signal. Interesting, but is just creating a 3 Hz water ripple by a male strider is what it takes to win over a female? Not at all. Males after courting a female, mount over them and do something scary (in human terms).

Female water striders have evolved a “genital shield” to guard against unwanted males mating with them. In response, the male water striders have evolved a strategy so that the female is more likely to submit to advances. The male taps the water’s surface in a way attractive to aquatic predators. Since the female is beneath the male, and nearer the water, she will be the one first gobbled up by a fish or other hungry creatures. Thus, it behooves the female to mate quickly and not deploy the shield. So the next time you dismiss ripples on waters as ordinary waves, care to see if a male water strider is wooing a female nearby.

ODD VS EVEN

WHY CHITALS DOMINATE ELEPHANTS?



When you move across any forest in India, you start realising that the forest has many types of ungulates (animals with hooves). Among them, the even toed ungulates like Chital, Sambhar, Barking deer, Chausinga etc generally out number the odd toed ungulates like Elephants, Rhinos and Wild asses. In fact the forests of India are dominated by even toed ungulates only. Why is that the case? To understand this, one must understand the changes that happened in the plant kingdom.

66 million years ago i.e by the end of Cretaceous period, a mass extinction event happened (amongst which dinosaurs too went extinct). Post this event, there was a rapid rise in flowering trees and plants, which were filling the void left by ancient plants. Simultaneously the void created by dinosaurs was being filled by the mammals which included the plant- eating odd toed ungulates: the ancestors of Elephants, Rhinos, Giraffes etc.

These ungulates had a simple digestive system and they fed on large quantities of plant material that were becoming abundant. However during the Oligocene- Miocene epoch, there was a global cooling. As a result, the forests began to recede and the land was beginning to be dominated by the grasses. And this is where things got interesting.

Till now our odd toed ungulates were feeding on plant material which were relatively easier to grind and extract nutrition. But rise of grasses meant a different game altogether. Grasses were rich in fiber with a higher silica and lignin content which the digestive system of odd toed ungulates weren't able to negotiate. And this is when the even - toed ungulates began to dominate. Some of these even toed ungulates had complex digestive systems which were able to ferment the grasses (breaking down these hard grasses by microbes). Also they began to ruminate (yes the continuous chewing which we might have observed the Gaurs, Chitals performing in the shades of our forests). All this enabled these ungulates to extract more nutrition from resource depleted grasslands.

And this meant, the even toed ungulates began to displace the odd toed ones, and became dominant in a changed world which continues till this day. The next time you see a Chital or a Gaur grazing in our meadows, remember: it just took a new digestive system to dominate the Indian forests.

BEYOND ROMANCE

A NATURE'S 101 ON LOVE

Everyone understands reproduction. But have you ever wondered why there is a male and a female in a species? Or the numerous ways in which these male and female animals mate and make families? In fact billions of years ago, life was much simpler. Single-celled organisms would meet and exchange genetic material by merging similar-sized cells. There was never a male and a female cell. But soon things began to change.

When a new cell forms by merger, it always helped if there was more food material within the cell. This meant there was an evolutionary pressure for cells which are bigger with lots of food to be selected by natural selection. But it should be costlier to make those cells, right? So only few were produced. The moment this happened, there was an opposite pressure that began to operate.

As bigger cells were being produced, there must also have been smaller and medium-sized cells trying to merge with the bigger cells to access more food. However, smaller cells had an advantage. First, they were relatively cheaper (energy-wise) to produce. Second, they died and were replaced by other smaller cells quickly, which meant they were evolving faster with better genetic traits. As a result, the medium-sized cells lost the battle, and only two types remained. Smaller cells, which were being produced in larger numbers (sperms), tried to merge with cells produced in smaller numbers (ova). And that's how males (sperm-makers) and females (egg-makers) came to be!

Since males could make lots of sperm quickly, they often competed for females who produced fewer but more precious eggs. But then why don't we just see males winning a single female, forming a family and choosing to live happily ever after? Are they even choosing? This is where things get interesting.

Take mammals and birds. Most mammals are polygynous (males mating with multiple females) while most birds are monogamous. Why? Female mammals have the ability to lactate (produce milk) and hence many times a male doesn't need to be present for providing food for the young. Also in mammals the gestation period of a female (the duration between conception to birth of young ones) is long. So the female generally can't desert a relationship while a male can. So the male tries to increase his reproductive success by seeking new mates, and hence polygyny is more common in mammals. But this is not the case with birds. Because there is no female lactation, male birds often have to provision food for the young. In many birds like raptors, the young ones are born naked and blind, so the female must guard them while the male goes hunting for food. Both sexes have to co-operate in parenting and hence monogamy seems to be more common in birds.

Of course this is a macro view. Within mammals and birds, there are other factors which change these mating systems. Take pheasants, for instance. Unlike raptors, they are precocial meaning their young ones are relatively mature to move and feed immediately after they are born. So this reduces the pressure on the male to parent and hence polygyny is more common in them. Then, is it all just the physical traits of a species which dictates mating choices?

Not so easy. There are ecological factors at play as well. Have you observed the weaver birds who are readily recognized for their elaborate nests on trees? There are some species of weaver birds which reside in forests and they are mainly insectivorous. Because insects are dispersed in the forest and finding them is difficult, both male and female weaver birds have to stay together to find and feed their young ones and hence they remain monogamous.

However there are other weaver birds who have evolved to feed on seeds. Because grasslands have plenty of seeds, they reside in such habitats. They need thorny trees like acacia for nesting in grasslands (as it gives protection in a open habitat), and the males compete to defend such trees. So, many female birds flock to males that provide these nesting trees, and because grasslands supply plenty of food for them, they do not seek male help for parental care either. These weaver birds are hence polygynous. All these might sound as if the females are at the receiving end of reproductive responsibilities but that is not the case.

Interesting things happen when we turn to fishes where male parental care is more prevalent. This is because unlike other species, fishes have external fertilization. Female lay eggs in male territory and male releases sperms to fertilize it. Because the male is already guarding the territory for the female to lay eggs, he continues to guard the eggs after fertilization as well. In fact, many females prefer males who continue to guard the eggs, meaning the chance to attract a mate is still available for a male that is caring for the fertilized eggs.

In shore birds like Jacanas or Sand pipers too, role reversal happens.The females of these shore birds generally have limited clutch sizes. And unlike tree nesters, their eggs are more vulnerable to coastal predators like crocodiles due to the exposed nature of shores. So the only way a female can increase its reproductive output is to lay multiple clutches of eggs. And for ensuring genetic diversity, they have to mate with multiple males as well. With female busy managing male harems and matings, it becomes the duty of male to guard eggs and care for the young. No wonder there is more of female desertion in shore birds with male doing all the parenting. Phew!

How much ever cultures romanticise the life lasting pair bonds of Sarus Crane or villainize Langurs for their promiscuous harems, nature clearly doesn't follow our storybooks. What we see as romantic or scandalous are simply different solutions to life's greatest challenge: passing on genes to the next generation. May be in this grand experiment of evolution, there are no villains or heroes - just countless fascinating strategies that have stood the test of time!

