

## Current Science Reports

### Paleoclimate in Western Himalayas *Tree rings record*

Annual growth rings in trees hold clues about year to year variations in local weather conditions. What do tree rings from long-living alpine trees tell us about the paleoclimate of the Western Himalayas?



Image: Vikram Singh

Recently, researchers from the Birbal Sahni Institute of Palaeosciences, Lucknow, the Banaras Hindu University, Varanasi and the Wadia Institute of Himalayan Geology, Dehradun collaborated to look into the matter.

They collected more than five hundred cores from long-lived chilgoza pine and Himalayan cedar trees from a large area at Kishtwar, in the Jammu and Kashmir region. From these, they selected tree ring materials from sixteen moisture-stressed sites for investigation.

The team dated the ring-width sequences and measured ring widths at a 0.01 millimetre resolution. There was high correlation and strong year-to-year coherence of tree rings from all the sites, indicating the influence of a common climate on tree growth.

The researchers reconstructed annual precipitation data from 1383 to 2017, based on tree ring width, and verified it against available records from the twentieth century. The results indicate three distinct centennial phases in the 635 years data. The initial expansion of glaciers may have occurred due to winter precipitation apart from dropping temperatures.

'In the middle phase, between 1650 and 1850, we see signs of stable precipitation over the western Himalayas. This coincides with the well-recognised Little Ice Age recorded in other parts of the world,' explains A. D. Singh, BHU.

But, before and after the middle period, things were relatively unstable with high-magnitude drought or low precipitation.

'Our reconstruction captured regional scale features and confirmed that the Little Ice Age induced stable precipitation over the entire Western Himalayas,' says Vikram Singh, Birbal Sahni Institute of Palaeosciences.

'The temperature records of the western Himalayan region show that the eighteenth and nineteenth centuries were the coldest in the last millennium,' they say.

DOI: 10.1029/2020GL091298

### Unusual Hailstorms in 2014

#### *Mechanism explained*

February–March 2014. Prolonged, widespread and severe hailstorms with large hailstones battered central India. The storms hit late at night and early in the morning. What led to these unusual events?

To find out, researchers from the India Meteorological Department and the Indian Institute of Tropical Meteorology, Pune used available atmospheric data. From satellite reanalysis products, they found warm, moist winds from the Bay of Bengal, blowing in from the southeast in the lower troposphere. And, in the upper troposphere, cold and dry winds coming from the west.

These opposing winds interact, driving the warm-moist winds to the cooler upper troposphere. The moisture condenses into droplets and ice crystals. The crystals move along the updraft and coalesce with other super cooled droplets to form hailstones. The hailstones get bigger upon collision till their mass overcomes the updraft strength. And they begin to fall.

The researchers tested this on a weather forecasting model. Model simulations supported the mechanism and revealed some finer details.

The clouds had mixed phase hydrometeors – water, ice, snow, soft hail and hail – below freezing level. The phases collided and accumulated into hailstones. The melting of ice crys-

tals and hailstones released latent heat which fuelled the updraft. And the stronger updraft led to larger hailstones and prolonged the hailstorms. The latent heat feedback also sustained the storms at night and in the early morning, even without heat from the sun. So, daytime heating fuelled the storms directly, whereas the feedback supported it until the next morning.

Now that we know the mechanism, we can be better prepared for such events even before they occur.

DOI: 10.1007/s13143-021-00235-4

### Analysing Drought Hotspots

#### *Across 24 Indian river basins*

According to a World Bank report, India has suffered at least one drought every three years over the last fifty years. Agricultural failure can bring starvation and force migration in the wake of a drought. The risk of drought varies in different river basins.

Manish Kumar Goyal and team from IIT Indore recently investigated droughts across 24 major river basins in India.

Meteorological drought reduces stream flow, leading to hydrological drought and insufficient soil moisture, causing agricultural drought. Since these factors are not completely independent, but coupled, the researchers used statistical copula models to unravel the relationship between drought severity and duration. They constructed various copulas with rainfall, runoff and soil moisture data from 1982 to 2013 from major river basins.

For calculating drought probabilities that exceed certain severity and duration thresholds, the team analysed copulas at different percentages of severity and duration. They also calculated drought return periods at different thresholds.

They found low occurrence probability and high return periods for the Mahi, Sabaramati and Luni river basins in western India, which they attribute to long periods and severe

droughts. They also observed long-lived and severe droughts in the Brahmaputra and Barak in eastern India, and the Tapi and Narmada in central India.

'Since droughts of longer periods tend to deplete soil moisture, these river basins are prone to agricultural drought,' says Srinidhi Jha, IIT Indore.

