

JANTAR MANTAR

CHILDREN'S SCIENCE OBSERVATORY

English Bi-Monthly

Volume 25 Issue 1 January - February 2025 Rs. 30.00



Hyacinth Macaw

Dick Colling **1**

Scarlet Macaw



Paint the feather Red

Narayani Subramanian



Blue and Gold Macaws

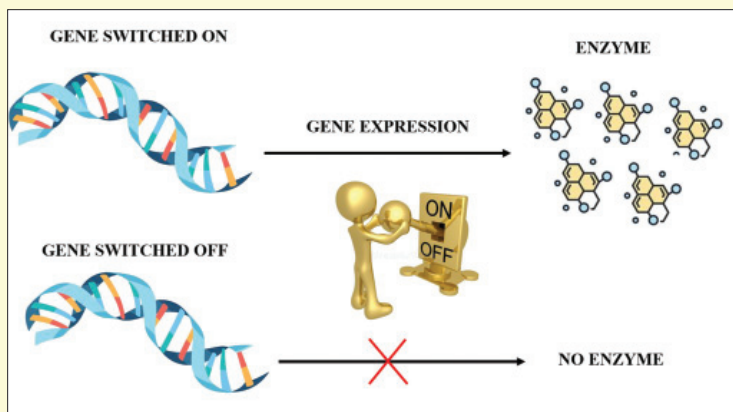
you might have heard of “Carotene”. Carotenes are pigments of yellow, red or orange. The carotene is what gives the carrot its characteristic yellowish orange colour. Carotenes belong to a group of molecules called carotenoids. Birds with red or orange colouration use carotenoids to produce those colours. However, many of these birds cannot produce carotenoids on their own. They have to acquire these pigments through the food they eat.

When we think of parrots, the first thing that comes to mind is a thick billed bird in bright green. But there are many non-green parrots in

the world. *Scarlet macaws* have blue, red and yellow colouration. *Blue and Gold Macaws* display bright blue and yellow colouration over most of their body. *Hyacinth Macaws* are blue. There are over 410 species of parrots and they come in all colours and shades of the rainbow!

Scientists who study orange/red coloured parrots know that their colouration is very special. Unlike other birds, these parrots do not need an external food source to produce colours. They have a pigment called “**Psittacofulvin**” which gives them their characteristic colour. Do not be intimidated by the complicated term. In latin, *Psittaco* means parrot and *fulvin* means yellow. So this word basically means “Yellow colour of the parrot”.

Even though psittacofulvin was discovered way back in 1882, there was a lot of confusion regarding how these pigments are genetically coded and expressed. Two studies by different



What is an enzyme?

An enzyme is a protein that speeds up chemical reactions in living organisms. Enzymes are biological catalysts that are not consumed or altered during the reaction. Without enzymes, many metabolic reactions would not happen fast enough to sustain life.

research teams have recently provided some important clarifications. One team conducted research on parrots and the other team focussed on birds that take carotenoids from food.

Dusky Lory

Dusky Lory is a beautiful parrot species native to New Guinea. A team of scientists lead by **Roberto Arbore** took this as their study species and studied its coloration. Techniques like *spectroscopy*, *mass spectrometry* and *chromatography* were used to analyse feathers. The team also did *enzyme studies* and *genetic mapping* to understand what happens to the colour pigments on a molecular level.

The results were very fascinating. They understood that psittacofulvins in this species have two variations. One version has a chemical group called *aldehyde* attached to it. (See the figure for the chemical formula; here R is any chain containing carbon and hydrogen atoms). This aldehyde-containing version is red in colour. The other version has a *carboxyl* group attached to it, this version is yellow in colour. There is a gene called **ALDH3A2**, which codes for a particular enzyme. This enzyme can convert the aldehyde group into carboxyl group. To put it shortly, this enzyme can convert the red coloured

pigment into a yellow coloured pigment. If the feathers have a large amount of ALDH3A2 enzymes, they become yellow coloured. Otherwise, they are red in colour. “The change of colour is not a complicated process at all, it is a very simple chemical modification”, says Roberto Arbore. So in this species, the change in colouration happens through an enzyme which



Hyacinth Macaw

Dusky Lory



Long Tailed Finch



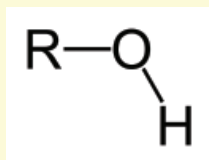
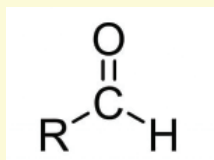
alters the chemical structure of the pigment.

Long Tailed Finch

David Hooper and his team of researchers focussed on the long tailed finch from Northern Australia. The speciality of this bird is that it has two subspecies - one subspecies has a yellow beak and the other one has a red beak.

The long tailed finch does not have psittacofulvin. It has to take up the carotenoid pigments from the food it eats. However, the carotenoids in its diet are yellow or orange in colour. Then how does the bird get red colouration? David Hooper and his team wanted to find out the answer.

The team used detailed genetic analysis to understand the mechanism behind the pigmentation. They found out that there are two different types of enzymes in the bodies of these finches. One enzyme is called **CYP2J19**. This enzyme can convert the yellow carotenoids in diet to red carotenoid pigments. There is another enzyme called **TTC39B**, which enhances the process.



So, what happens inside the body of these beautiful birds? How do they have different coloured beaks? In the red beaked subspecies, these two enzymes are active, so the beak becomes red coloured. In the other subspecies, the genes for these enzymes are switched off, so the beak turns yellow. See the picture where the beak colour changes progressively from yellow to red as you move across Australia.

“Imagine you want to change the lighting level in a room. You can either install a light switch, or change the entire lighting system. Which is easier? Having a switch is definitely easier. That is what happens here. By switching on or switching off the genes responsible for the enzymes, the colouration can be changed”, says **Simon Griffith**. He is a professor of Avian Ecology at Macquarie University. Another scientist called **Keith Gordon** feels the same. “Nature often uses elegantly simple reactions to achieve significant change”, he says.

These two studies have provided some important insights regarding the mechanisms used by birds to process red and orange pigments.

Do you think this research has practical applications? Write to **JM** and let us know!

Early village settlements in the Deccan

*Smriti Haricharan, Mumbai, and
Kamal Lodaya, Bengaluru*

Pastoralists and agriculturists

When you drive from Ballari to Toranagallu you may miss a hillock by the side of the road. This is the Kudatini *ashmound*. Archaeologists believe that these ashmounds were made from burning cow dung and other material. Over time some of them formed what we now see as hillocks. Standing on the hillock one can see far towards the Bellary Thermal Power Station. And one is surrounded by natural hillocks and green

undulating landscapes.

We do not have all the answers to what was the reason people in the past created such huge accumulations of dung and burnt them. What we do know is that people during this time most likely led a *pastoral* life, they kept herds of cows, sheep, goats and other domestic animals.

Kudatini is not the only ashmound in this region of Karnataka. There are many such ashmounds dotting this landscape. Over time there has been some amount of alteration and destruction of them. Another such ashmound in Ballari district is at Sanganakallu.

These ashmounds belong to the *Neolithic* period, named after stone tools we find. (*Paleolithic* is also named after older, cruder stone tools.) The Neolithic period dates from 4000 BCE and continues until around 1200 BCE, when the *Iron Age* begins where implements made of iron are found. We know this also because *megalithic*

Kudatini



Sangankal frE



Journeys
across
Kamataka

burials have been found within these ashmounds. Megalithic burials are, as the name suggests, mega and lithic—large stones that mark either burials, or remains of the dead, or memorials.