FUNGI

DECOMPOSING THROUGH FUTURE

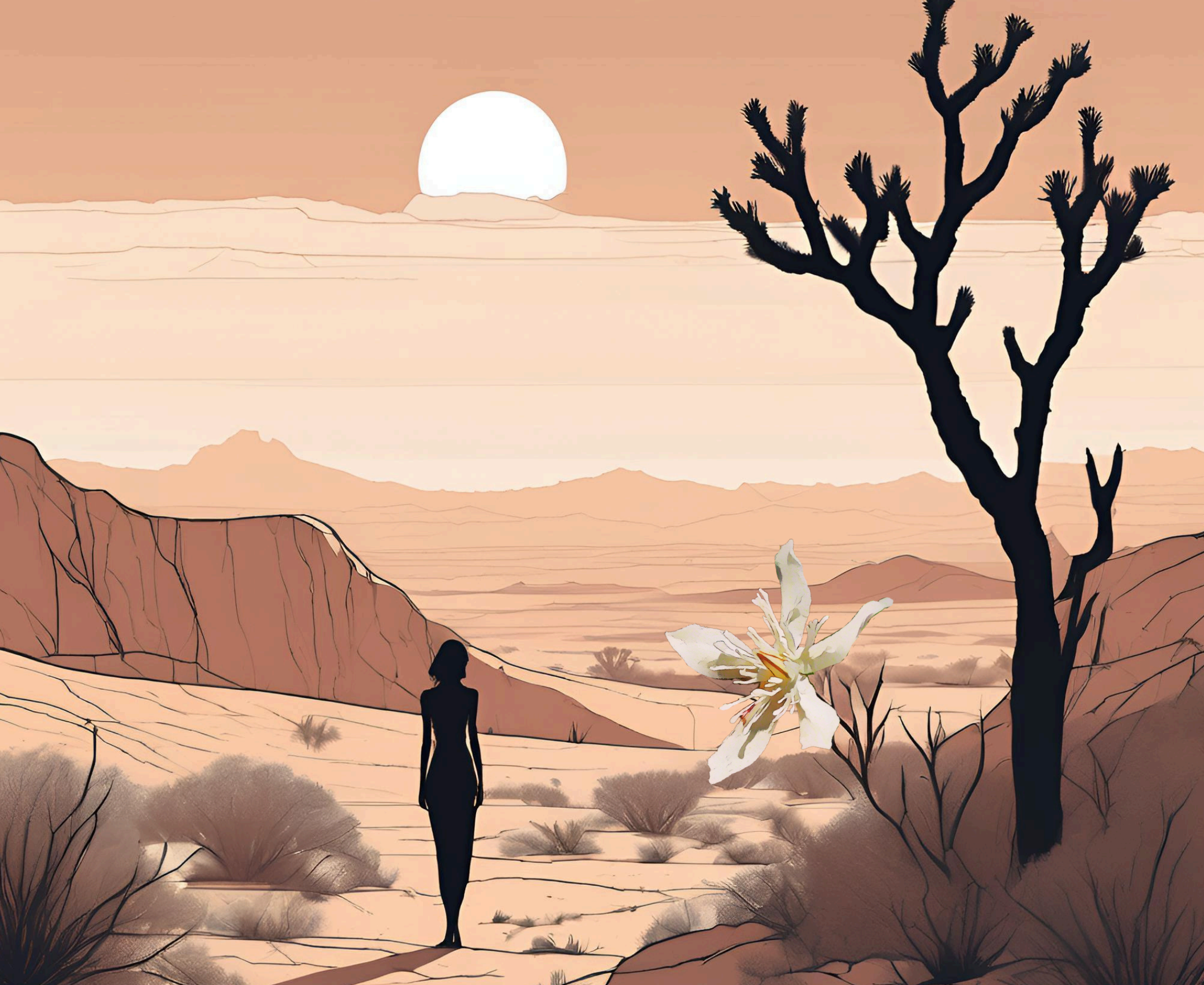
Let us travel back 300 million years to the Carboniferous period. Vast forests were beginning to cover much of the land. As these plants died, their remains accumulated on the forest floor without decomposing. Where were the bacterial decomposers to get rid of the dead matter? They were there, but terrestrial plants were posing a new challenge to the decomposers. As early plants moved from the aquatic environment to the harsher land environment, they evolved to be covered with lignin — a hardy, resistant material. Nothing could effectively break it down. Dead plant material lying on the ground meant not just zero space for new tree growth, but also a lot of trapped carbon that wasn't being released into the atmosphere — which could have caused rapid cooling of the Earth.

But luckily, the Earth already had someone on the scene. It was an organism that was neither a plant nor an animal — a fungus. What was so interesting about it? For the first time, an organism had the ability to digest lignin and absorb nutrients from it by releasing enzymes. But wouldn't these enzymes harm the fungus itself? No. As it turns out, these fungi were covered by a resistant material known as chitin, which, incidentally, is the same material that makes up the outer layers of insects.

But is just breaking down lignin or other organic matter enough? Weren't bacteria already able to break down organic matter? Yes. But when it came to absorption, bacteria could do it only through their cell membrane, which meant limited surface area for absorption. Fungi, however, had the ability to generate a network of cells known as hyphae (visualize a spider's web), which absorbed nutrients from anything that came in contact with its surface. Because the hyphae could grow extensively, they increased the total surface area for absorption. The hyphae were also able to penetrate dead or living matter, so no nutrition remained beyond the reach of fungi — a capacity bacteria did not possess. Moreover, while digesting this matter, fungi were able to produce spores to disperse and spread to new sources of dead matter. In fact, the mushrooms we immediately recognize as fungi are simply the spore-producing structures of fungi.

While fungi might be the last thing a person might care to notice in a forest, all the above traits of fungi that changed the world are proving to be useful once more. We humans always fantasize about colonizing space. But once we land, where do we live? How do we build a house? What about the furniture? To solve these architectural problems scientists are turning back to fungi.

Remember, fungi evolved a billion years ago on Earth, when there was high radiation and extreme temperatures — conditions that humans will have to face once they reach space. Because fungi, through its hyphae, can grow on any substrate and into any mold (say, the shape of a house), all while dealing with cosmic radiation (some fungi even grow by absorbing radiation), they might become the next brick and mortar for human space architecture. An organism that made Earth a living space for us might also help turn the next planet we land, into our home.



WRIGHTIA TINCTORIA

PAIN IN A BLOOM

My heart that worshipped my lover
has gone with him,
On a path where tigers roam,
Palai trees abound
with clusters of fruits that are like tongs,
their white branches fibreless
since the barks are torn
by female elephants with big nails...

...I remain here, lovesick and facing endless
slander..!

This is an excerpt from a poem in Sangam literature (Natrinai 107). One could immediately feel the harsh emotions the woman goes through.

In Sangam literature, the emotions continue to happen in the mindscape of human beings. But when this emotion is taken out from heart and placed in a natural landscape, that is when Sangam poetry happens. For the poem to work, the natural element chosen must reflect the human emotion.

Across Sangam literature, the emotion of separation of love is symbolized by an arid landscape with a tree known as Palai (Wrightia tinctoria). Of all the trees in an arid area, why does a poet choose Palai? Standing here in 21st century, one can only guess it. But here is a hypothesis.

Most of the trees, or any higher order life forms for that matter, try to mate with a genetically different individual to ensure a successful offspring. One can see this emphasized across human cultures too. But Palai is a tree where self pollination happens. The flower of the tree has a cone in the middle inside which both male and female parts are present alongside the nectar. An insect trying to reap the nectar puts its probe into the cone, but once finished feeding, finds that its probe is stuck. So when it tries to remove its probe from the cone, the pollen falls on the female part within the cone and reproduction happens.

The reason the Palai tree has evolved such a strategy is that, in an arid landscape, reproductive parts dry up easily, and one cannot rely on a bee or the wind to carry its pollen to another tree. So, the tree self-fertilizes in response to the harsh landscape it inhabits. No wonder this tree symbolizes the arid geography and the emotions it holds. For a poet to choose this tree, imagine how much insight into nature he or she must have had before putting those emotions into words!

FROM NEST TO NEST

A CUCKOO’S MASTERCLASS IN DECEPTION

One of the first stories one hears about birds in one’s childhood is a cuckoo laying its eggs in a crow's nest. Sadly, that is the last time one thinks about it too. The above behaviour of cuckoo is known as brood parasitism and different cuckoo species parasitises different birds, not just crows. But have you ever wondered what it takes for a cuckoo to achieve this? Let's begin with basics.

A cuckoo's young one needs to feed on invertebrates like insect larvae, caterpillars etc. So this means a mother cuckoo cannot choose the nest of a seed/fruit eating bird. A female cuckoo is also relatively larger in size and hence it cannot choose a bird that lays its eggs in a hole in the nest. So once it has chosen an insect feeding, nest making bird, things should be pretty straight forward? No.

First the cuckoo has to time its egg-laying when the host bird is not around. So it should have an absolutely faster laying time (less than ten seconds) so that it quickly grabs a host egg, replaces it by laying its own and flies away. Now, is it done? Not yet.

It is the time for host mother to respond. Birds generally have better colour vision than humans and so host mothers start discriminating the cuckoo eggs from their own by evolving to lay eggs with unique patterns and colours. Now the cuckoos too begin to mimic host eggs to deceive the host birds, and this egg arms race continues.

All the while the mothers are playing this evolutionary race, the chicks can't stay idle. The survival game has to be played by the cuckoo's chicks too. Cuckoo chicks have some of the shortest incubation periods (they have to hatch earlier than the host eggs) and even when blind and naked, they start ejecting the host eggs out of the nest, to be a lone choice for the host mother to care for.