'Droughts in the Cauvery, Pennar and Krishna river basins are more frequent, but short lived and less severe,' adds Vikas Poonia, her colleague.

'Drought events in western and central India are longer and more severe than those in south Indian river basins,' concludes Manish K. Goyal, IIT Indore.

National disaster teams and cultivators can now formulate prevention and mitigation strategies based on these results.

DOI: 10.1002/joc.7091

### Banana Fibres

#### Blending with ramie

Banana production is huge in India, generating nearly 37 million tonnes of pseudostem that goes waste. The pseudostem has fibres that can be used for making textiles. But the fibres are coarse, making them hard to process.

Leena Mishra from the ICAR-National Institute of Natural Fibre Engineering and Technology, Kolkata and Nabnita Gogoi from the Assam Agricultural University, Jorhat have been working on easy ways to extract ramie fibres. Ramie is one of the oldest known textile fibres. Unlike banana pseudostem fibres, ramie fibres have a smooth texture. Can mixing the two fibres produce better yarn?

To investigate, the researchers used a wild, fast-growing banana variety, *Musa balbisiana*. *M. balbisiana* fruit have seeds, making them unpleasant to eat. So, the variety is not popular.

The team submerged *M. balbisiana* pseudostems under water to loosen fibres from the sheath. After 28 days, the fibres got completely separated. Further immersion led to the blackening of the fibres.

The fibres were then bleached. This reduced diameter and surface impurities and improved the appearance and micro structure.

The researchers blended banana and ramie fibres in various ratios. A 50 : 50 blend ratio, they found, was better for spinning banana-based yarn. When banana fibre alone was used, the breakage rate while spinning was high. Mixing the fibres improved the yarn's mechanical properties.

'The 50 : 50 blend has good absorbance and strength – a potential source for textiles,' says Nabita Gogoi, Assam Agricultural University, Jorhat.

'Scaling up the technique can help banana farmers get extra income by selling banana pseudostem,' adds Leena Mishra, ICAR-National Institute of Natural Fibre Engineering and Technology, Kolkata.

DOI: 10.1080/15440478.2021.1897728

### Extracting Lycopene

#### From watermelon juice

Watermelon juice is a natural source of lycopene, an antioxidant used as a nutraceutical and in energy drinks. Extracting lycopene from watermelon juice involves removing the pulp and then reducing the water content. Unfortunately, during industrial processing, watermelon juice undergoes changes, compromising the quality of the final product.



Image: Udham P K

S. Sridhar and team from the CSIR-Indian Institute of Chemical Technology, Tarnaka have now come up with an ingenious method to concentrate lycopene from watermelon juice while retaining quality. The principle is simple: osmosis – a semipermeable membrane to separate water from dissolved solutes. But the problem was that the membrane soon gets clogged. So they used a polyamide membrane

that they had been working on – a hydrophilic membrane that is one-fiftieth of a millimetre thick.

They first extracted lycopene from fresh watermelon juice using a liquid-liquid solvent extraction process to remove most of the other components. Now the juice had about 55 milligrams of lycopene per kilogram. This liquid was pumped to circulate on one side of the membrane and, on the other side, they pumped salt solution. The water from the lycopene solution would thus move towards the salt solution through the membrane. And the circulation of the lycopene solution reduced the fouling and clogging of the membrane.

The researchers optimised the salt concentration and the pumping rates to increase the lycopene concentration to 230 milligrams per kilogram over ten hours. The product had good sensory qualities and could be stored at 4 degrees for one month without degradation.

The membrane is useful for concentrating other bioactive components from fruit juices, say the researchers

DOI: 10.1002/jctb.6720

### Treat Obesity, Insulin Resistance

#### With magenta berry

High fat diets lead to obesity, and are suspected to promote insulin resistance – leading to diabetes type II. Treatments and drugs for obesity-related diabetes are costly and associated with serious side effects.

To treat obesity and diabetes, the tribal population of the Tirumala Hills, Andhra Pradesh traditionally use *Syzygium paniculatum* fruits, which they call *adavi nerudu*. But there was no adequate scientific evidence to support the effectiveness of the treatment.

Researchers from the Sri Venkateswara University, Thirupati collected these fruits, dried, powdered and extracted the water soluble components and lyophilised the extract. They sent this powder to researchers at the Annamalai University.

The researchers there fed rats with a high fat diet. The herbal extract was fed to one group, while another received orlistat, an anti-obesity drug. With only the high fat diet, rats gained

more weight than rats on a normal diet. Rats that received the extract or orlistat showed initial weight gain, but then the weight remained steady.

Blood sugar, insulin and lipid profiles showed that rats on the high fat diet were progressing towards insulin resistance and metabolic syndrome within four months. But these factors remained near normal in rats receiving orlistat or the fruit extract.