Archaeology depends a lot on two principles,

one of *superimposition* and another of *association* or *context*. These principles revolve around the concept that **chronology** or a sequence of events can be understood by the order in which they are exposed. For example if we think about

Sangankal-frSW





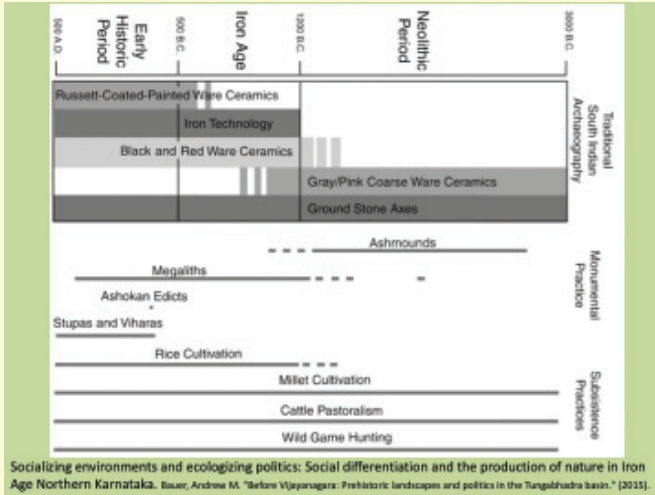
a cake, we know that the lowermost layer has to have been laid before the topmost layer. Secondly when two objects are found in association with each other, then this context helps us understand the objects. Megalithic burials are dated from the Iron Age period onwards. These were found buried within the ashmound at Kudatini. The inclusion of the burials within the ashmounds indicate the sequence of events. An existing archaeological feature, the ashmound, was altered by people who later occupied the landscapes.

Sanganakallu is thought to have been a “factory” before 3000 BCE. Stone tools were manufactured by the people living here. It is one of the largest such sites in South India where pottery and stone axes are found. Village settlement seems to have started around 3000 BCE, with settlements dating to the late prehistoric period being found on the plateaus on top of the large granite hills. The picture shows the view from Hiregudda hilltop.

Sanganakallu village site is visible on the central hilltop. (Picture courtesy: Dorian Fuller)

In the subsequent Iron Age people seemed to have moved their settlements to live more on the plains. We do know that the Neolithic people cultivated small millets and pulses which are native to Karnataka. Cultivation of small millet-grasses (including browntop millet (*Brachiaria ramosa*), and bristley foxtail grass (*Setaria verticillata*)) and pulses (mung bean (*Vigna*





radiata), and horsegram (*Macrotyloma uniflorum*)) were found here by American archaeologist Dorian Fuller (of the University College of London). It is likely that these were cultivated during the summer, were they eaten in winter?

People here kept cattle and sheep. They kept separate areas for cow dung (and sheep dung). Until 1200 BCE, these were seen as ash mounds,

which were thought to be for burning dung. Were cattle kept in pens to stop them from grazing on crops, as asked by British archaeologist Raymond Allchin? Were there cattle feasts, as asked by archaeologist K. Paddayya of Deccan College, Pune?

Fuller used archaeobotanical samples from Sanganakallu to look at the beginning of agriculture. This does not mean people stopped being pastoralists in order to be agriculturists. We know for example from research at **Catalhayouk** in Turkey, one of the earliest Neolithic sites in the world, that people practised both pastoralism and agriculture simultaneously.

Landscapes of the dead

The practice of building megalithic burials lasted for centuries in South India, starting from around 2000 BCE and continuing for thousands of years. One such site is Hirebenakallu, Koppal district, 800-200 BCE. It is located around 10 km from Gangavati in Koppal district. Locally

Kettledrum



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known as *elu guddagalu* (“seven hills”), the path to this site is covered with thorny bushes and slippery scattered boulders. A rivulet has to be crossed to reach it. Hardly any tourists get here, as there is no proper signage. The Tungabhadra river flows not far away.

The location of megalithic burials on the outcrops, like at Hirebenakallu, can be seen at other places such as Mallasandram in Krishnagiri District. The unusual aspect of such burial sites is that often they are more symbolic or memorial in nature than actual burials. There are around 400 burial chambers here making this one of the larger megalithic burial sites in southern India.

Megalithic burials have been built in various different types that vary in their appearance, some of these include *cist*, *cairn circles* and *dolmens*. The most common type of burial at Hirebenakallu is the dolmen (left picture), three-sided chambers with capstones forming the roof. They flank both sides of what would have been a main street. Stone implements, pottery and iron slag are also found in the site. Rajankollur in Yadgir district is another such site, but it is smaller.

Local belief gives people the impression that these megalithic burials contain valuable objects—such as gold. People living in and around these sites have been known to dig up the burials in search of gold, thus leading to destruction of these archaeological monuments. Lack of dissemination and sharing of research findings also contributes to these beliefs.

Hirebenakallu also has caves, rock shelters with red ochre paintings. They were either residences or places of worship. The paintings show people dancing, hunting, holding weapons. Among the animals deer, peacock, bull, cow,

horse can be seen.

There is an interesting hemispherical stone kettledrum, about 2 metres in diameter (see picture). When it is struck, it can be heard 1 km away!

Andrew Bauer has surveyed and mapped this archaeological site. It would have taken a significant contribution of labour and time in order to quarry stones and build these burial stones. He calculated the volume of the stones based on their measurements. Based on the volumes he discusses whether and how social hierarchies could be reflected in these burials. One of the earliest studies on these burials was conducted in Brahmagiri in Chitradurga district of Karnataka.

The chart from Bauer’s book *Before Vijayanagara* shows a timeline of activities carried out by people from 3000 BCE to the historic period of 500 BCE.

How do we know what we know?

What we do know about the Neolithic and Iron Age landscapes of northern Karnataka is based on research by various archaeologists over decades. The archaeologists who worked in 2006 in Sanganakallu were led by Ravi Korisettar from Dharwad University, Nicole Boivin who is part of Max Planck Institute in Germany, Micheal Petraglia, Griffith University, Australia, and Dorian Fuller of UCL, but included a team of over 47 experts from across the world. Archaeology is a collaborative discipline requiring people with various expertise in order to carry out a project. Many archaeologists have carried out work on the ashmounds before this project, including Raymond Allchin and K. Paddayya.

●

Do You Know?

1. Can plastics really enter our body tissues through what we eat? How do we decrease the amount of plastics in our bodies?
2. How can our body distinguish good and bad bacteria?
3. Fingerprints are used in crime detection. Can the wrong person be sent to jail if their identical twin committed the crime?
4. What is Hippopotomonstrosesquippedaliophobia? Do you suffer from it?

Answers in the next issue of JM.



Answers to Last Issue's Do You Know?

1. *Since plants cannot see, how can they evolve to adapt to attract specific insects?*

Ans: Many flowers use colours to attract insects, sometimes helped by coloured guiding marks. Flowers are often shaped to provide a landing platform for visiting insects or to force them to brush against anthers and stigmas. A number of flowers have sugary nectar to attract insects. Flowers have sticky pollen grains which get stuck to the body of insects and get carried away to other flowers. Rose, marigold, sunflower, and China rose are some examples of insect-

pollinated flowers.

Some flowers have scent to attract insects. Many of these scents are pleasing to humans too, but not all – some flowers attract flies with a smell of rotting meat. Colours can't be seen in the dark, so scent is important for flowers that are pollinated by night-flying insects such as moths.

2. *When animals get sick, do they use medicine?*

Ans: Wild animals have developed various behaviors and instincts to help them cope with illness and injury. A common strategy is to rest in a safe, quiet place. Some species engage in zoopharmacognosy, where they consume specific plants or substances that have medicinal properties. For example:

- Elephants may eat specific herbs to relieve discomfort.
- Chimpanzees have been observed eating leaves of Veronia plant that have anti-parasitic properties (Tanzanians also use this herb!). Moreover, chimpanzees who are not sick do not eat these leaves as they are bitter.



- Baboons live both above and below the Awash water falls in Ethiopia. Only those living below the falls ate the Balanite date tree's fruit. This fruit is known to repel snails living in the water. Baboons living above the falls were not in contact with the water-snails and therefore had no need of the medicinal fruit.

- Many animals eat minerals like clay or charcoal for their curative properties, or even soil with high kaolin content.

There are many more examples.