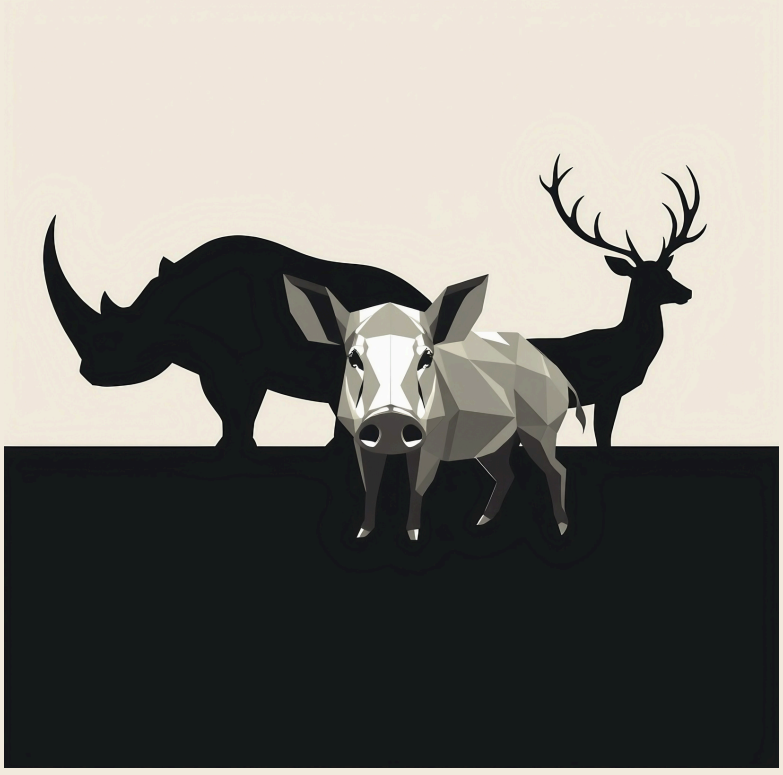
But wait. Didn't we just learn that birds have better colour vision? Even if the egg mimicking might deceive the host mother, after the chicks hatch, the host mother should have identified the chicks as not one of its own and rejected it. Because consider this- cuckoo chicks grow larger than host chicks and even larger than host mothers at times. Also, Cuckoo chicks have beak colours which are completely different than the host birds. So when host birds have evolved to reject eggs that are visually different from theirs, why not just do the same to the cuckoo chicks?

This is because rejecting chicks is a costlier choice for the host mother than rejecting the eggs. To answer this, let's assume a host bird lays eggs for the first time and it is parasitised by a cuckoo egg. The host birds do try to reject cuckoo eggs by analysing visual differences but because recognition errors happen, sometimes they reject cuckoo eggs and sometimes they reject their own eggs. Because it can go right or wrong for the bird, it is indeed a costly choice for it to make and still the bird takes this risk. Why? Consider the other option of rejecting after chicks hatch.

Let's say the cuckoo chick has hatched and it has ejected all the host eggs and the only chick the host bird sees is that of the cuckoo. Then the host assumes the cuckoo to be its young one and would continue to reject its own birds in the future even if the cuckoo doesn't parasitise the host bird. This is even more costlier a choice. That is why, for host birds 'accept every chick' is better than abandoning, once the eggs have hatched. Phew! That's some strategy for a cuckoo.

BEYOND CROP DAMAGAE

KNOWING THE WILD PIG



They damage crops and something needs to be done’ is the only lens through which wild pigs are viewed in India. But how much do we actually understand about one of the most widespread mammals on Earth?

Wild pigs originated on the islands of South East Asia during the early Pliocene climatic fluctuations about 3–4 million years ago. They are even-toed ungulates (like the Chital or the Sambar), but they do have certain traits of odd-toed ungulates (like the Elephant or the Rhino). Why do we say that? Even-toed ungulates are often characterized by their ability to ruminate and by their specialized digestive systems — both of which enable better absorption of nutrients from plant material. And wild pigs are the only even-toed ungulates which lack both. They have the odd-toed ungulate's digestive systems in which digestion is relatively poor and excretion happens well before proper absorption of nutrients from ingested food. Incidentally this is the reason they feed more food (and come in conflict with farmer crops) to get the required nutrients, an important compensation mechanism for a lower digestive efficiency.

Back to their evolution story. After their emergence, they soon began to spread through most of Eurasia and Africa. But what enabled them to spread this rapidly? Of course their digestive system allowed them to feed on any food available, thus making them adaptable to a varied environments. But another enabler for their spread is their rapid population growth. Unlike any other ungulate, the females reach sexual maturity at a very early age (at just 6-10 months of age). The implication is that, in addition to adult females, even sub adult females may begin to breed when resources are available. All these contribute to the rapid rate at which wild pigs' population can grow, thus allowing the newer population to spread to different places.

While reproduction is prolific, life isn't easy initially for these young piglets. Compared to other ungulates, neonatal piglets are very small and have very little body fat and are unable to effectively regulate their body temperature until approximately 2-3 days and sometimes even up to 2 weeks post birth . Hence adult females generally make nests of twigs, leaves and straws on the ground to provide young piglets protection from weather and possible predation. One can spot these nests during the breeding season of wild pigs.

In terms of temperature regulation, even the adult pigs don't fare that well. Pigs do not have functional sweat gland as a result of which their body gets heated up fast. So how do they deal with this? Mud baths, of course and that is why wild pigs can often be seen wallowing on mud beds to cool their body.

While we often miss the ecological nuances of wild beings in general, this is even more true for species that come into conflict with humans. But how can one manage a species without knowing about it?

THE ULTIMATE PUZZLE

LIFE OF BAMBOO

Is there anything more mysterious in plant kingdom than Bamboo? Consider this- Bamboo is a grass yet it competes with trees in many of the forest areas. Bamboo is the fastest growing plant with some species growing 3 feet in just one day. It flowers only once in its lifetime and that too might happen as late as 120 years. Adding to this, the flowering happens synchronously . Any bamboo cut from such a bamboo will also flower regardless of wherever it has been planted in the world. And all of them die immediately after flowering as well. What can explain all of these?

Let's address the growth puzzle first. Unlike many trees, individual bamboo shoots emerge from the ground at their full diameter and grow to their full height in a single growing season i.e. in three to four months. After that there is no change in their width or height unlike trees which continually keep growing all through their life.

Now why is that? Trees generally grow by cell division. Cells divide, new cells are added to the plant which is what we observe as height or stem diameter. But in bamboo, or in any grass for that matter the height is not due to cell division. The shoot we see, in its miniature size with all the nodes, is already produced underground. When the shoot emerges out, the cells just elongate vertically and that is what we see as the growth of the shoot. Basically there are shoot cells which produce certain special chemicals that make the cells flexible and inflatable. Once the shoot cells come out, they just start elongating.

But then, not all grasses with similar cell elongation grow to the height of bamboo, right? Yes, that is because in other grasses, as the cells elongate, the cell walls thin out and weaken due to stretching, thus limiting the height to which the grass can grow. Bamboo however has evolved to deposit more layers in its cell wall to strengthen it and keep elongating. It is hypothesized that, this trait evolved as bamboos generally grew in forest areas where it had to keep pace with trees to access the sunlight (In fact bamboo is one of the most light seeking species in forest).

But why doesn’t the bamboo grow along its width the way a tree's stem grows? The cells of bamboo are such that the elongation happens only in the upward direction and not sidewise, and without any cell division as well, the diameter of the bamboo is also never changing once it has emerged out of the ground.

Now that the growth puzzle is sorted let's move to the next- The synchronous bamboo flowering followed by death. There are many hypotheses, but here is a plausible one. Remember bamboo trying to grow rapidly to outcompete trees in forest ecosystems? When we said trees grow thicker in diameter by cell division, it also means the trees can remain sturdy for many years. Continuous growth also means newer vessels to carry water are being created in trees, to replace the older ones which worn out due to hydraulic stress. Bamboo lacks all these, yet how does it dominate the trees?

Consider a patch of land in which a particular bamboo species (A) flowers once in 30 years. Let's assume another bamboo species (B) invades that area and it flowers once in 15 years. It is easy to see that this invading bamboo will fail when it flowers in 15th or 45th year because it's seeds will germinate and die under the closed canopy of the existing bamboo A. But now consider another bamboo species (C) flowering once in 60 years, invading this area. Unlike the bamboo B, this species will successfully invade because in the 60th year both the species A and C, will flower and die and both seeds will have an opportunity to grow. But after 15 years (i.e. the 75th year), species A again flowers and dies, but this time the seeds are under the canopy of already grown species C and hence will fail under shade. In short, a species that flowers synchronously and in intervals of higher multiples of a resident species dominates in long term and that could explain the longer flowering intervals we see today. Of course these are hypothesis that need to be tested in different geographies.

But how does a bamboo cut from a synchronously flowering bamboo and planted anywhere, also flower at the same time? Is there a "memory" or an internal "alarm clock" in the bamboo that triggers flowering after specific intervals? Now that is a mystery beyond hypotheses, at least yet!