'Liver samples after four months showed obvious pathologies in rats with the high fat diet. But the pathology was unnoticeable in rats that got orlistat or the fruit extract,' reveals Vijayakumar Natesan, Annamalai University.

'Looks like tribals in the Tirumala Hills were on the right track when they used *adavi nerudu*,' says Krishna Kumar Jaiswal, Uttaranchal University, who helped analyse the results.

'Of course, we need to analyse the active components in the extract to standardise the product,' adds Y. K. Prabhakar, Krijan Biotech Bangalore.

DOI: 10.1016/j.jep.2020.113576

### Peafowl Group Size

#### *Response to parasites and predators*

While doing field observations on the effect of providing food to peafowl populations, Dhanashree Paranjpe and her team from the Abasaheb Garware College, Pune observed a curious phenomenon: peafowls come together in large groups in summer. But, during the monsoon, peafowls are seen in smaller groups.

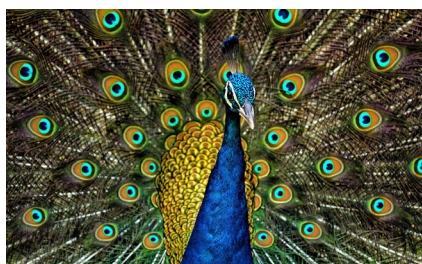


Image: Jatin Sindhu via Wikimedia Commons

Why? What is the basis for this variation in group size?

Such changes in group size are known to occur in some other animals and birds as a strategy to reduce parasitic infections. Is this the case with peafowl?

The team selected three different sites for their study: Morachi Chincholi

and Nashik in Maharashtra, where about 60–70% of food for the peafowls are provided by villagers and villages near the Ranthambore National Park, Rajasthan where the peafowls receive only about 40% of their diet from humans. The monsoon starts in June in Maharashtra. In Rajasthan, it starts one month later.

The team started documenting peafowl group sizes. Pre- and post-monsoon, group sizes increased.

'In the hot dry summers, peafowl are easily detected by predators. So they seek safety in numbers,' explains Priyanka Dange, Abasaheb Garware College.

'Monsoon increases food availability and green cover. So the groups start splitting. This is also conducive to their mating behaviour,' says Pranav Mhasalkar, her colleague.

The team collected and analysed peafowl excreta from far and near the food provisioning sites. They analysed the sample for cyst forming as well as non-cyst forming parasites. Both prevalence and parasite load were lower during the pre-monsoon and increased rapidly during the monsoon.

'The probability of parasite transmission is higher in the wet season. Social distancing during the monsoon reduces the chances of infection,' says Dhanashree Paranjpe, analysing costs and benefits.

Most parasites increased near food provisioning locations – probably an effect of crowding.

Intricate interactions are the foundations of animal societies. These systems swing on the pendulum of costs and benefits. When benefits are high, animals coalesce. But, when costs outweigh benefits, they move apart.

Interesting lessons to learn in the time of the pandemic.

DOI: 10.1007/s10211-021-00366-x

### Woodpeckers as Indicator Species

Monitoring forest health is cumbersome, requiring a high level of expertise. The problem becomes acute when dealing with forests stretching over widely varying elevations as in the Western Himalayas. An indicator species to monitor changes in forests there can ease the task.

Tarun Menon, from the National Centre for Biological Sciences, Bengaluru noticed that changes in the populations of the woodpecker species accompany changes in bird diversity and forest cover. Woodpeckers are easy to locate from their calls and drumming. Can they be used as indicators of habitat quality and bird diversity, he wondered.

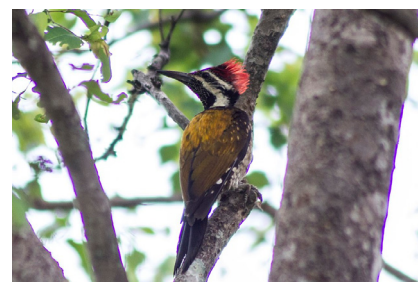


Image: Nagaraja Iyer via Wikimedia Commons

With Ghazala Shahabuddin, Centre for Ecology Development and Research, Dehradun, he decided to evaluate the possibility of using woodpeckers as indicators. Using local knowledge and satellite imagery, the researchers selected 74 sites frequented by woodpeckers, across dense to fragmented oak forests in an area of 400 square kilometres in the Kumaon region of the Western Himalayas.

Choosing 74 forest sites along a gradient of human disturbance, the team counted all birds sighted within a fixed radius of 30 metres. The process was repeated in different seasons over two years to incorporate seasonal variations. The team found that areas with higher numbers of woodpeckers were also rich in other bird species.