3. Did Neanderthals have families?

Ans: By analysing ancient DNA recovered from bone fragments found in two Siberian caves, researchers have identified a set of closely related Neanderthals: a father and daughter, as well as several other more-distant relatives. The work suggests that Neanderthal communities were small, and that females may have left their families to join other groups.

4. Sometimes, you get poor quality signal



on your cell phone. Why does that happen?

Ans: In the next issue of JM.

Sources: Many online sources, including <https://www.sciencelearn.org.nz/resources/80-attracting-pollinators>

METAMATERIAL MAGIC: THE FUTURE OF SCIENCE IS NOW!

Blessy Shemurah K.

Thanjavur

Metamaterials are special materials, usually made from multiple materials, such as metals and plastics, which are arranged in repeating patterns. What is unusual is that the patterns are at very very small scales.

Metamaterials have a property that is rarely seen in naturally occurring materials: they are engineered to have a property that arises, not from the properties of the materials it is made from, but from their specially designed structures. Their precise shape, geometry, size, orientation, and arrangement, all go into giving them their smart properties. In particular, they can manipulate electromagnetic waves (that is light waves), acoustic (sound waves), or even seismic waves, by blocking, absorbing, enhancing, or bending them in a manner that normal materials cannot achieve.

Imagine a material that super bends light and makes the object invisible and revolutionizes technology. Yes, it seems fictional – remember

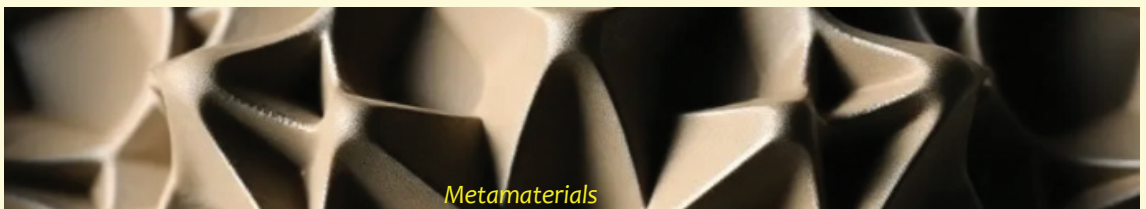
Harry Potter's invisible cloak. What if I tell you that cloak is true? These incredible materials are called **metamaterials**, and they're not just the stuff of dreams – they're the future of science. Ready to dive into the magical world of metamaterials and discover how they could change our lives? Buckle up, this journey will amaze you.

What are metamaterials?

The word meta in Greek means "Beyond". So, when we talk about metamaterials, we're essentially talking about materials that go beyond ordinary, with properties that are unimaginable. They are not our everyday materials. Imagine constructing LEGO blocks. These metamaterials are artificially engineered ones with ordered micro- and nano- structured patterns and 2 dimensional structures. See the picture for an AI-generated image of a metamaterial. These super materials can control and manipulate light. The thickness of the material must be of sub-wavelength of the incident light.

Negative Refractive Index

One of the coolest things about metamaterials is the *negative refractive index*. What if I tell you that it doesn't obey Snell's Law. Yes, in normal materials, light bends in predictable way, when passes from one material to another, like air to glass. This bending is described by Snell. But here the light bends in opposite direction, this leads to some strange and amazing effects – super lenses, that can focus light more

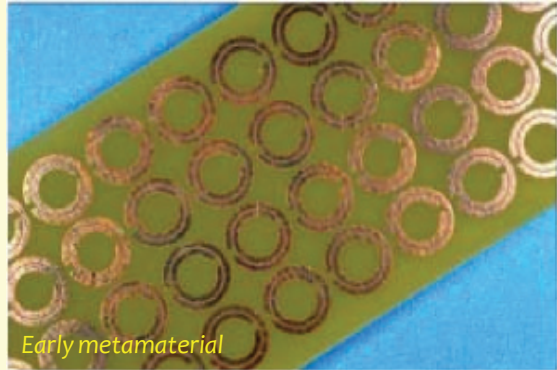


precisely than conventional lenses. It's like having a microscope with superhero vision. By bending light around the object, metamaterials can create the effect of invisibility. Light travels around the object and does not go through it, making us believe that the object isn't there – like an *invisible cloak*.

Metamaterials are artificial materials which have the property to manipulate electromagnetic waves with its negative values of permittivity (response to electric fields), permeability (response to magnetic fields) and refractive index. Normal materials have positive values of both (so that light bends *towards* the normal when it travels from air to glass, etc). A negative value of these quantities means that they have unusual responses compared to normal materials. The property can be understood from the figure: the right hand side figure shows “normal” refraction from a rarer to denser medium. The light (red line) bends towards the normal (black line). The left hand figure shows light falling on a metamaterial. Instead of bending towards or away from the normal, the light bends the other side! This is what makes metamaterials so unique.

Now, let's go back to 1968, when Victor Veselago, a Soviet Russian physicist first predicted materials with such *negative* permittivity and permeability. However it was difficult to find these materials in the lab. This is because the materials that had negative permittivity (response to electric fields) showed such behaviour for light at very high frequencies (we know that blue light has higher frequency than red light). But negative permeability materials (response to magnetic field) occurred at much lower frequencies.

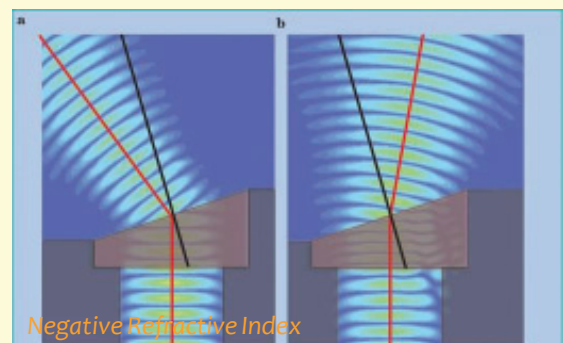
In 2000 John B. Pendry, and his colleagues,



proposed a variety of geometric structures that they thought could make artificial metamaterials. They gave a concept of a “perfect-lens” that could overcome diffraction limit from conventional lens to allow for imaging at much higher resolution than what could be achieved so far. Then David R. Smith, a physicist and electrical engineer at Duke University, United States, joined hands with him and created the first metamaterial by bending microwaves in ways that natural materials couldn't. In 2006, they designed and built the invisible cloak which bend microwaves and effectively make the object invisible.

Metamaterial Antennas

Imagine antennas that are super tiny but really powerful. They can do incredible things which normal antennas can't. They can pick up signals from different places and frequencies, making them super versatile. These antennas fit



Stuttering

*Monica Sueha. K. Dr. Kannan. K
and Sabareesh. M.*

American College, Madurai

When we talk, sounds are made by the muscles in our throat, mouth, and lips, and our brain helps us do this. Sometimes, people may have trouble speaking clearly, which is called stuttering, or “thikkuvai” in Tamil.

Stuttering usually starts when children are between 2 and 6 years old. They might



repeat sounds or words, like saying “m-m-m-mom.” They may take a long time to say a word or get stuck trying to say it. Sometimes, they feel frustrated or embarrassed when talking.

For example, they might say “a-a-a-amma” or make sounds like “ssssss” while trying to think of the right word. Some may blink their eyes quickly or move their lips a lot while speaking.

If you know someone who stutters, it’s important to be patient. Let them take their time when talking, and don’t interrupt them.

perfectly inside our smartphones, so that we can be connected all the time. For example, right now we have 5G communication. But the 6G antenna communication will be of metamaterials. They make GPS more accurate. Regular antennas are good, but when we add metamaterials, they have now superpowers!

Other applications

Some metamaterials can control sound waves too. They can block or absorb sounds, which could be majorly used for making quiet rooms or even helping with noise pollution. Another application is they can also affect heat. Metamaterials can help to make things cooler or warmer than they usually would be, and can be widely used in electronics to prevent the heating of devices.