PREY IN PLAIN SIGHT

SURVIVAL ETCHED IN FUR

Anyone who has tried some pencil drawing would know that to make an object look solid on paper, one has to add shades and shadows to the object. This is because human eyes (many animals) detect shapes and depths using this shading effect. If that is so, wouldn't a prey animal have an advantage if it somehow counters this effect to deceive a predator? This is exactly what is happening in few of our deers like Chital and antelopes like Blackbucks.The first thing one observes in these animals is the dark coloured upper body with a light coloured underbelly. Wait a second. If the objective of these animals was to deceive the predator, wouldnt this color contrast make them easier to be detected? No, not when the sun shines from above.

Imagine a stone lying on the ground in bright daylight. The upper part of the stone will appear lighter as the light shines on it and the lower part of the stone will appear darker because of the shade. This creates a contrast and makes the stone easily visible. However if the stone is dark colored on the top and light colored at the bottom it will cancel the effect of sunlight and shadows. There won't be a contrast and it will be difficult to detect the solid shape.This is the technique that is appearing in the animals with a light shaded underbody. This is called countershading, one of the many camouflaging techniques used by prey animals. Now one might wonder, why don’t deer species like Sambhar show countershading? Does this have something to do with the habitats which a Chital prefers vis a vis the one Sambhar does? Keep observing.

THE BATWAY

FROM FIG TO FLIGHT

Bats! Barring the Batman movies of Christopher Nolan, when was the last time we wondered about bats? Caves of many of our forest areas teem with these winged creatures. Being the second largest species group in mammals, bats are broadly classified into two major groups- One being the Megabats (fruit/nectar eating bats) which are more common in our forest areas and the other, Microbats (insect eating bats). Remember the fox/ dog faced bats we might have spotted in caves or in the large trees near our residence? These are the fruit eating megabats commonly known as flying foxes.

But how do these megabats move out in night to feed? Echolocation right? No. Think about it. Megabats eat fruits and nectar for their living. So most of the megabats have evolved strong sense of smell and large eyes to detect them at night. Why need to echolocate, when one can smell or see a fruit, right?

Contrastingly, it is the insect eating microbats who evolved to have echolocation to identify their moving targets. You can identify microbats from the presence of longer ears instead of larger eyes (a character missing in megabats).

Now that eating food is off the table, how do bats quench their thirst? Bats are generally not able to land on water. Neither do they dive to drink. Instead they fly so low that their body is touching the water and after landing somewhere nearby, lick water off of their body. Strange. But stranger is bats hanging upside down. Now, why would a species do that?

When you think about a bird or an insect, and contrast it with a bat, you can immediately sense that bats are too heavy for flying. Taking off to flight for a lighter weighing bird might be easy. But that is never the case for a heavier bat. So for easy take off, the bats hang upside down so that when they fall, they generate necessary motion to initiate flight.

The more you observe bats, the more you realize that for every normal way, there is a bat way of doing things. Take longevity for instance. Generally it is observed in mammals (and many other animals as well) that larger body sized animals (say an elephant or a whale) live longer than smaller ones (like a mouse). This is because larger bodied animals have slower metabolic rates (less active) and thereby take longer time for life functions to deteriorate. But the only mammal that breaks this trend is the Bat.

On average, the lifespan of bats is 3.5 times longer than that of a mammal of similar size. This is despite the fact that every time bats fly, their heart rate rises to 900 beats per minute and their body temperature rises to 41°C. A similar condition in another mammal might qualify as a medical emergency — but not in bats. With longevity being a pursuit for humans since time immemorial, it is time we start observing these winged beings, at least to add a year or two to our own lifespans.

MOTION IN STRIPES

MECHANICS OF A PALM SQUIRREL

Whenever one spots a palm squirrel in Indian forests, one often experiences a strange feeling. Having watched the little creature around households, spotting it in a forest makes one question if it is wild or a domesticated animal. But palm squirrels along with pigeons, rhesus macaques etc fall into a category known as 'synanthropes'. These are animals that have benefitted from human modified environments thanks to abundant food resources and lack of predators and yet they are beyond the control of humans (hence not domesticated).

The word 'Squirrel' is derived from the Greek word skiouros (skia meaning ‘shade’ and oura meaning ‘tail’. Basically squirrels are rodents with fluffy tails. While intuitively we understand that the tail helps in providing balance to squirrels while climbing trees, the more fascinating role a tail plays is thermoregulation. True to its Greek name, the tail is used by squirrels like a shady umbrella to shield their bodies during excessive heat. Even more interestingly, whenever their core body temperature rises, warm blood is diverted into the tail to dissipate some of the heat, much like a radiator in a car.

Another interesting aspect of the palm squirrel is its ability to climb down a tree. Because we see squirrels climbing up and down the trees all the time, we never wonder about the mechanics involved in it. In fact squirrels are one of the very few mammals that can descend a tree, head-first. They do so by rotating their ankles 180 degrees, enabling their hind feet to point backward and thus grip the tree bark from the opposite direction.

One other common image we have is squirrels collecting nuts and hiding it underground or under leaf litters. While this might work in temperate regions, in tropical humid areas such ways of storage may lead to fungal growth, decomposition or even germination. So squirrels in these regions generally place nuts in the gaps between tree branches. Interestingly, many plants we find growing on trees might be from a seed stored and forgotten by a squirrel!

But are all the palm squirrels the same? No, there is a North-South divide in these squirrels with Northern Indian ones (Northern palm squirrel) having 5 stripes at their back and the Southern species (Indian palm squirrel) having 3 stripes on their back. So which of these species is part of the Ramayana legend where it is believed that the stripes on the back of the squirrel were the caressing marks of Lord Ram's fingers? While you contemplate this, let’s pause. Why are there stripes in the first place?

In fact, when you think about many of the giant squirrels, such as Maharashtra's state animal (the Indian giant squirrel), they are dark-coated but do not have stripes at all. What explains this? One hypothesis is that giant squirrels are generally found in dense tropical forests, where the dark coloration provides sufficient camouflage (due to limited light penetration in tropical forests caused by the canopy), making stripes unnecessary. On the other hand, palm squirrels are found in open habitats where camouflage is a challenge. Hence they go for dazzle camouflage which involves presence of stripes or other shapes on bodies to create visual distractions to predators.

Unlike other forms of camouflage, the intention of dazzle is not to conceal but to make it difficult for a predator to estimate the squirrel's range, speed and direction of motion, thus improving the squirrel's chance of escape. Such dazzle camouflage inspired from nature were painted on War ships of World War I primarily to mislead the enemy about a ship's course and thereby causing them to miss the firing. Isn’t the squirrel an engineering marvel of nature?

BEYOND THE COLOURS

SCIENCE BEHIND A PEACOCK'S SPECTACLE

"Sight of a feather in a peacock's tail, whenever I gaze at it, makes me sick!," wrote Charles Darwin in 1860, as peacock didn't fit in his theory of natural selection - To him, the large feathers in the tail of a peacock (known as 'train') appeared more of a burden to the bird, than providing any physical advantage in its survival. So was it all an evolutionary waste of energy for the bird?

Not really. While one aspect of explaining evolution involves male individuals evolving strategies to dominate other males (for instance, Chital evolving antlers), evolution also has another driver- Males evolving strategies to signal its fitness to a female. Something similar is happening in peacocks. While the long feathers are indeed a physical burden, the very presence of it is a signal to the female that the male is in good body condition to maintain a long train feather. It is also argued that it is an honest signalling strategy, as a weaker male will never be able to mislead a female into mating by growing longer train feathers (as it is prohibitively expensive to maintain one).

In fact, it takes a full three years for the train feathers to develop in a male, until which time a peacock and a peahen appear very similar. So how can one distinguish between the two? Look carefully at the neck: it is blue in the male, whereas it is green in the female. One wonders what could be the reason for this colour difference.

Speaking of colours, any guesses on how many pigments go into making the spectacular feathers of a peacock? 4,5,6? Surprisingly, the feathers are made of a single melanin pigment only (which gives the feathers a dark appearance, especially the eyespot). The remaining colours we see are an outcome of something known as 'structural colouration', where sunlight interacts with the structures on the feathers to create colours. You can visualise it this way- creating colors using tiny mirrors and prisms built into a surface, rather than painting that surface. Only that the structures in feathers itself act like prisms. But why would a bird opt for such a strategy?

Remember that the point of all was to signal a female? It is structural coloration that allows for multi-coloured shiny effects, where colors shift and change with viewing angle - a way to grab attention of a female. Of course a male investing so much time in displays, naturally falls short in its parental duties. It is the mother that ends up taking care of the eggs and the hatched young ones. Luckily for the female, the peachicks are able to walk and forage on their own immediately after they hatch thus relieving the burden of their mother in nurturing them in a nest. Some solace!

But, wait a minute. Some of us might have seen white peacocks in captivity. If colouration of feathers were due to the structures than pigments, why are the feather trains of white peacocks not colourful? Most of what we understood about peacocks till now were from work done outside India. Despite it being our national bird, what was obviously lacking was a curiosity to actually know about the bird. So why don't we start exploring the question of white peacocks?