'This suggested that woodpeckers are good indicator species for forest bird diversity,' says Tarun Menon, National Centre for Biological Sciences.

Vegetation structure influences the nesting and foraging behaviour of birds.

So, the researchers measured tree height, girth, density and canopy cover. They found that woodpecker and other forest bird populations correlated strongly with canopy cover.

'Good canopy cover has better microclimate which supports insects. This attracts foraging and nesting woodpeckers,' explains Ghazala Shahabuddin, Centre for Ecology, Development and Research.



The researchers observed that woodpeckers and the other bird communities preferred areas with fewer but larger trees. Woodpeckers have loud calls and distinct tree drumming behaviour that are easy to locate.

So, with some basic training, they can be used as indicators by forest managers in planning and monitoring forest health.

DOI: 10.1007/s10531-021-02164-0

### Indus and Ganges River dolphins *Distinct or subspecies?*

The Ganges river dolphin, *Platanista gangetica* major, and the Indus river dolphin, *Platanista gangetica* minor, are now considered subspecies. Mitochondrial DNA studies suggest that the two species diverged some half a million years ago. Has the long history of geographic isolation led them to develop into distinct species?



Image: Zahangir Alom via Wikimedia Commons

But it is hard to compare morphological differences as the two rivers are separated by international borders. So, Ravindra Kumar Sinha from the Patna University turned to researchers in Pakistan, the UK and the US.

From existing literature, the team compiled data on the external and cranial morphology of the dolphins. They also mailed a questionnaire to other researchers working on South Asian river dolphins. Seventy-three per cent of the respondents confirmed that Indus and Ganges river dolphins are uniform light brown/grey.

Data on body length, weight and sex were available for 126 individuals – 80 from the Indus and 46 from the Ganges. International museums in Germany, Scotland and Japan provided skeletal materials of the

river dolphins. There were only a few specimens, and most were damaged. But the team managed to get 80 skulls and skeletal measurements of 29 dolphins from the Indus and 45 from the Ganges.

Extensive statistical analyses showed that Ganges river dolphins have a larger left crest and shorter tail. While the Ganges dolphins had an average of 28 teeth in the upper jaw and 29 in the lower, Indus dolphins had an average of five more teeth.

Female Ganges river dolphins are larger than the males. But there is no major difference between males and females in Indus dolphins.

‘Our skull data set is small. And there were only a few adult specimens for Indus dolphins.

So, it is difficult to fully describe skeletal differences between the two,’ says the Dolphin Man of India, Ravindra Kumar Sinha, Patna University.

Yet available evidence suggests that Indus and Ganges river dolphins seem to be distinct species.

Though the Indus river dolphin is recognised as the National Mammal of Pakistan and, in India, the Ganges river dolphin is the National Aquatic Animal and a ‘nonhuman person’, the populations of both have been reducing. Reduction in their habitats due to declining flow, barrages and entanglement in fishery nets threaten their survival.

DOI: 10.1111/mms.12801

### Did Lockdown Reduce Accidents? *Road fatalities during COVID*

Last year, the COVID-19 pandemic led to lockdown in most countries. Travel restrictions drastically reduced movement. With less traffic on roads, did the number of accidents decrease? Or did rash driving increase? A recent study from IIT Bombay might have the answer.

Monika Gupta, Nishant Mukund Pawar and Nagendra R. Velga collected data on the strictness of lockdowns from January 2020 to July 2020, in 15 countries, including the

US, Australia, Russia, Japan, Brazil and 10 countries from the European Union. Google’s global mobility report gave the traffic measurements.

With increased lockdown restrictions for over 6 months, recreational trips went down by 60% compared to data from January 2020. Trips to groceries and pharmacies reduced by 20%. With work from home becoming the new norm, trips to the workplace reduced by 45%. Did this reduced traffic reduce road fatalities?

Compared to the average number of road fatalities per one lakh people over the previous years, the results show that fatalities decreased in all 15 countries. In countries with low percentages of young people and low freight commercial transportation, fatalities reduced by around 7%. In countries with a higher percentage of youngsters and greater commercial transport needs, road fatalities reduced by only 3%.

‘Young drivers are more likely to engage in risky driving, especially with decreased traffic during lockdown,’ says Monika Gupta, IIT Bombay.

‘With lockdown restrictions, e-commerce demand increased, which might have put pressure on commercial drivers for faster delivery. These factors could account for the differences,’ adds her colleague, Nagendra R. Velga, IIT Bombay.

The minor reduction in road accidents even with highly reduced traffic shows that better safety regulations and driver compliance are important for reducing road fatalities.

DOI: 10.1080/19427867.2021.1892937

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ACKNOWLEDGEMENT: IISER Pune for access to scientific databases.

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