As metamaterials evolved, their unique properties opened up incredible possibilities. One of the most exciting areas where they make significant impact is the realm of sensors. These sensors are crafted with precision, offer sensitivity and specificity, and are used to detect slight changes in the normal environment. Their periodic structure makes them perfect for medical diagnostics too. The non-invasive treatment is its super specialty. They can monitor blood glucose level for example.

Future potential metamaterials hold immense promise for the future, from revolutionizing quantum computing to creating advanced wearable technology. Let’s gear up to the new realms of innovation.

Note: The author is a research scholar under the guidance of Dr. K. Arockia Jayalatha, SASTRA Deemed to be University, Thanjavur.

References: Wikipedia, Physics Today article at <https://pubs.aip.org/physicstoday>

This will help them feel more comfortable and confident.

Stuttering can happen for several reasons:

1. It might start in childhood. It can also change in the future.
2. Feelings like sadness or low confidence can cause it as they grow up.
3. It can also happen because of nervous system problems due to accidents.

Research shows that stuttering can run in families. Some studies have found changes in certain genes (such as GNPTAB, GNPTG, NAGPA and AP4E1) might be related to stuttering.

Sometimes, a stressful environment can make stuttering worse. Kids who stutter might feel more comfortable when they are in calm situations. It's also important to know that stuttering doesn't mean someone is scared; many children who stutter are brave!

Every year on October 22, we celebrate International Stuttering Awareness Day. Famous people like Hrithik Roshan and Rowan Atkinson (famous as Mr. Bean) have also dealt with stuttering.

Children and adults who stutter may be helped by treatments such as speech therapy, or a form of therapy called cognitive behavioral therapy. Since stuttering disrupts the normal flow of speech, electronic devices to improve speech fluency can also be used.

If you have a friend who stutters, encourage them to talk naturally. Give them time to express themselves without stress. This will help them communicate better and feel good about themselves!

Toxic Algae

Toxic Algae Are a Menace. Humans Are Giving Them Ammunition.

Algal blooms are killing wildlife and making people sick. Here is how we aided their reign of terror.

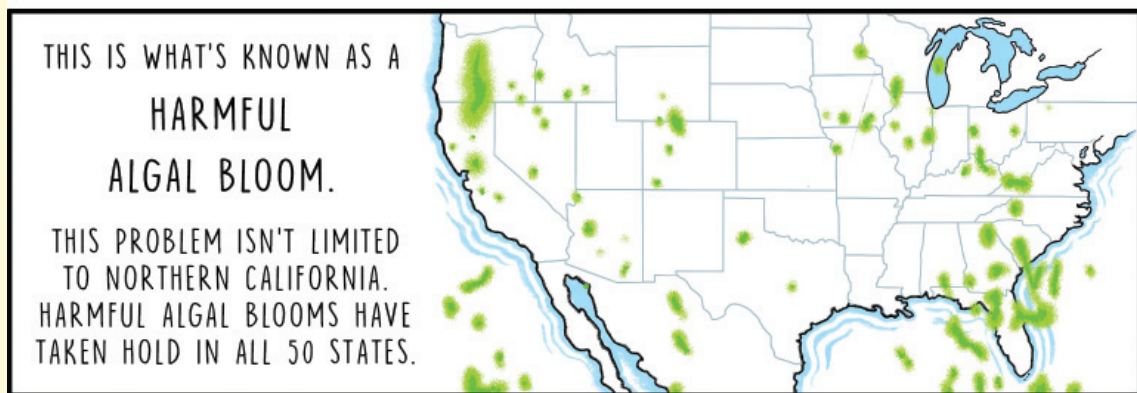
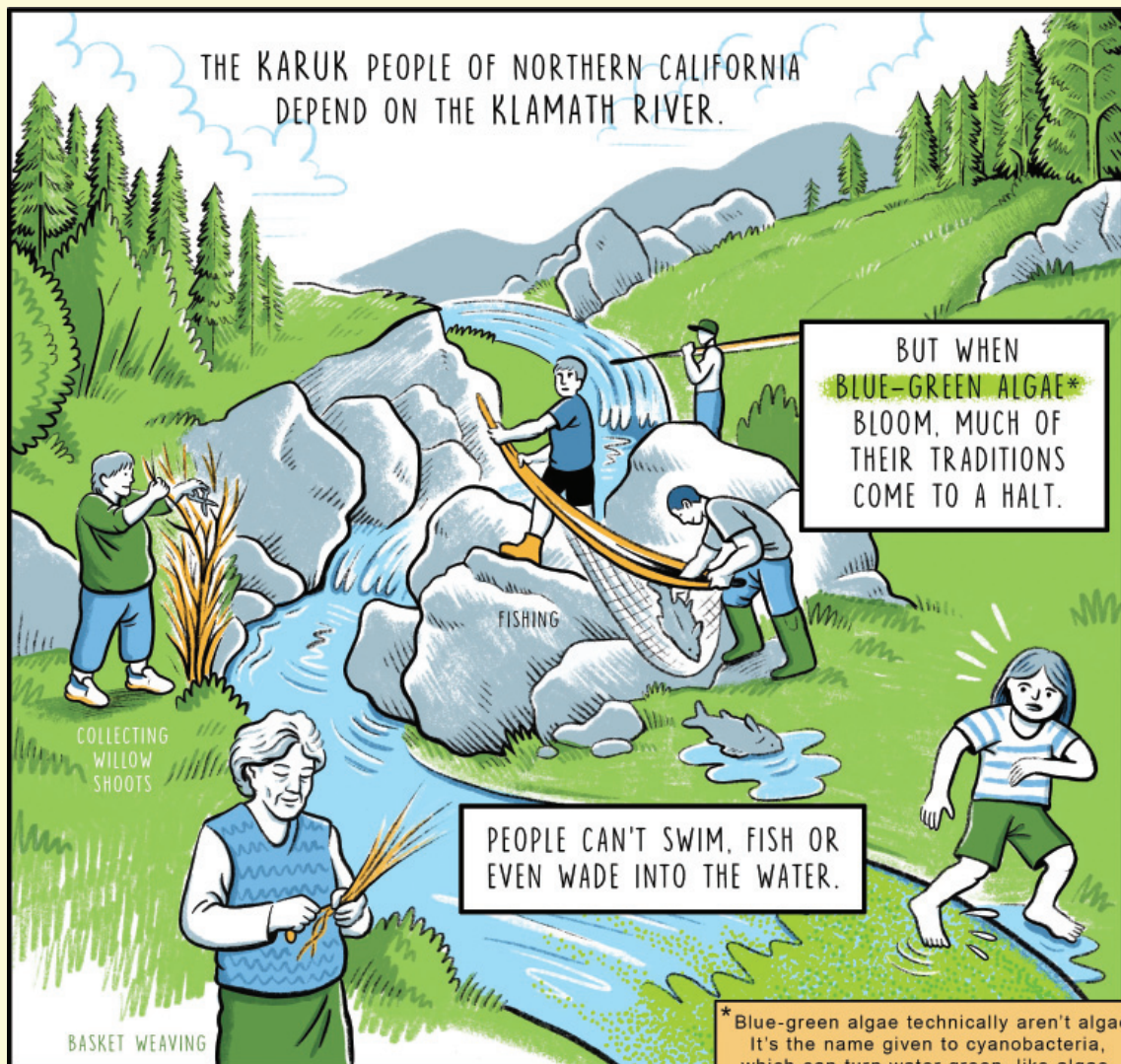
Matteo Farinella, Jeremy Deaton

Published in: PBS Peril & Promise The Years Project

Matteo Farinella is a neuroscientist-turned-cartoonist who uses comics to explain science. You can follow him @matteofarinella. Jeremy Deaton writes for Nexus Media, a nonprofit climate change news service. You can follow him @deaton_jeremy.

<https://nexusmedianews.com/toxic-algae-are-a-menace-humans-are-giving-them-ammunition-cc8905d2846f/>





map adapted from nrdc.org

MOST OF THE TIME, BLUE-GREEN ALGAE GET ALONG WITH OTHER CREATURES.

