

## Current Science Reports

### Assessing Coral Bleaching

#### *Sensing sea-surface temperature*

The Malvan marine sanctuary in Maharashtra is rich in corals. These colourful animals are indicators of marine ecosystem health. From 2014 to 2019, Baban Ingole and team from CSIR-NIO, Goa have been conducting underwater surveys. Over the period, there was an alarming decline in coral colonies.



Image: Kalyan De

Monitoring the condition of corals in turbid seas is difficult and underwater surveys require resources. So the team decided to try satellite data for the purpose. Collaborating with researchers from the Punjab Remote Sensing Centre and the Kuwait Institute for Scientific Research, they measured thermal stress on corals in the eastern Arabian Sea.

In 2015, sea-surface temperature rose to a record level. A 12-week cumulative measure of thermal stress remained above threshold levels from 2014 on, peaking in 2016.

'When stressed, corals expel symbiotic microalgae. The algae provide nutrition and energy. Without them, corals turn pale and die,' explains Baban Ingole.

'Satellite sea surface temperature data is cost-effective to monitor coral reefs and predict bleaching,' adds his colleague, Kalyan De.

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### Increasing Ocean Temperatures

#### *Isolating marine assemblages*

Most marine fish have a biphasic life cycle. They spend their early life as free swimming larvae near the surface, dispersing through phytoplankton, and settle to the bottom after maturity.

Increasing ocean temperatures speed up development in fish. How does this affect fish larvae dispersal?

Rohan Arthur, Nature Conservation Foundation, Mysuru collaborated with researchers from Spain to find out.

The team sampled around 1500 individuals representing 9 common species in the Mediterranean Sea. To understand early life traits – growth rate, settlement size, hatching and settlement dates – they counted growth rings in the otolith, a structure in fish ears which produces growth rings annually.

How long the larvae stay near the surface before settling to the bottom determines how far they disperse. The data helped the researchers predict how changes in temperature affect larval stages from hatching to settlement and influence their ability to disperse.

Nearly all species showed a decline in surface larval displacement with increase in temperature. They grew quicker and settled down.

Reduced population dispersal and contraction of ranges may isolate fish populations. This can impact fisheries and marine ecology and evolution, say the researchers.

DOI: 10.1111/1365-2656.13435

### Ghost Gear in Ganga

#### *Threat to biodiversity*

Ghost gear, discarded fishing equipment in water bodies, traps aquatic animals. Ruchi Badola and team from the Wildlife Institute of India, Dehradun set about identifying the sources of ghost gear in the Ganga, in collaboration with researchers from Bangladesh and the UK.

The team selected nine locations along the river, ranking them based on gear density. Ghost gear increased in the river as it flowed towards the Bay of Bengal – remnants of plastic nets, some with mesh sizes that are illegal.

Air breathing aquatic animals are the most affected.

'Turtles, otters and the endangered Ganges river dolphin are at high risk

of entanglement,' says Hina Khatoon, Wildlife Institute of India.

Fishing is a major occupation in nearby villages. The researchers found that the fishers were not aware of fisheries regulations and proper gear disposal.

'Ineffective regulations worsen the situation,' says Sumit Kumar, Wildlife Institute of India, Uttarakhand.

The economic condition of fishers prevents purchasing better gear. And low quality gear deteriorates rapidly.

'With better environmental awareness and if fishing boards provide better gear cheaper, the problem of plastic in the Ganga might shrink,' says Aditi Dev.

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### Microplastic Pollution

#### *Macro pollution in Marina Beach*

Microplastics are less than 5 millimetres in size. We ingest around 30 such particles everyday through sea salt alone. They cause nervous and reproductive disorders, and even cancer. We need to understand microplastic waste better to manage the menace.

Recently, researchers from Pachaiyappa's College, Chennai, and Bharathidasan University, Tiruchirappalli collaborated with researchers from Japan and France to investigate microplastic waste from Marina beach, in Chennai.

They processed samples from sea water, and wet and dry sand along a 5 kilometre stretch. There were 250 to 400 microplastic particles per kilogram of sample. Under a microscope, most microplastics were like filaments. Some were like granules.

'The number of microplastics here is almost twice what is found in Mumbai, Tuticorin or Dhanuskodi beaches,' says S. Venkataraman, Pachaiyappa's College.

The team found that most were polyester or polyfluoride compounds. Polyester is a commonly used synthetic textile and polyfluoride is used in electric batteries, food processing and packaging. Synthetic textiles, domestic water and fishing material are major sources of microfilament plastic.

Banning plastic bags is not enough to stem the microplastic menace.

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### Wildlife Behaviour

#### *Temporal interaction*

Fear of predators drives temporal patterns in prey. Chances of detecting prey determine carnivore activity. But these patterns are not rigid. Subtle changes in niche regulate the ecosystem.

Urjit Bhatt and team from the Wildlife Institute of India, Dehradun set up sensor-based cameras to document animal activity patterns in Manas National Park, Assam.

The team found that smaller carnivores foraged at night, those of medium-size were nocturnal or diurnal and large animals were active as and when they needed food or water.

'Body size seems to decide active periods,' explains Urjit Bhatt, Wildlife Institute of India.

