

Current Science Reports

Rock–Ice Avalanche

Chamoli region

There was a flash flood in Chamoli district on 7 February 2021. This was reported to be due to a large mass of snow, ice and rock crashing into the Ronti Gad valley. The event led to a flash flood that resulted in more than 200 casualties.

Yunus Ali Pulpadan from IISER Mohali joined hands with researchers from other universities to investigate the disaster and to find ways to avoid such calamities.

The team used 28 satellite images that covered the Ronti Glacier to examine the deformation of the source ice–rock chunk that caused the landslide. They tracked the deformation of the terrain using Sentinel 2 satellite imagery in the COSI-Corr software that allows sub-pixel measurements of ground surface changes. Images from Pleiades stereo satellites helped them generate a digital elevation model of the area after the event and to quantify the volume.

They found that the rock–ice avalanche was influenced by a sliding wedge block. The movement in the rupture plane was the source of the landslide. The team identified two deformation zones, one of which had caused the 2021 Chamoli event.

They also identified an unrecorded landslide on 9 October 2016 that had taken place in the immediate vicinity, piling up water and a thick pile of sediment. The researchers suggest that accumulated rock debris from the landslide in 2016 was an extra source for the flash flood in Chamoli. The material moved farther down because of reduced friction due to vibrations similar to those produced by rock avalanches.

The research team warns that another deformed slope, which they identified above the already broken slope, needs monitoring as it poses a threat to the downstream community. They propose tracking the deformation using satellite data and ground sensors for early warning.

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Himalayan Brown Bears

Connectivity of habitats

The reddish-brown Himalayan brown bear is an endangered subspecies. There are only around 300 of them left at higher elevations of the Himalayas, distributed mostly over Jammu and Kashmir, Himachal Pradesh and Uttarakhand. Human activities and land use changes have affected the habitats of the bears and isolated them in small pockets in the region. For the conservation of the species it is important to have connectivity between the populations.

What connectivity is left between isolated Himalayan brown bears in the western Himalayas? What can be done to conserve the brown bear populations for the future?

To find out, researchers from the Wildlife Institute of India, Dehradun, Amity University, Noida, and the University of Kashmir collaborated with a researcher from the US.

The investigators used a previously developed map to assess the present distribution of Himalayan brown bears in the Western Himalayan mountains of India. They considered eight land-use patterns to understand how Himalayan brown bears move around currently. And they found that the bears are more likely to move around at an intermediate elevation between valley and ridge locations where human activity is low.

They could identify four areas that need bear management efforts: the Zaskar mountain range with rich alpine meadows and high connectivity suitable for bears in Ladakh, the Great Himalayan Mountain range with moderate-to-high connectivity, the Pir Panjal range with low-to-moderate connectivity and the northwestern region of the Ladakh range with low connectivity.

The team identified a potentially important route through the Kishtwar mountains connecting Himalayan brown bear subpopulations between the Great Himalayan Range and the Pir Panjal Range.

They discovered a single large connected patch that allowed high disper-

sal and medium dispersal. There were three isolated patches with potential for low dispersal.

The researchers tried different climate change scenarios to predict future changes. At low connectivity, the core area was projected to be fragmented into 15 isolated patches by 2070. However, the core area with high connectivity will remain a single patch. Due to climate change alone, high dispersal core areas may shrink by 2050 and reduce further by 2070.

Human activity and climate change prevent Himalayan brown bears from moving across the Western Himalayas, and the movement of the bears may be severely threatened by 2070, say the researchers.

Policymakers and land managers need to take these findings into account to protect the ecosystem and conserve the Himalayan brown bears.

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Diet of Dholes

In tiger reserves

Dholes, or Indian wild dogs, have reddish to white fur, look like foxes and are almost as tall as Alsatians. They are the only dog species that live in forests.



Image: Davidpraju via Wikimedia Commons

India houses the highest number of these shy, endangered canids – in the Western Ghats, and in central and north-east India. These diurnal carnivores are fast runners, good swimmers, impressive jumpers and excellent hunters. But their prey base and hunting habits are a mystery.

Researchers from the Wildlife Institute of India, Dehradun, led by Bilal

Habib and Parag Nigam, recently determined dhole diet preferences. In six tiger reserves in Maharashtra, they radio-collared some dholes and followed them for three years. Analysing over 190 kills by dholes, the researchers found that the canids preyed mostly on chital and sambar.