BUT UNDER CERTAIN CONDITIONS, THEY CAN GO WILD AND START LEAKING TOXINS INTO THE WATER.

KILLING ANIMALS AND MAKING PEOPLE SICK, SOMETIMES CAUSING LIVER DAMAGE.

THEY ALSO COVER THE WATER'S SURFACE, SO LIGHT CAN'T REACH PLANTS BELOW.

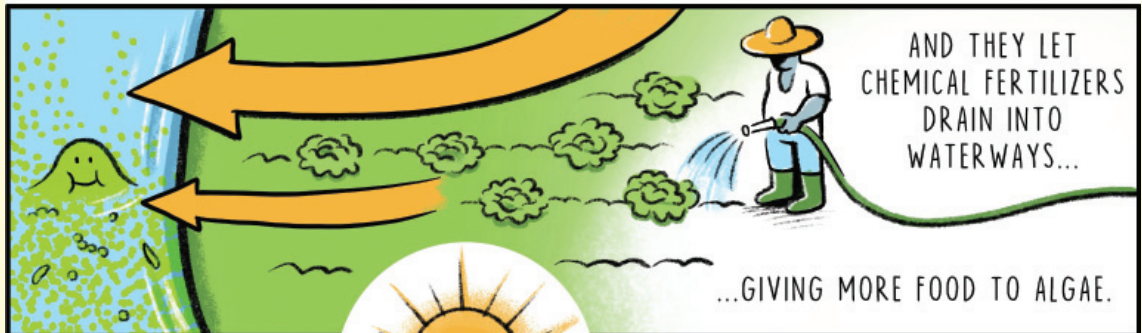
AND WHEN ALGAE DIE, THE DECOMPOSITION PROCESS CONSUMES A LOT OF OXYGEN, LEAVING OTHER CREATURES TO SUFFOCATE.

SO, WHY ARE ALGAE GOING WILD? BLAME HUMANS.

ALGAE GROW WHERE THEY CAN FIND NUTRIENTS.

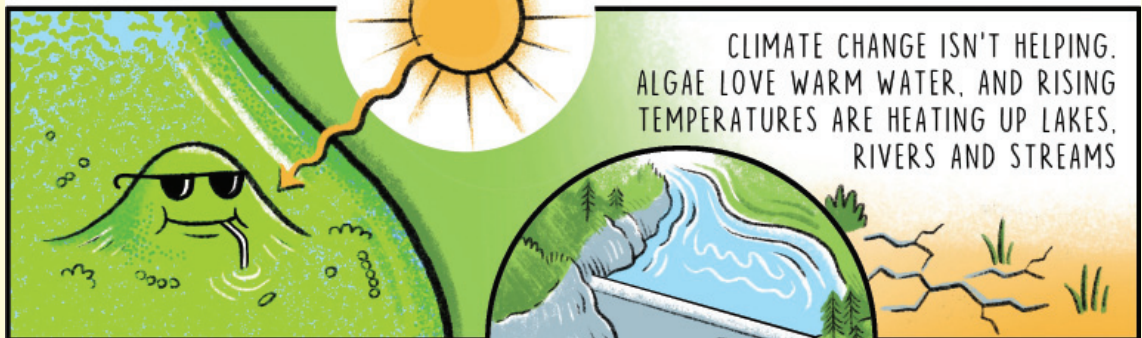
IN RECENT DECADES, PEOPLE HAVE GOTTEN RID OF WETLANDS, WHICH ABSORB NUTRIENTS.

NUTRIENTS



AND THEY LET CHEMICAL FERTILIZERS DRAIN INTO WATERWAYS...

...GIVING MORE FOOD TO ALGAE.



CLIMATE CHANGE ISN'T HELPING. ALGAE LOVE WARM WATER, AND RISING TEMPERATURES ARE HEATING UP LAKES, RIVERS AND STREAMS



ON THE KLAMATH RIVER, PEOPLE BUILT DAMS, MAKING WATER COME TO A STANDSTILL, WHICH GAVE ALGAE THE CHANCE TO WARM UP EVEN MORE.





Thiruvananthapuram Zoo Collage

Mobility, jumps and tails

Zareena, Mookayi, Mari

Zareena, Mookayi and Mari had come with Mari's mother Usha who was attending a biology conference at the Indian Institute of Science Education and Research at Thiruvananthapuram. They were on vacation from college, and liked to visit Kerala so they had jumped at the opportunity.

The three had learnt that Thiruvananthapuram Zoo is one of the large zoos of the country spread over 30 acres of land. So they resolved to spend a day there. The zoo had changed from the usual iron barred, cement floored, dingy animal cages to open moated, spacious, nature immersing enclosures. (The picture shows the Indian Leopard, Rhesus Monkey, Lesser Adjutant, Lion Tailed Macaque, all at the Zoo). They saw several endangered species and came to the much-talked-about *Lion-tailed Macaques* for which the zoo had a Conservation Breeding Programme.

Usha, as promised, met Zar, Mooks and Mari outside the lion-tailed macaques area.

As they were passing through the place where Lion-Tailed Macaques were sitting on the top of the trees and *Nilgiri Langurs* were a bit close to the ground, Mooks pointed towards them and said, “They have such long tails! Why don’t humans have tails like monkeys?”

Usha smiled. “That’s a great question, Mooks. We humans have diverged from a family called *apes*. This family includes chimpanzees, gorillas, and orangutans. When they diverged from monkeys the apes probably lost their tails millions of years ago.”

“Why?” asked all three in unison.

“It’s linked to our evolution,” Usha began. “Recently, researchers found that a small change in a gene called **TBXT** might be responsible for tail loss in apes and humans. This gene controls the development of tails in embryos.”

“So we all have tails when we’re babies?” interrupted Mari.

“Exactly, Mari”, said Usha. “All mammals, including humans, have a tail during early embryonic stages, but in us, it gets absorbed as we develop.”

They went to the tiger enclosure. There sat a beautiful tiger, dozing in the shade. Mooks pointed at the tail of the tiger, swishing its tail with ease. “Like the monkeys, the tiger uses its tail for balance. How did apes manage without one?”

“Great to hear your observation,” Usha replied. “Losing the tail was probably part of an adaptation which helped *upright walking*. This change was likely helpful for **hominoids**, which includes apes and humans, to move more

Evolution

Evolution refers to the process by which living organisms change over time through changes in the genome. Such evolutionary changes result from *mutations* that produce genomic variation, giving rise to individuals whose biological functions or physical traits are altered.

Evolutionary history is the study of how life on Earth has changed over time. It’s based on the idea that all life shares a common ancestor, and that species change over generations. It studies changes in the inheritable characteristics of populations over successive generations.



Nilgiri Langur

efficiently on two legs, freeing up their hands for tools and carrying food.”

“Does that mean we’ll never grow tails again?” Zar wondered aloud.

Usha laughed. “Probably not. This mutation happened millions of years ago, and human bodies adapted to life without tails. But studying this helps us understand how small **genetic** changes can lead to big **evolutionary** shifts.”

Mooks turned to Mari and said, “I think it’s cool we don’t have tails. We wouldn’t be able to sit comfortably in class!”

Mari laughed. “True, but can you imagine using it to hold things like langurs do. We could all be multitasking champions!”

As they moved further into the zoo, they reached the big aviary where they saw many birds. They were glad to see Spoonbills, Rosy Pelican, Grey Pelican, Grey Heron, White Ibis, Adjutant Stork, Painted Stork, Pond heron, Purple Heron, Egrets, Oriental

Langur tail



© Nihad V Vajida/Mercury Press

Tiger



darters and Parrots of course.

Brightly coloured parrots sat on branches, gracefully wagging their long tails as they hopped around. Zar pointed at them and asked, “Even birds have tails! Why did we lose ours while so many other animals kept theirs?”