BEHIND THE BUZZ

HOW HONEY BEES REWRITE GENDER RULES

In many of the colony living insects like honey bees, we might be aware that their society has the following members- a female queen bee, female worker bees and male drone bees. It is the female queen bee and the male drone bee which reproduce, while the female worker bees don't reproduce and only help in raising the young of the queen bee (which are often their sisters). Now this is weird right? Why would a female worker sacrifice her own reproduction and instead raise the young of her mother? In fact, why is the mother queen bee so supreme? Why isnt there even a king bee? All of these have to do with the way reproduction happens in honey bees.

We know that asexual reproduction usually happens in lower forms of organisms and sexual reproduction happens in higher life forms. But in honey bees, life is different. A queen bee can reproduce both sexually and asexually. The queen mates with a male drone bee to lay fertilized eggs, out of which our female worker bees emerge (sexual reproduction). How do male bees emerge then? The queen bee can produce a male bee without even having to mate with an adult male. The queen bee just produces unfertilised eggs from which male bees emerge (asexual reproduction). But how does this explain the sacrificing nature of the female worker bees?

Think from the perspective of the female worker bees who have just emerged from the above system. Each of them received half of their chromosomes from their mother and half from their father. This means they share more than 50% of their genetic material with their sisters. If a female worker were to give birth to a male or a female, only half of her genome would be passed on to her offspring — which is less than what she shares with her sisters. Thus, there is an incentive for female bees to remain workers, not reproduce, and instead focus on caring for the offspring of their mother, the queen bee. In this way, they help ensure that a greater proportion of their genetic material is passed on to the next generation without having to reproduce themselves.

Interesting, but how does this explain the absence of a king bee? If you had noticed, the sex of the individual coming out of the egg of a honey bee is dependent on whether fertilization has happened or not. A female bee comes out of a fertilized egg while male bee comes out of an unfertilized egg. This however is not the case in say a human or a bird where sex of the offspring is determined not by fertilization. In fact, all offspring come out of a fertilized egg and their sex is determined only by the sex chromosomes (men have XY and female have XX chromosomes).

Because fertilization determines sex in honey bees, the female gains a dominant position. But wait. Like honey bees, termites also live in colonies and have queen termites. However, they also have a king termite. Why isn’t that the case in honey bees? This is because, in termites, the queen is always dependent on the king for sperm. But in honey bees, the queen stores male sperm long-term in her body and can control fertilization without the active presence of a male bee. All of this has led to the honey bee colony being dominated by the queen, without a king. Who would have imagined that the 'Game of Thrones' in a bee hive would turn out to be a sheer ‘Game of Genetics’?

NOT EVERY GREEN IS A GRASS

MARVEL OF THE FERNS

When you take the time to look at the vertical surfaces of rocks along a forest trail, you often find small, green leafy structures. Instinctively, one can sense that it is neither a grass nor a herb. Some, recalling their middle school botany, might correctly identify it as a fern. But what else do we know about this group?

Ferns are the first in plant kingdom to develop separate structures for conduction of water and food (vascular plants). This had a tremendous evolutionary significance because the ability to take water and food through pipes meant the plants for the first time could grow tall against gravity, which eventually led to the rise of trees in the plant kingdom. Most of the ferns we find today belong to the period of post-dinosaur extinction (Late Cretaceous). During this period, the flowering plants rose in prominence, and ferns survived under their canopy as they possessed a genome that allowed them to survive in low light conditions.

Ferns also have leafy structures known as fronds. When you turn a frond over and look at the underside, you will often find small circular structures. These are the spore-producing reproductive structures of ferns. They play a significant role in explaining why ferns are typically found in warm and moist places. First, let's address the warmth. When you observe these circular structures, you will notice that they have thin, water-like coverings. In summer, or when the temperature rises, this water evaporates, causing the spores to be released. This is why most ferns are found in warm tropical areas. But why do they need moist places?

The released spores develop into new short-lived structures that produce both sperm and eggs. Once the rains arrive, or even if there is some water in the area, the sperm swim through it to reach the eggs and fertilize them. This is when a new baby fern is born. It is as if the ferns release spores which develop into a male and female organism who then mate during the rains. Interesting way to propagate and that is why you would always find ferns in moist places as the sperm of ferns need some water to swim and reach the egg.

But this is not the only way in which ferns reproduce. Some ferns also reproduce vegetatively — when the frond tips of ferns from the Adiantum genus touch the ground, new ferns begin to develop, as if the ferns keep walking into new areas wherever they touch. Such ferns are known as walking ferns and you are more likely to find them on rock walls. So the next time you walk near a fern, remember not everything small and green, is just a grass.

IN MATTERS OF SIZE

WHY FEMALE RAPTORS OUTWEIGH THE MALES?

One of the most common raptors (birds of prey) one finds perching in Central Indian forests is the Crested Serpent Eagle. True to the name, the bird feeds predominantly on tree snakes, in addition to other reptiles and birds. But arent these birds affected by the snake venom? Unlike the honeybadgers or mongooses who have resistance in their body to resist snake venom, many of the birds like peacock or eagles do not seem to have any genetic resistance. It is just that with the bird's speed and scaly legs, the snakes do not have a chance to inflict a bite on these birds in an attack. Hence the birds never faced an evolutionary pressure to develop venom resistance. But these birds do face pressures of a different kind.

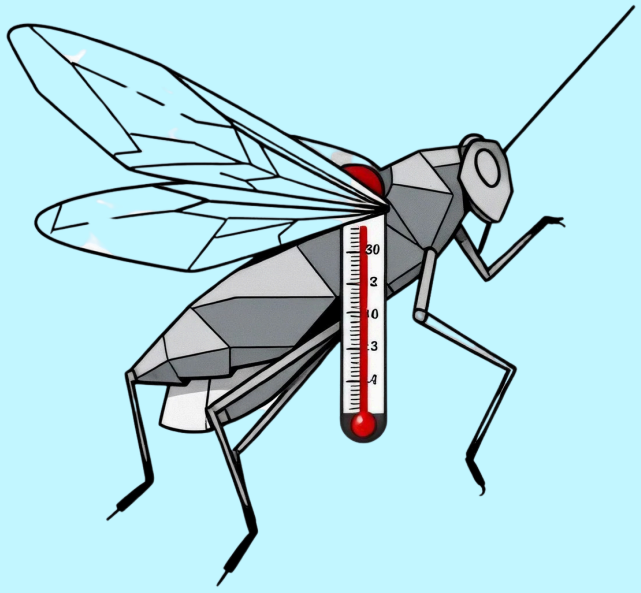
Think about humans, tiger or even birds like peacock. You will immediately notice that the males are generally larger than females. But if you observe a Crested Serpent Eagle or any other

raptor species, you will find that the female birds are larger than the males. This is referred as ‘Reversed Sexual size Dimorphism’ (RSD) where females of a species are larger than the males. In fact, this has been found in most of the raptor species across different geographies. What explains this?

One of the most popular hypothesis is as follows. Being the apex predator, mortality in adult raptors is generally less. The most vulnerable stage for any raptor is only during their egg and nestling stage. In fact predation of eggs and nestlings have been found to be the single most important cause of population failures in most of the raptors. This means there is an evolutionary pressure for the raptors to do something about it, especially the female raptors who spend most of the time in nest. That is why in raptors females grow larger in size than males.

Wait a minute. The same female responsibility to nest can apply to other birds as well right? Why then do we not see this RSD in other bird species? True, but the difference is that, unlike many other birds, raptors are actually equipped to defend a predator due to the presence of strong talons and hooked beaks. Not many birds actually have the ability to keep predators at bay.

So, for defending female raptors, greater body mass is advantageous. If physical contact occurs, a greater body mass in the defending female results in greater force, and thus potentially more severe injuries may be inflicted by the female’s talons on the predators. If you look at the few raptorial species where this phenomenon of large females doesn’t occur, one common factor is that nest defense is not primarily the female's responsibility (for instance, in Eurasian griffon vultures, both male and female share incubation, and hence we do not see a stark difference in male-female body sizes). So, the next time you see a larger female in a species, you might well ask: why isn’t the male larger?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NATURE'S THERMOMETER

MEASURING TEMPERATURE WITH A CRICKET'S SONG

We always hear the sound of crickets chirping around but isnt it difficult to sight one? Try approaching towards the sound and you will find that the sound has suddenly vanished. Have you wondered why ?

The sound we hear is produced by male crickets rubbing their wings together. This is mainly to attract females. However, chirping also makes the males vulnerable to predators, as enemies can easily locate them. Therefore, the males always chirp from hiding, making it difficult for predators to spot them. They are also sensitive to vibrations, so when they sense approaching footsteps, they perceive danger and fall silent.