They collected over 800 faecal samples from the radio-collared dholes and other randomly found scat samples. An analysis of the samples revealed that prey protein content varied from area to area. Over 75% of the scat samples had grass, mostly bamboo. Sambar, chital, chousingha, wild pig and langur proteins were found in the samples.

The dholes also hunted smaller animals such as black-naped hares and rodents, depending on availability.

The researchers noted an incident of the consumption of a snake run over by a vehicle. The most diverse prey base was observed in reserves with high human interference.

There were cattle remains in some scat samples. However, the forest department had no reports of dholes attacking cattle. So the researchers attribute the cattle remains in the scat to disposed cattle carcasses and the scavenging of tiger kills.

Statistically analysing the data, they found that dholes preferred medium to large prey. But, where there was higher tiger density, they preferred fawns to adults. In general, smaller packs of two to four dholes preferred hunting fawns, while larger dhole packs with more than eight members hunted adult ungulates.

'To conserve these carnivorous dogs, we need to maintain relatively high densities of their preferred ungulate prey species,' suggests Parag Nigam, Wildlife Institute of India, Dehradun.

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Food and Activity-Rest Rhythms

In fruit flies

Diurnal changes in the activities of organisms are due to circadian clocks that enable organisms to anticipate changes in their environment. External cues like light and temperature can entrain the activity-rest cycles in organisms. Food availability may be yet another such factor. Can the daily timing of food availability synchronise the activity/rest rhythm of fruit flies?

Sheeba Vasu and the team from JNCASR, Bengaluru looked into the possibility. They designed a set of experiments where they subjected fruit flies, *Drosophila melanogaster*, to feeding-starvation cycles.

In one experiment, they starved three sets of flies for 12, 14 or 16 hours before feeding them and observed their locomotor activity rhythm. For longer starvation hours, the fruit flies exhibited changes in activity levels. But after a few cycles, the activity cycle became similar to that of controls. After a week of feeding-starvation cycles, there was no synchronisation of the locomotor activity rhythms of the fruit flies to any of the feeding-starvation cycles. Similar results were obtained when the feeding-starvation cycles were shifted by 6 hours.

The researchers now changed the 24-hour cycle by experimenting with fruit flies for 26 and 21-hour feeding-starvation cycles. When such divergences from normal diurnal cycles were introduced, the flies appeared unable to synchronise their locomotor activity. However, the period of the internal clock was influenced by these 26- and 21-hour cycles.

The researchers infer that, while food cannot directly act as a time cue, it can indirectly impact the circadian clock properties of the fruit fly. The internal clock of fruit flies does not synchronise to food availability cycles, but responds by making small changes to clock properties without changing the overall diurnal pattern of locomotor activity.

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Enhanced Mutualism

Mechanism for invasive success

Invasive species usually have high rates of growth and reproduction, especially in newly introduced ranges. They spread over an area very quickly, and, to do this, they form symbiotic interactions with bacteria and fungi. Take, for example, the Canadian horseweed, *Conyza canadensis*. It is a widespread agricultural weed, which has started showing resistance to commonly used herbicides.

Conyza and arbuscular mycorrhizal fungi are mutualistic and benefit from each other. The fungal hyphae extend the reach of the plant's roots for seeking nutrients.

To study the eco-evolutionary associations between arbuscular mycorrhizal fungi and *conyza*, Manzoor Ahmad Shah from the University of Kashmir recently collaborated with an international team of researchers.

They selected four different biogeographical regions, across continents that encompassed both native and non-native ranges of the horseweed. In each region, they carried out sampling along disturbed sites like roads and railways, where no fertilisation or irrigation takes place.

They analysed the principal components that led to these differences. In terms of biomass, *conyza* plants in the non-native range had almost the same cover but were three times larger than plants in the native range.

Most populations were highly colonised by arbuscular mycorrhizal fungi in both ranges. The results indicated that non-native plants were mostly colonised by fungi in the Glomeraceae family. Native *conyza* plants, on the other hand, formed relationships with a wide set of fungal taxa, which do not include Glomeraceae.

The team grew *conyza* in a greenhouse with different permutations of the fungal species. They harvested above-ground biomass and recorded data about plant performance. In greenhouse shoots, biomass remained the same for plants from both ranges. In plants from the native range, shoot biomass was positively correlated to root size in *conyza*, but negatively correlated with the abundance of fungal taxa.

In plants from non-native ranges, roots produced lower biomass, indicating a shift in allocation patterns. Yet the plants thrived because of increased symbiotic relationships with a tighter cluster of mycorrhizal communities from the Glomeraceae family.