Usha straightened her specs and replied, “Good question as usual, Zar. Loss of tails in our ancestors was probably due to some combination of genetic changes along with evolutionary needs. Most interestingly, it deals with mobile

Genome

Genome is the complete set of genes or genetic material present in a cell or organism. For instance, the human genome is the complete set of DNA instructions that make up a human being.

DNA elements —bits of genetic material which move around in our *genome*.

One of these mobile elements, called **Alu**, played a major role.

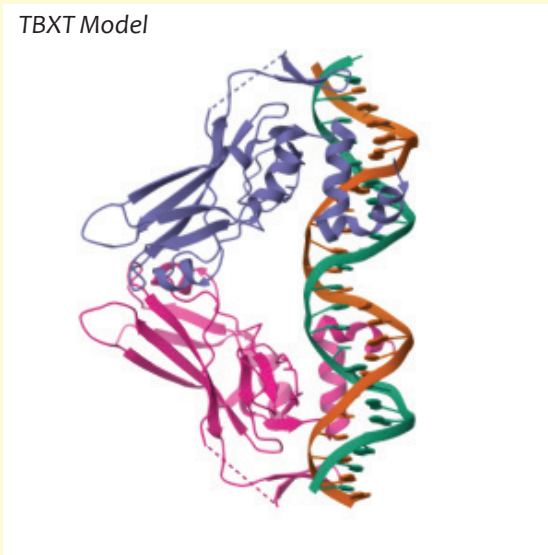
Mooks shook her head in bewilderment. “Mobile DNA? Like moving robots?”

Usha smiled. “Well, not really. Mobile DNA elements, like Alu, are sections of DNA that can be copied and inserted into the genome. They are more colloquially called ‘jumping genes.’ Alu elements are found aplenty in primates and more so in humans. Millions of years of time have passed with Alu in existence.

Mari wrinkled her brow thoughtfully. “So these jumping genes somehow managed to infiltrate our DNA and tail-wagging ability suddenly disappears?”

“It’s a bit more complicated than that,” Usha

TBXT Model

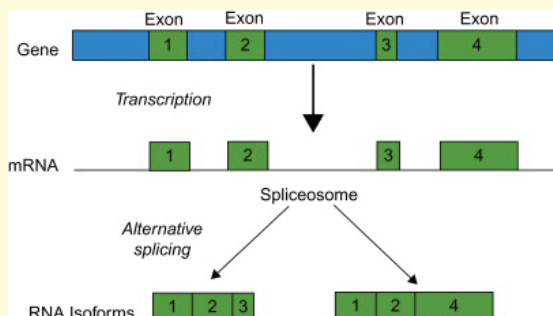


said. “One Alu element inserted itself into the TBXT gene—the gene that controls tail development in embryos. This caused something called *alternative splicing*, where a part of the gene, *exon 6* to be exact, was skipped or omitted. This change stopped the development of a long tail.”

“What’s splicing?” Zar asked.

“It’s like editing a movie,” Usha said. “Think of having a film reel that runs for many minutes. Cutting and editing scenes is known as splicing. Alu insertion skipped some of the scenes - which are referred to as exons - resulting in TBXT of a shorter size that could not produce tails.

“But, but.” Mooks blurted out: “Wouldn’t it



have an impact on everything? I thought tampering with a gene can be problematic.”

Usha nodded in agreement. “You are absolutely right, Mooks. Genetic modification often has its consequences. In this case, the Alu-created mutation in TBXT did not end only tail growth. This can cause a disorder known to be associated with *neural tube defects*, a condition encountered during the early development stage of the embryo’s head and spinal cord. Examples of such a defect include an imperfect closure of the spinal cord.

Mari gasped. “So, does that mean that humans can also suffer from these problems?”

“Yes,” said Usha gravely. “Neural tube defects, like **spina bifida**, do affect human babies with regional variations. It shows how an evolutionary change, while helpful in some ways, can come with costs.”

“So, the tail loss wasn’t all good?” Zar asked.

“It’s a trade-off,” Usha said. “The loss of the tail freed up their hands to grasp tools and hold onto food. But it came with other genetic implications. Sometimes, evolution’s payback is a balance of rewards and penalties.”

As she watched the parrots clean their feathers, Mari turned to her mother and asked, “So if all this was from the Alu elements, are they still flitting around inside us?”

Usha smiled. “Most Alu elements are simply an old part of our inheritance in DNA now. Like fossils. The genome can change in a spectacular manner when they move. Their moving around have been shown to also link with other changes beside this TBXT gene.”

Zar’s eyes shone mischievously. “Then the jumping genes are rather like tiny researchers

Mugger crocodile



testing something inside us?

“Exactly!” said Usha. “Mobile DNA elements have shaped many aspects of evolution. They’re like nature’s way of randomly introducing new possibilities, some of which may help species adapt.”

As the group made its way toward the reptile area Mooks asked, “Could tails come back one day? Like if another Alu jumped into the right place?”

Usha laughed. “Unlikely. This insertion occurred millions of years ago when our tails disappeared and our bodies changed fully. But

Alu elements teach us something about the great complexity of evolution and the way small changes may trigger big effects.

Like the stream near the crocodile enclosure, their conversation flowed easily. The three kept marvelling at how something as small as a piece of mobile DNA could shape the story of apes and humans. It showed them how in living organisms, the smallest things may often have a big impact.

Usha smiled to herself. She was glad the zoo visit had sparked such questions and led to a learning about evolutionary history. ●

Puzzle

Jamshed was looking through the family photograph album, which has a photo of each of his parents, each of his grandparents, all the way up to each of his great-great-grandparents.

How many photos is that?



Answer upside down:

2 parents,
4 grandparents,
8 great-grandparents,
16 great-great-
grandparents, 32 great-
great-great-
grandparents. So 62
photos in all.



The banyan tree must be one of the most well-known trees in India. I am sure all of you know that it is a huge tree that provides shade, that it has aerial roots that can grow down, take root, and become trunks, and that its bark, seeds, leaves and roots have been used for medicinal purposes from ancient times.

But there are some amazing facts about the Banyan that you may not know. Here are some of them.

The Strangler Fig

The banyan is a type of fig: yes, it is one of more than 750 species of fig trees. Banyans are also called strangler figs. This is because they all start life as a seed that germinates on another tree. How does this happen?

The Banyan tree starts off as a seed which is laid in the crevices of a host tree by a bird which expels it there after eating the fruit of

another banyan tree. The seed germinates on the host tree and slowly grows around it. It first grows as a vine which is dependent on the other tree for support. Eventually, the roots it sends down strangle its hosts! Later, roots grow from outward-extending branches and reach the ground, becoming trunk-like. This expands the



footprint of the tree, so it is sometimes called a 'walking tree'.

How does the seed form?

Well, how does the seed form in the first place? By *pollination*. This is also a peculiar feature of the tree. Banyan trees are pollinated by **fig wasps** through a process called *obligate mutualism*. This means that the banyan tree and the wasp species are so dependent on each other that without the wasp, the tree would go extinct.

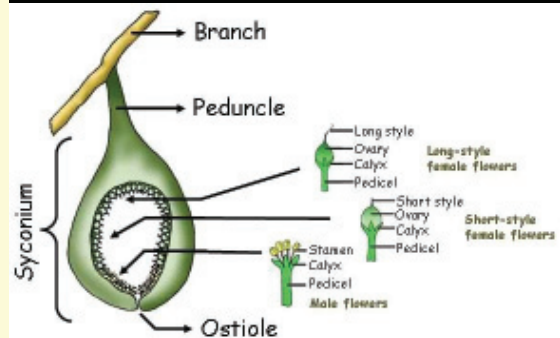
This co-evolution has gone on for millions of years. The banyan tree has figs (not the Mediterranean fruit) growing on them. These figs are biologically part of a structure called a **syconium**. This syconium consists of a fleshy inner wall and a hollow interior. This interior consists of both male and female flowers. The male flowers produce pollen and the female flowers can get pollinated and produce their own individual fruits.