But what about the female crickets? They cannot chirp but they use the chirps to identify the male of their species. The louder a male cricket calls, the more likely she gets attracted to him. So does that mean, the smaller males, who obviously cannot be as loud,the losers in this game of love?

Not really. Smaller males have been observed chewing holes in large leaves and chirping through them, creating an amplifier effect for their songs. In this way, they can be 2–3 times louder, thus attracting more females than they normally could. And these chirps become even more interesting.

Imagine you are in the middle of a forest with crickets around, and someone asks you to guess the temperature of the area. You are not given a thermometer either. So what would you do? You just have to observe the number of chirps a cricket makes in 15 seconds and add 40 to it. This would roughly give you the temperature of that area (in Fahrenheit). This is because crickets are cold-blooded insects. As the temperature increases, their bodies get warmer, which in turn allows their wing muscles to move faster. And the faster they rub their wings, the higher their chirping rate. This entire mathematical relationship is known as Dolbear's Law and has been found to provide a reasonably accurate estimate of temperature. Now, don't you want to check out this law?!

THROUGH SMELL AND SOUND

WHAT MORE IS THERE TO KNOW ABOUT A TIGER?

If you see the types of forests in India (or even in the world) where Tiger survives, you will find that they are present in a variety of habitats - Evergreen forests of Periyar, Dry Deciduous forests of Melghat, Moist Deciduous forests of Similipal, Terai grasslands of Kaziranga and so on. Tigers tolerate temperatures ranging from 48 deg C of North Indian summers to -35 deg C of Siberian winters. So what is common in all these landscapes that makes the Tigers thrive? It is the presence of large, forest ungulates (hooved herbivores).

In fact the evolution of tigers is closely linked to the evolution of large ungulates. In the late Miocene epoch (5-6 million years ago) the earth was warm and grasslands were expanding. This led to rapid evolution and diversity of large ungulates, particularly deer and wild cattle. This in turn led to rapid evolution and diversity in the Wild Cats. And thus emerged the tigers, around 2 million years ago in the Eocene epoch.

The linkages between ungulates and Tigers run so deep that even the orange colour of the tiger coats evolved due to the ungulates. Remember human eyes can perceive the 3 primary colours of red, green and blue? (Trichromatic vision). But many of the ungulates like Chital and Sambhar have dichromatic vision- their eyes can perceive only blue and green. This gives an advantage to orange coloured Tigers, as ungulate eyes see orange as green, thus camouflaging tigers in the green forests and grasslands. No wonder the orange big cat began to dominate the forests of East and South Asia.

While the word 'big' is being loosely used here to indicate the larger size, it has also been used by ecologists to denote wild cats which have the ability to roar. Vocal chords of tigers, lions, leopards and jaguars have specialized structures which enable them to roar, unlike other wild cats (including cheetah) which can only purr. That is why these four are traditionally considered as the 'Big Cats'. But what could the evolutionary advantage of roaring? Acoustically, a roar is a low frequency sound and this means it is less scattered by dense vegetation (in case of forest dwelling tigers) and it can travel longer distances (in case of Savannah dwelling lions). Either way this helps in better advertising to other animals in defending territories.

It is not just sounds, but Tigers are interesting even in their sense of smell (not the one done through nostrils). Have you observed tigers curling their upper lip and exposing their front teeth? It looks almost as if the tigers are making a mocking face at us. Technically it is known as a flehmen response- the tiger's way of smelling scents left by other tigers. By curling the upper lip and closing the nostrils, the animal allows scent to reach the roof of its mouth where a special organ (namely Jacobson) is located. A male tiger can actually tell if a female is ready to mate by smelling her urine, by this way. This is almost smelling in high definition.

One can keep on going. Why do tigers have black stripes on their coats? Why are tigers even territorial? Why do tigers (or any cat for that matter) have only four digits in their hind limb, while dogs and even primates have five digits? Every question about a tiger has some story to be told. Seeing a tiger in wild is an experience? Try learning about them.

MILTON'S MISTAKE

GREED OR GENIUS

Readers of English literature readily recognize John Milton's famous work 'Paradise Lost' - A work which portrays the biblical story of the expulsion of Adam and Eve from the Garden of Eden after being tempted by Satan. The striking thing in his work is that Satan supposedly takes the form of a Cormorant (a symbol of Greed) before influencing Eve. But what does a cormorant have to do with greed ?

Cormorants have excellent fishing skills and are known to consume massive amounts of fish - even fishes way bigger than their sizes. This gives cormorant a bad reputation among fishermen. It eventually seeps into folklores and myths as a greedy bird eating lots of fish. But what makes this bird the best fisher? It is this bird's ability to dive deep in the water, thanks to an amazing engineering in its feathers.

One always remembers a cormorant as a bird sitting near water, spreading out its wings, right? Without much thought, we often explain this as a way of drying its wings. But why don't we see other birds like kingfishers or ducks, which also fish in water, drying their wings?

The answer lies in the microscopic arrangement of the feathers of ducks and kingfishers. Compared to terrestrial birds, waterbirds in general have rough and interlocked feathers. The interlocking angles of these feathers prevent water from penetrating inside, and hence, the feathers remain dry. However, the trade-off is that this makes the feathers of a kingfisher or duck buoyant in water, thus affecting their ability to dive deep.

This is not the case in cormorants as this microscopic buoyant arrangement is absent. As a result, the water penetrates their feathers, thus decreasing their ability to float. However, this means the birds can dive deep inside water with much less energy compared to other water birds. They do pay for this by spending a lot of time perching and drying out their wings.

But doesn't this wetting affect the bird's body temperatures especially as they dive deep underwater where temperatures are cold? Feather engineering has found a way out for them, here as well. Although Cormorant plumage retains water, only the outer portion of the feathers is wettable. The insulating layer next to the skin is always maintained which keeps the cormorants warm. Only if Milton had tried learning a little more about the bird!

AM I A CAT OR A DOG?

THE HYENA MYSTERY

Is Hyena a dog or a cat? Hyenas appear like dogs (having non-retractable claws for instance) and hunt like them- they wear the prey down in long chases and inflict bites in them in a dog-like manner. However, they do not belong to the dog(Canid) family. So they should be cats then? In fact they are evolutionarily more closely related to cat(Felid) family. For instance like other big cats, they mark territory by anal gland secretions without raising their legs (members of dog family raise their legs while marking territories). But they do not belong to the cat family as well. Hyenas have their own family Hyaenidae, which includes the Spotted and Striped Hyenas and it is the latter that occurs in India.

The most striking feature of a striped hyena is that its front legs are much longer than its hind legs. This difference gives hyenas their distinctive walk, making them seem as if they are always limping uphill. But why is that? It has more to do with the

scavenging diet of the striped hyena, which is predominantly ‘bone-scavenging’. In order to feed on bones, these hyenas have evolved incredible jaw strength supported by massive jaw muscles. It is to support these massive jaw muscles, the hyena's forelimbs are much longer than hindlimbs unlike the case in other Cats or dogs. And this bone scavenging also makes their scats look whitish unlike that of any other animals.

But being predominantly a scavenger also means that the animal is not naturally aggressive. That is why, when faced with a predator, striped hyenas sometimes fake death. But how does that help? Wouldn't that make it easier for the predator to prey on them? Surprisingly, in many other species that fake death as well, it has been observed that predators often lose concentration when the prey appears dead, creating an opportunity for the prey to escape. It is risky, but seems to work at times in many animals. Still striped hyenas sometimes stand up against predators, especially when there are food disputes. So what do they do?

Have you observed the unusually large mane on the body of a striped hyena? In moments of disputes, a striped hyena raises the mane hair along its back. This way it can nearly double its size—or at least appear much larger. This is not an act of aggression but the hyena’s last effort to "pretend" to be brave and hopefully, keep the predators away.

Despite being interesting, hyenas have always been portrayed in a negative light in popular culture — for example, Disney's Lion King depicts them as the “evil, idiotic, bad guys.” Although the ones portrayed in the movie are spotted hyenas, even striped hyenas aren't depicted any better in Indian myths. So try answering this question: why does a culture choose to celebrate the lion while defaming hyenas? Many times, the reasons reveal more about us than about the animals themselves.

LOOK DOWN TO SEE A TREE

HOW ROCKS DECIDE WHAT GROWS WHERE

When we start travelling across several forest areas, we begin to wonder why certain forests naturally have Teak while others have Sal. While one might immediately look up, searching for answers in the surrounding temperatures or altitudes, the ground beneath those trees could also be a good place to start. Yes — geology!