Plants in the non-native ranges had higher biomass and were also more fecund.

When *conyza* migrated to non-native ranges, it would have encountered a different set of conditions that required adaptation. The researchers suggest that the eco-evolutionary shift provided the non-native plants advantages which the plants in native ranges lacked. Besides, the native plants could also be

facing competition from pathogens naturally found in the native ranges.

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Onion Seed Yield *Improving quality and quantity*

Onions have high demand. To increase the yield, seed availability is a bottleneck. Pollination plays an essential part in onion seed production and insects play a major role in pollination.

However, if we want hybrid seeds, we cannot depend on insects since the pollination will be random. Artificial pollination, therefore, is a possible solution for higher seed production as well as for creating planned hybrids.

But onion pollen is quite sticky. What is the best method for artificial pollination?

A team of researchers from various ICAR institutions started investigating the problem at the ICAR experimental farm in Almora.

The team started observing pollinators and pollinator abundance at different times of the day. The number of insects visiting onion flowers was greater in the afternoon than in the morning or evening. The Indian bee was the most frequent visitor during all three time frames.

The researchers then analysed the results of cross-pollination with hand pollination using gloves made of different materials such as cloth and rubber as well as with a brush and sponge puff, covering the flowers to prevent insect pollination.

They found that open and sponge-pollinated onion flowers yielded more seeds than obtained by using a camel hair brush or gloves made of cloth and rubber.

If bees are not abundantly available for pollination, farmers in Uttarakhand can use artificial means to achieve higher onion seed yield.

India is already the second highest in onion production. If adequate amounts of good quality seeds are made available, India may even take the first position.

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Metabolites Against SARS-CoV-2 *Molecular computation*

Current COVID-19 therapeutics primarily target the spike glycoprotein, which

initiates infection, the RNA-dependent RNA polymerase, which replicates the viral genome, and the 3-chymotrypsin-like protease necessary for proper packaging of the next generation of virions.

Unlike the spike protein, which goes through mutations, the protease structure remains largely the same. This makes the enzyme an ideal target for developing broad-spectrum antivirals.

Researchers from IIT Indore did an *in silico* investigation of human metabolites which block the functions of the protease. They downloaded around 3500 human metabolite structures from a database and converted them into 3D structures.

Then the team used structure-based docking algorithms to screen the metabolites by comparing them against the protease structure. They selected seventeen metabolite molecules based on their binding affinity with the protease enzyme.

Finally, the team narrowed them down to eight complexes based on glide scores, a proxy for binding scores depicting the binding affinity of ligand and protein. One of the predicted metabolites was isobavachalcone, which has shown efficacy against the protease of SARS-CoV.

Another metabolite was a polyphenolic flavonoid with a potential antiviral property.

The researchers then predicted a metabolite, a stilbene glycoside, that has the potential for treating SARS-CoV-2 infection.

There was another set of metabolites, 1-benzopyran compounds, which interact with the binding cavity of the major protease of SARS-CoV-2. The ligand-protein interaction between the protease and the metabolites showed great affinity, suggesting potential to inhibit the activity of the protease.

The researchers also estimated total binding affinity to confirm the specificity of human metabolites. The isobavachalcone metabolite had the highest affinity for the protease.

The team analysed the metabolites' pharmacological and toxicological properties to explore their use in drug design.

Though isobavachalcone was the best metabolite, it had a poor toxicity profile at the concentrations required.

On the other hand, benzopyran exhibited excellent pharmacological properties.

These human metabolites have good potential as possible COVID-19 protease inhibitors and can play a promising role in managing SARS-CoV-2 infection.

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Signs of Higher COVID-19 Risk *Abdominal symptoms*

During COVID-19, a higher rate of complications and mortality has been reported in patients with abdominal symptoms. So, perhaps, the presence of abdominal symptoms may help risk assessment during COVID-19 treatment.

Physicians and surgeons from the Ramaiah Medical College, Bengaluru, investigated this possibility recently. They took data from about 700 patients from a COVID-19 tertiary care hospital and classified the patients into mild-to-severe and severe cases.

About 20% had abdominal complaints. The most common symptoms were distension of the abdomen, vomiting and abdominal pain.

Abdominal complaints were higher in patients with severe illness than in those with mild-to-moderate illness. A high number of such patients also had nausea and vomiting.