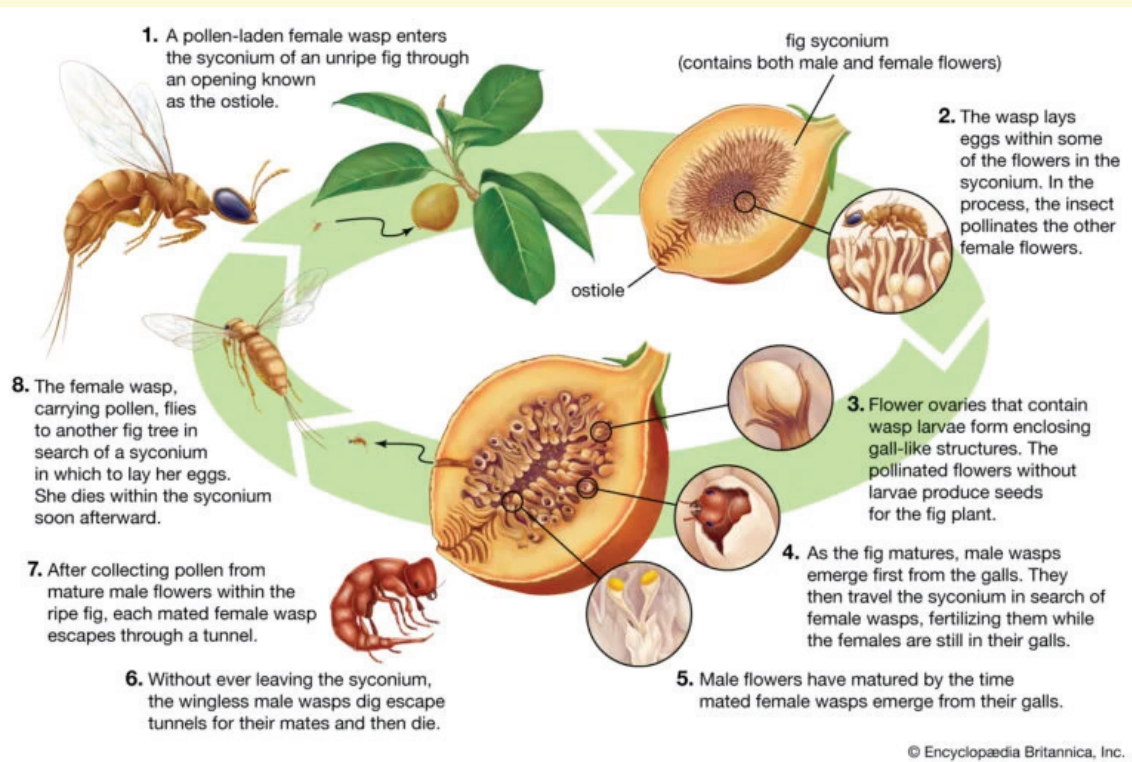
How does pollination occur?

The banyan tree releases a scent to attract female wasps. A pregnant female wasp follows the scent to the tree. The syconium has a special opening called the **ostiole**. When the syconium is ready for pollination, the ostiole loosens to let fig-wasps enter inside the syconium.

The wasp squeezes through the ostiole of the fig (the slightly darker green region at the bottom of the syconium in the picture), often losing her wings and antennae. She lays her eggs in some of the flowers. She disperses the pollen covering her body. The wasp dies, and the fig digests her remains.

But there is even more. The eggs of the wasp inside the fig hatch and the male wasps become active after 4-6 weeks, mate with the





Miscellaneous Facts on Banyan Trees

. Banyans all over the world are essentially **hemi-epiphytic** in nature. In biology, epiphytic means trees which grow out of seeds germinating in the nooks and crevices of other trees.

. Banyans are **ecological linchpins**. They produce vast crops of figs that sustain many species of birds, fruit bats, primates and other creatures, which in turn disperse the seeds of hundreds of other plant species.

. The first Europeans to encounter banyan trees were **Alexander the Great** and his army, who reached India in 326 BCE. The notes they took back to Greece informed **Theophrastus**, the founder of modern botany, and — ultimately — led 17th-century English poet John Milton to write in *Paradise Lost* that Adam and Eve made the first clothes from banyan leaves.

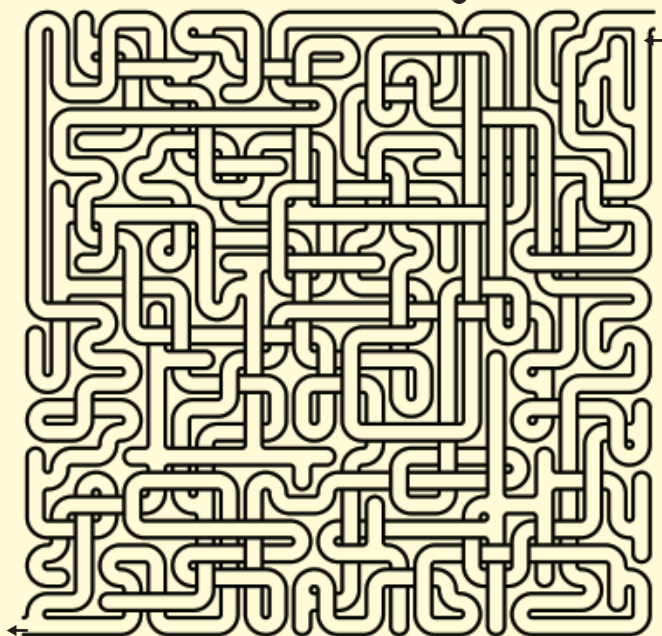
. The banyan tree is the national tree of India and Pakistan.

female wasps and cut through the fig to create openings. The female wasps then squeeze out of the fig, collecting pollen from the male flowers while doing so, and then escape the fig to pollinate other trees. Thus the wasps reproduce with the help of the banyan fig.

Interestingly, the *shape* of the ostiolar opening of the fig is extremely specific for specific species of fig-wasps. Hence, specific species of fig trees are co-dependent on specific species of fig-wasps for survival. And vice-versa. And hence, the banyan and the wasps help each other reproduce and thrive.

Sources: *Wikipedia, How Stuff Works*,
<https://www.rachnakar.com/the-banyan-tree-a-world-of-its-own/>
 by Parul Jauhari

Find the way!



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TNSF, Chennai 600 086

Typeset at
Fineline

Design, Illustrations and Layout

Basheer
Rajeswari

Printed at
Sri Murugan Printers,
7/1, Boobegam 3rd St, Anna salai,
Chepauk, Chennai - 600 002.

Single copy Rs. 30/- Annual subscription Rs. 200/- Life Subscription Rs. 2000/-
Bank Details: Jantar Mantar, Indian Overseas Bank, Dr. RK Salai Branch, Chennai - 600004
AC No: 029101000031081 IFSC Code: IOBA0000291

Painted Stork



My Talk With Birds -1

C R Ramana Kailash,

Tirunelveli



Greater Flamingo

This is the first part of a two-part article on bird watching by a young bird watcher.

Birds are one of the richest and most spectacular creations in Nature. They are descended from the prehistoric feathered dinosaurs of the late Jurassic period. Today they are spread across the world: from the frigid poles to dry Saharan deserts, from tropical rainforests at the Equator to the watery oceans of the Pacific. These creatures are able to adapt and thrive in the harshest conditions on Earth.

Birds have evolved and diverged in different sizes and colours. Birds like New Zealand Moa and Elephant birds are more than ten feet while a few birds like Bee Hummingbirds are as small as a coin. The rich diversity in these animals is peculiar to this spectacular class, Aves.

Birding is a hobby or profession of observing birds in their habitats. This hobby helps us to connect with the natural world and interact with it. Birding is a recreational activity or a citizen science. Unlike other nature-based hobbies,



Bar-headed Geese at Koonthakulam Bird Sanctuary

birding can be followed by amateurs too. This hobby engulfed me when I was 9; since then I learned to observe and celebrate these wonderful creatures.