When we say that the occurrence of a tree is influenced by geology, it could be due to the physical or chemical nature of the underlying rocks. Physical could refer to the structure of the rocks and, consequently, the soil derived from them, which might influence how water is retained or lost. Chemical could refer to the presence or absence of certain nutrients.

Take Teak for instance. When you compare Teak with Sal, the amount of calcium in leaves of Teak is almost twice than that occurs in Sal. This is because Teak prefers soil with higher

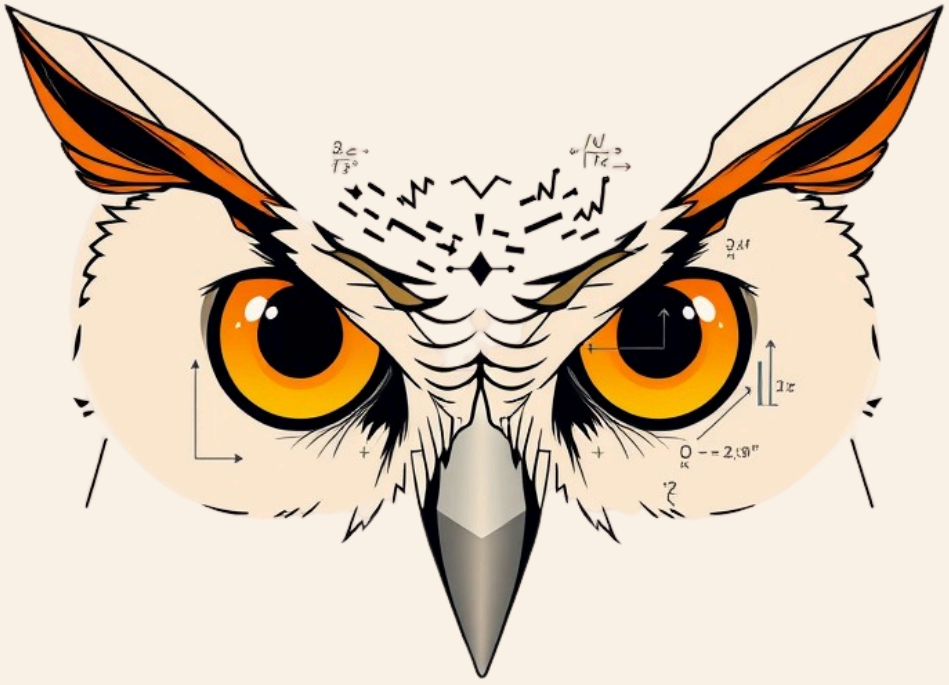
calcium content. And generally, soils derived from igneous rock (Deccan trap soils derived from Basaltic rocks of volcanic origin) are rich in these and hence we have Teak distributed in most of Peninsular India. Then one might ask, why is Teak present in say Kerala's Nilambur or in Burma where the soil is not derived from Basalt?

Firstly Basalt rock is not the only source of Calcium, as soils from other parent rocks might also have higher Calcium as in Burma (limestone formations). Also to be considered is, in addition to calcium, growth of teak is also influenced by drainage. Soils which do not have water logging like the well drained alluvial soils of rivers also support Teak, as in Nilambur. The water table also should not be close to teak growing soil layers. Thus proper drainage and soils with higher calcium content play a major role in Teak distribution.

But when you move into Pachmarhi hills of Satpuras from Peninsular India, suddenly Teak is replaced by Sal. In fact there is an almost North-South divide of Sal-Teak in India. Why is that the case?

In the case of Pachmarhi hills, the geological strata is composed of Gondwana sandstones (sedimentary origin) which do not have these calcium nutrients and also have a lot of clay content that retains a lot of moisture. Hence they do not support Teak. Instead we find Sal trees taking over in these areas, as Sal prefers soils with characteristics exactly opposite to that of Teak- acidic soils, soils with moisture retention, and less calcium but more iron content. Such Sal-Teak divides are also found in other tropical countries and these divides are largely controlled by geological factors.

While moving through forests, one hardly notices the soil, or the rock strata underneath. But every rock, every soil in an area has something to do with the presence or absence of a tree. So whenever you look at a tree, ask yourself what it tells you about the world under your feet. You might be stuck at the heights of superficiality, but geology will bring you, literally and metaphorically, down-to-earth.



BINOCULAR BRILLIANCE

WHAT EYES TELL ABOUT AN ANIMAL

The first thing that captures our attention in an owl is its eyes. The big round eyes seem to stare at us intently. But we never see them move or roll their eyes. Why is it so ? Because owls don't have eyeballs. Wait, what? Their eyes do have those circular black balls, right? Yes we will get to that.

We know that owls hunt at night and that requires specialised eyes. The owl eyes are large to allow more light to enter their eyes. Once inside, the light falls on the the retina where even slightest movement and colour contrasts of the objects are picked up. There is also a reflecting membrane at the back of their retina- tapedum lucidum which catches any light that may have passed through the retina and bounces it back to retina again. All these makes the owls see better even in low light condition. But these big eyes take up almost 5% of their total weight. Hence they have to be held in position by a tube. The black part we often mistake for eyeballs is actually this tube attached to the skull. These tubes are fixed and that is why owls cannot move their eyes. But to compensate, owls have evolved their famous ability to turn their necks incredibly far in either direction up to 270 degrees. And if you observe closely, the eyes of Owls are also closely spaced. In fact owls have the most forward-facing eyes of any group of birds! This is similar to the eyes of humans or many other predators.

But what difference does eye spacing make? The closer the eyes, the more the field of vision of each eye overlaps, thus providing depth perception for any object in focus — a trait that is very important for a predator to assess the position of its prey. This is what we refer to as binocular vision. Contrast this with a bird like a pigeon or other prey species like a deer, whose eyes are wide apart, positioned almost on either side of the head. This enables these species to see independently with each eye at wide angles. All this allows easy detection of predators due to a large field of vision. Of course, they can’t perceive depth — but who cares when life is at stake? So, the next time you see the eyes on an animal's head, ask yourself: what does it say about the animal itself?

NOT A BISON

THE GIANT THAT IS GAUR

Indian Gaurs are the muscular beasts of Central Indian forests. Being the largest cattle in the world, they are often wrongly referred to as Indian Bison. In fact, Gaur and Bison belong to two different genera. They are as different as a Sambar is from a Chital. Gaurs are predominantly forest-dependent species, while Bison are species of grasslands.

Being a forest species, they browse on a variety of vegetation and in summers we might even observe them feeding on the barks of Teak or Haldu trees. While the digestive system of Gaur has enzymes to break down the hard lignin in bark, there is another reason for this bark feeding habit. In dry seasons the overall quality of food in a Gaur's diet is pretty low. So to extract the maximum nutrition from whatever food is being ingested, digestion needs to occur slow.

So what do you do? Feed on bark to add more fibre in the diet thus increasing the retention time of food in the gut for digestion. Intelligent, one must say.

Gaurs like many other ungulates like Sambhar and elephants also require abundant water on a daily basis. But one striking feature is that we don’t see Gaurs wallowing (mud-bathing), do we? Why is that? Come to think of it, mud bathing is generally practiced by animals to regulate body temperature and also to keep one's body away from parasites. Gaurs tend to rest under shades for regulating temperature, but the parasites? Gaurs practise licking behaviour in herds by which individuals groom each other. While keeping off their bodies from parasites, this also helps in building their social grouping.

Another striking feature of Indian Gaur is the whiteness below the knees in the fore and hindlimbs called 'stockings' which develop in both male and females after 3 months of age. The horns of young calves which start black also begin to turn white gradually, and as the Gaur ages, the proportion of white in the horn with respect to black also increases. This is infact one way of estimating the age of Gaur. What about identifying the sex then? Here too there are few rules that come in handy. It is only the male Gaurs whose coat blackens with age whereas the female's coat remain dark-brown. Also if one observes the horn, one will find that in males the horn generally curve outward and upward than the females, whose horns curve inward with age. The irony of being a Gaur is despite being such a visible species, not many would have observed them. Why don’t we now?

PURPOSEFUL RANDOMNESS

WHAT ANTS TEACH US ABOUT THINKING

Lying down under trees, our childhood days passed - wondering what the ants that were climbing the trees, actually doing up top! Especially in seasons when there was no fruit or flower, what was there on the trees for the ants to be so busy anyway? In a rotting tree, some ants form nests in cavities. But why climb a live tree?

It turns out that these ants come for the sap-sucking insects that feed on the phloem sap of the tree. Phloem sap is a nutritious liquid consisting of sugars and minerals, produced by the leaves and transported through the phloem vessels of trees. Sap-sucking insects puncture these vessels and feast on the liquid, but there is a problem: the sap is so highly concentrated that the insects' bodies cannot handle it. Therefore, these insects absorb the nutrients they need from the sap and excrete the excess sugars in the form of honeydew. This is where ants come into play; they are attracted to the honeydew and, in return for this sugary treat, provide protection to the sap-sucking insects from predators.