The team analysed relationships between patients with abdominal symptoms and their serum inflammatory markers. They found a higher neutrophil to lymphocyte ratio in patients with abdominal symptoms.

When the doctors compared the death rate of patients with different symptoms, they found a higher number of deaths occurring in patients with abdominal symptoms.

They also compared survivors and non-survivors with respect to abdominal symptoms. Around 40% of the deceased had at least one abdominal symptom.

Physicians could, perhaps, use abdominal symptoms as a sign of higher risk from SARS-CoV-2.

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Pathos of Pathology Labs *The case of Indian hospitals*

The more than 60% of clinical decisions depend on laboratory tests. So the

WHO recently updated their list of essential tests that should be available at all Primary Health Centres. ICMR, too, released a list of essential tests that should be available at primary, secondary and tertiary hospitals in India.

However, the facilities for these tests and the trained manpower to carry out these tests are, sadly, lacking. In fact, out of the 525 medical colleges, only 350 have post graduate courses in pathology and the medical graduates that come out of the colleges do not have an adequate background in clinical pathology.

A team of pathologists from the Post-Graduate Institute of Medical Education and Research, Chandigarh, the Government Medical College, Baramati and the Manipal Hospital–Yeshwanthpur, Bengaluru, examined the sorry state of affairs in pathology and laboratory medicine in Indian health care and have come up with practical suggestions for improving the situation. This includes making accreditation mandatory in all the laboratories in the medical schools to raise the standards of medical care and teaching in India. They have also come up with a questionnaire to assess the quality of pathology laboratories in medical colleges.

Though health is a fundamental right as per the Indian Constitution, the allocation for health is only 1.3% of the GDP. Yet, since the contribution of the laboratory to overall health expenses is only 10% even in the most developed countries, setting things right will not be difficult, argue the doctors.

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Cashew Nut Crackers

All noise and low smoke

Fireworks pollute the air. Sulphur dioxide is a major emission from the bursting of firecrackers.

When cashew seeds are heated in fire to extract the nut, they crackle. Can

we use waste cashew shells to make firecrackers and reduce these emissions?

Researchers from the Kalasalingam Academy of Research and Education, the CIT Sandwich Polytechnic College and the SRM Institute of Science and Technology, Tamil Nadu, collaborated to experiment.

Spectroscopic techniques showed that cashew nut shell did not lose its chemical properties even after heating at 110°C, making it an ideal candidate for the experiment. The researchers prepared mixtures of various proportions of cashew nut shells, aluminium, potassium nitrate and sulphur. The mixtures were added to standard flash powder samples and stuffed into bijili crackers.

The team estimated the cashew nut shell powder mixture's ability to produce the desired sound effects while controlling sulphur emissions.

The noise level was monitored as per Government of India directives. The researchers found that a mixture containing 5% cashew nut shell powder could emit the desired levels of noise and lower levels of sulphur dioxide.

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Used Plastic

As construction material?

There are many attempts to use waste plastic to prepare construction materials combining different types of plastic waste and cementing material. But which combination of plastic and cementing material is the best?

Researchers from Rajiv Gandhi Proudhyogiki Vishwavidyalaya, Bhopal, set out to find the best composite mix. They collected plastic waste – shampoo bottles, soda bottles, milk containers, plastic cans, ...

Different plastics have different melting temperatures. So the team segregated the plastic waste into high-density

polyethylene, low-density polyethylene, and polyethylene terephthalate. The plastics were cut into small pieces and washed to remove any unwanted residue.

Heating plastic with engine oil prevents it from burning and releasing toxic gases. So the researchers mixed the plastic with hot used engine oil collected from mechanic shops. When the plastic started melting, they added sand, crushed stone, or a mixture of both, in different proportions. They stirred the mixture to make it homogenous while it was hot and poured the mixture into moulds, to cast cubes, cylinders and beams.

They demoulded the casts after drying them for 3–4 hours in open air and tested the materials for use in construction.

The composite material prepared with high-density polyethylene and coarse aggregates was the densest. It also had the highest split tensile strength, the load at which the specimen breaks apart. But the composite with fine aggregates absorbed the least amount of water.

High-density polyethylene and fine aggregates performed well in tests for compressive strength on cubes and cylinders and for flexural strength on beams.

'The high-density polyethylene mix performed better than normal and fly ash bricks. But it cannot replace concrete mix,' says S. S. Bhadouria, Rajiv Gandhi Proudhyogiki Vishwavidyalaya, Bhopal.

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