Different birds play different indispensable roles in our ecosystem. They help in keeping biodiversity balanced, as birds evolved with different lifestyles; Scavengers, Herbivores, Predators, Insectivores and fish eaters. The world of birds is diverse and rich; birding is one way to get connected with this vivid and beautiful world.

Scavengers: These are birds such as vultures that eat dead animals, helping to keep the surroundings clean.

Herbivores: Like geese and parrots, they eat leaves.

Predators: Also known as raptors, they are hyper-carnivorous bird species that actively hunt and feed on other vertebrates such as rats. Falcons and eagles are examples.

Insectivores: Birds such as magpies and



Black Ibis Thiruvallur



Pheasant-tailed jacana Breeding Plumage

swallows eat insects, often catching and eating them in the air.

Fish eating birds: Herons, kingfishers, etc., all can dive into the water to catch fish.

Birds can be classified by their family, habits, characteristics or their habitats. Identifying and classifying birds according to their habitats are

much easier than other methods, especially for children. Birds can be divided broadly into two, Aquatic and Terrestrial. In the first part of this article, I will talk about aquatic birds.

Aquatic birds live predominantly in or around water bodies, and are mostly fish-eaters. A few are migratory. Each of them are adapted



Pheasant-tailed jacanas pair feeding



in distinct ways like having

- dense, waterproof feathers, so they can fly away easily when needed,
- long legs, as in flamingoes and cranes, to easily walk in water, keeping the rest of their body dry,
- webbed feet, as in ducks, for swimming
- streamlined bodies, etc.

painted Storks soared over the skies; the sound of flapping wings of those massive birds resembled the whirring sound of helicopter. Terns flew all around the watch tower; The Lake located farther away from our watch tower looked pinkish because of numerous greater Flamingoes. A few painted Storks nested near human habitations. The place was an example of peaceful coexistence between humans and



Mangrove forest in Manakudi Kanyakumari

Aquatic birds can be subdivided further into freshwater, saline, seabirds, shorebirds, waders, waterfowls and even more. Birding of aquatic birds is easier.

Freshwater Birds

I got interested in bird watching while visiting Koonthankulam Bird sanctuary, a freshwater lake in Thirunelveli. Numerous

animals.

I started getting familiar with bird names such as Bar-headed Geese, Caspian Terns, Little Grebe and Open billed Storks. We stood on the watch tower for two hours waiting for Spoonbills. After 6⁰⁰ o'clock, a Spoonbill hovered over the skies. The ecstasy of spotting a bird I was longing for is indescribable.

Vaduvoor bird sanctuary

Vaduvoor bird sanctuary, Thiruvavur, was not as diverse as Koonthakulam, but it housed huge flocks of white Ibises, Cormorant and few painted Storks. Ibises were stranger than other birds with curvy, thin bills and featherless heads. I saw an Ibis feeding its chicks. I later found that Ibises are one of the most celebrated birds of Tamil literature as 'œandril paravaigal'.

Birding in Kanyakumari

During the birders meet in Rajapalayam (2018), I got familiar with many birds which I had never seen before. I heard the calls of Cinnamon Bittern, Reef Herons and Jerdon's Bushlark. During bird census in Kanyakumari, I was able to see a Pheasant-tailed Jacana with its breeding plumage, which is very different from its common coloured plumage (feathers). It has a brilliant silky golden nape, white front, wings and a long central tail which makes them more attractive.

I spotted a male with 4-5 females on a lotus pond in northern Kanyakumari. I also spotted a flock of Knob-billed Ducks flying over the skies. A large male bird among the flock had a comical round shaped bill. Those hefty Ducks had glossy greenish black wings, and black spots all over their white body. They are one of the rarest migratory birds in Tamilnadu. I was lucky to see them.

Vembanad Lake

Vembanad Lake is one of the largest freshwater lakes in India. This fragile, freshwater lake ecosystem houses many important birds of southern India. But we spotted only a few little Cormorants, Gulls and Gray Herons. Maybe, this was because of off-season or over exploitation by tourism. Cormorants and Gulls were quite

bold. These birds fished on waves split by boat propellers. Gulls and Cormorants dived into the water to get fishes.

Saline water Birds

Hundreds of birds live in saline Mangrove forests of India. As these coastal forests are surrounded by water, they are good, safe fishing sites. Sunderbans, Baratang Islands, Bhitarkanika, Pichavaram, Mumbai creeks and Godavari-Krishna river delta holds the major Mangrove forests of India. I had gone to a few important bird sanctuaries located in mangrove forests like Salim Ali Bird sanctuary, Goa, Muthupet lagoon, Point Calimere Wildlife Sanctuary and Manakudy-Rajakamangalam backwaters.

Point Calimere Bird Sanctuary

I visited Point Calimere Bird Sanctuary, Nagapattinam during off-season; it was dry under a scorching Sun. Blackbucks and feral horses ran all over the dry forests of Kodiakarai. Ashy-crowned Sparrow Bushlarks flew all over the bushy scrublands. Even though they were smaller, they were very active and flew swiftly over the air. In the marshy mangroves of Kodiakarai, we could spot a Pond Heron, few Brahminy kites and a Eurasian Curlew.

Manakudy mangroves

I had visited Manakudy-Rajakamangalam backwaters multiple times. Manakudy mangroves are richer and house hundreds of birds. During a boat trip through the complex mangroves of Manakudy, large Gray Herons and colorful Painted Storks waded in the shallow marshes. Whiskered Terns, Black-headed Gulls and Cormorants flew and dived in the brackish waters. As we return to the shore, heavy rains lashed and the sun was about to set. A huge flock with hundreds of birds including Gulls, Terns,



Cormorants and Pelicans circled the dense canopies of the mangroves and swirled around like a storm. It was one of the most memorable moments I ever had. Getting on shore, we saw a large Barn Owl on a cement pole, with a large black eyes and a whitish hearted face looking at me.

Migratory Birds

Mudflats and salt pans in Manakudy have a rich variety of shorebirds in Kanyakumari. Plovers, Stilts and Flamingoes can be seen around these salt pans. Little Stints, very small waders

found in flocks are the most impressive birds. I was surprised to know that these birds being small as mid-sized chicks, travelled from Arctic Tundra to Southern India. Bar-tailed Godwits, Spotted and Common Redshanks, marsh Sandpipers, Common Greenshanks and Ruffs are other few migratory birds seen here. These birds travel from high latitudes to Kanyakumari. I was amazed to see these beautiful travelers; I think we aren't welcoming them as guests to our neighborhood, though migratory birds like the *Chenkaal Naaraai* (White Stork) got its mention in Sangam literature itself. Also we saw a large flock of Flamingoes, like a pink cloud. Kanyakumari is the only place in India to see Flamingoes throughout the year.

Salim Ali bird sanctuary, Goa

Salim Ali bird sanctuary in Goa is another beautiful bird sanctuary located in the mouth of Mandovi River. Surrounded by urban settlements, this small river island nurtures a good population of birds. As we went inside the complex creeks of the mangrove forests, birds including Reef and Gray Herons sat on the weak branches of the trees. I had seen my favorite Raptors like Ospreys and white-bellied sea Eagles. We spotted white bellied sea eagles flying over the skies of mangroves; they were large raptors, heavily built and armed with razor-sharp talons and powerful beak. Sea birds or pelagic birds are another group of birds that spend most of their lives on sea, foraging for dead carcasses and fishes.

To Be Continued ...

Sources: Several, including Wikipedia, Birds of the Indian subcontinent_Richard Grimmett, Carol Inskipp and Tim Inskipp _Helm Field Guide.



Grey Langur

Published by S.Subramani Published at 245, Avvai Shanmugam Salai, Gopalapuram,
Chennai-600 086 Printed by P.S.Kumaresan, Printed at SRI MURUGAN PRINTERS,
No.7/1, BooBegum 3rd Street, Chepauk, Anna Salai, Chennai-600 002.
Owned by Tamil Nadu Science Forum, Editor: Dr. D. Indumathi