This is one of the many food foraging strategies of ants. But when you look at the decision making involved in this or any of their food searches, something deeper and fascinating emerges.

Remember that ants communicate using chemical signals called pheromones to exchange information about food? Let's say there is a food source nearby and one of the ants has located it. What would be the optimal decision flow in this case? One ant creates a pheromone trail from the food source to the nest. After this, many ants will follow the trail, locate the food, bring it back to the nest, and feast happily, right? Surprisingly, this is not always the case.

When you start observing individual ants, you get the impression that many of their decisions are plain stupid. Think about it: many of these ants, despite the pheromone trail, ignore abundant food nearby and continue to wander along random paths. Now, who does that? They could have followed the known locations of food, collected it, and eaten it, right? But they don't.

Instead of exploiting known resources, the ants are wired to explore the unknown. It turns out, this exploration is far more beneficial for their collective group than we might think. Most of the ants that go off randomly to explore, may not even find anything. And if they weren't part of a group, this strategy might even cost their lives due to starvation. But because they're part of a collective, they can afford to take such risks of exploration so that one of them will get a big payoff. And evolutionarily, this is one of the reasons why ants have been so successful as a cooperative society as it is an intelligent way to really continue to discover new food.

But think about us humans for a moment. Every time someone asks a question — why throw money into space research, or into some abstract quantum theories, or even why waste time dreaming under a tree — one wonders if decision-making in human societies is really better than in ants.

NATURE'S LITTLE SNIPER

HOW A KINGFISHER HUNTS

The first thing one admires in a kingfisher is its ability to plunge into water and prey on fish. Interestingly, despite the name (king 'fisher'), some birds in this family do not even feed on fish. Many of these birds belong to a subfamily known as tree kingfishers, whose habitats are non-aquatic and who nest in tree cavities. In fact, one renowned brand of cricket balls is named after one such tree kingfisher — the kookaburra, native to Australia.

But, whatever be the prey, when it comes to hunting, kingfishers employ the same tricks- perch, focus and predate. But what are its mechanics? Let us see one by one.

For such quick aerial and aquatic predators, perching is surely important. But many a time, the perch might be a tender shrub or a protruding branch, and hence, a strong grip on it is vital. So how do these birds achieve this? Observe the digits on their feet. Unlike many birds, two of the four digits on the feet of kingfishers are fused. This is thought to increase grip strength when the birds

are perching, as it forces the digits to act in tandem. Similar feet are observed in another aerial predator — the bee-eater. But then, one does wonder why a different foot arrangement is seen in flycatchers, which are no less aerial hunters. Now, that’s still a mystery to be resolved. Moving on.

After perching, now is the time to focus. But first try this. While reading this sentence, shake your head back and forth, and then nod up and down. Did you notice that you managed to read it, despite your head movement? What you just experienced is known as gaze stabilization. This is human's natural ability to maintain clear vision even when our bodies are in motion. We achieve this through eye stabilization. But a bit faster movement of our heads, and our focus falters. Such an eye based gaze stabilization is found in many mammals.

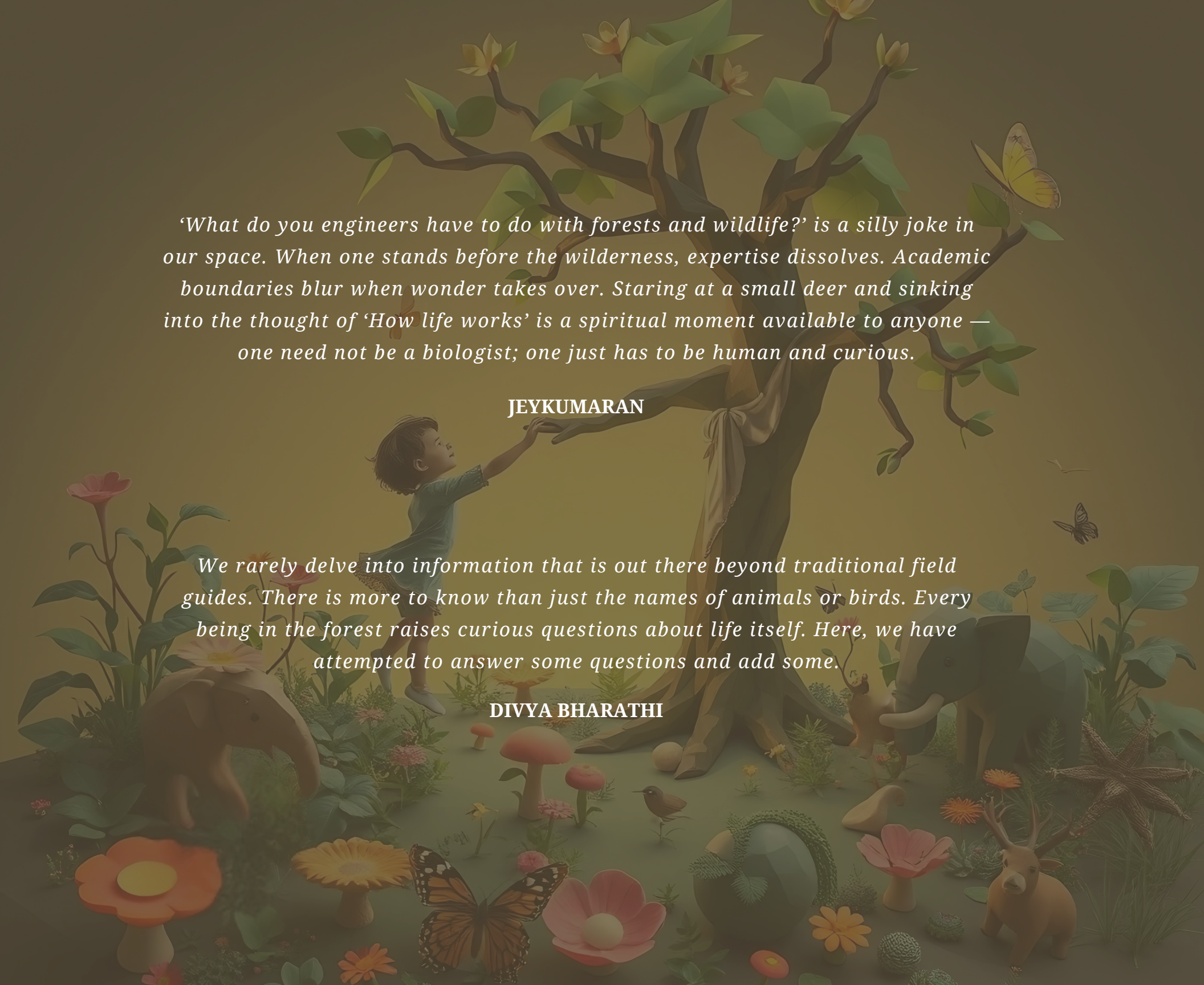
But think about a fast moving king fisher. Or even a king fisher perched on a wobbling shrub. Will a simple eye stabilization help focus, especially when your next meal is at stake? Definitely not and that is why these birds evolved to have head stabilization- Instead of the eyes as in mammals, here the birds keep their entire head completely steady, even while their bodies keep moving in flight or while perching on a wobbling shrub.

And how do the kingfishers achieve this? The secret lies in the large number of bones and muscles in the bird's neck, that can hold their head in place even when their body is in motion. In fact the image stabilization we have achieved in our cameras, falls way behind when compared to the ingenious stabilization achieved by these bird mechanics.

Now, it’s time to predate. For a prey in air or on land, it should be pretty straight forward. But what about the prey in water such as fishes? With reflection and refraction of light going on in water, how do these birds even judge the exact position of the fishes? The eyes of a kingfisher has the ability to polarize light, thus reducing reflection of light off the water surface. These birds can also adjust the shape of their lens to compensate for the refraction of light in water, allowing them to maintain incredible accuracy when diving for prey. Phew!

The next time you see a kingfisher perched near water, remember - we should be calling it a king 'physicist' instead!

Still searching for the tiger?



‘What do you engineers have to do with forests and wildlife?’ is a silly joke in our space. When one stands before the wilderness, expertise dissolves. Academic boundaries blur when wonder takes over. Staring at a small deer and sinking into the thought of ‘How life works’ is a spiritual moment available to anyone — one need not be a biologist; one just has to be human and curious.

JEYKUMARAN

We rarely delve into information that is out there beyond traditional field guides. There is more to know than just the names of animals or birds. Every being in the forest raises curious questions about life itself. Here, we have attempted to answer some questions and add some.

DIVYA BHARATHI