How do related carnivores avoid conflict? By overlapping the temporal patterns of the animals, the researchers found that, though similar carnivores hunt at the same time, they avoid competition in subtle ways. For example, clouded leopards avoid tigers by climbing trees.

Besides day, night or twilight, lunar phases also impact wildlife activity. There was a strong correlation between moon phases and foraging. To avoid predators and search for food, smaller prey species are more active on brighter nights. But their predators, small carnivores, are active on darker nights.

'The risk of competition and predation creates these temporal activity partitions,' says Salvador Lyngdoh, Wildlife Institute of India.

The behaviour of individual species evolves to maximise survival. So, various species coexist, maintaining a delicate balance in forest ecosystems.

DOI: 10.1111/btp.12917

### Restoring Biodiversity

#### *Role of planted forests*

Some argue that plantation forests are threats to natural forests. Others defend their role in biodiversity conservation.

What is the long-term impact of plantation forests on species composition, plant diversity and carbon storage potential? How do these differ from those in natural forests?

Anudip Gogoi and colleagues from the Mizoram University, Aizawl set out to explore. The team used the same sampling technique in a 39-year-old plantation forest and a natural forest in the Brahmaputra flood plains

In the natural forest, species dominance and evenness were higher. As were plant biomass and carbon stocks.

But, in the plantation forest, biodiversity indices were greater. Tree species richness was slightly higher. The number of herb species was three times higher.

'Plantation forests reduce human pressure on natural forests and create livelihoods for associated communities,' says Anudip Gogoi.

'Plant forests in degraded lands to sequester carbon,' suggests Jitendra Ahirwal, his colleague.

'Sustainably manage such forests to conserve biodiversity,' recommends Uttam Kumar Sahoo.

DOI: 10.1016/j.jenvman.2020.111671

### Stone Mining Deteriorates

#### *Dwarka river basin*

The Dwarka river basin in eastern India has huge reserves of building stones. Stone mining and crushing are common there. Recently, Swades Pal and Indrajit Mandal from the University of Gour Banga, West Bengal examined how these activities impact the environment.

Noise levels at mining and crushing sites were almost a hundred decibels higher than safe for humans. From satellite data, they discovered that surface temperature at the sites was up to three degrees higher than in peripheral areas. They found high levels of aerosols in the lower atmosphere. And vegetation health has deteriorated in a larger area. Soil in the area was highly alkaline and low in nutrients. Consequently, crop yield was low.

'Dispersed dust gathers on the river bed. The river is now shallower by almost half a metre,' says Swades Pal.

Water in the Dwarka river basin was high in dissolved solids and had higher

biological and chemical oxygen demand, making it inhospitable to aquatic life.

'Such conditions affect livelihoods. The long-term impact might be irreversible,' adds Indrajit Mandal.

The report is a wake-up call to use environment-friendly technologies for stone mining and crushing.

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### Indian King Prawn Farming

#### *Loss due to infections*

About 70% of export revenue from sea food is from the king prawn, *Litopenaeus vannamei*. However, diseases cause major losses for aqua farmers in India.

Recently, scientists from the ICAR-Central Institute of Brackishwater Aquaculture, Chennai, the Navsari Agriculture University, Gujarat and the West Bengal University of Animal and Fishery Sciences calculated the economic impact of diseases in king prawn farming in India.

They conducted surveys in Tamil Nadu, Andhra Pradesh, West Bengal, Maharashtra and Gujarat, covering about 90% of the farming area.

To estimate employment loss due to reduction in culture duration, the team interviewed more than 900 shrimp farmers.

Economic loss for each farm was calculated based on selling price for each size group.

Infection by *Enterocytozoon hepatopenaei*, a parasite, and white spot syndrome virus accounted for most losses. *Enterocytozoon hepatopenaei* infections caused an annual loss of about 2700 crore rupees and the white spot syndrome virus, 1200 crores.

The total loss is nearly 58,000 crores due to these two diseases when employment loss is also factored in. Other diseases accounted for a loss of about 500 crores annually.

Farmers are being trained to recognise the symptoms of these diseases early to reduce losses. But research on preventing and curing these diseases needs to be stepped up to reduce the burden on farmers and ensure sustained export revenue.

DOI: 10.1016/j.aquaculture.2020.736231

### Growing Lettuce Using hydroponics

Cultivating lettuce in soil is challenging. The crop is heat sensitive and grows slowly. Though lettuce leaves have high water content, lettuce water footprint is low. Can hydroponics help?

In deep water hydroponics, roots are suspended in a nutrient-rich solution. In nutrient film hydroponics, a shallow stream of nutrient-rich water re-circulates through the roots. Which method is better?

Recently, Maliqa Majid and her team from the Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar collaborated with engineers from the Central University of Kashmir and the Vaugh Institute of Agricultural Engineering and Technology, Uttar Pradesh to compare the methods.

They grew lettuce using both approaches. As control, they grew some in poly-house tunnels, ideal for soil-based cultivation.

Lettuce grew faster and yielded more in hydroponic systems. Deep water culture reduced growing period by 16%.

Hydroponically-grown lettuce had more total soluble solids, acidity and chlorophyll, protein and crude fibre content than lettuce from poly-tunnels.

There was no significant difference in water consumption between soil-based and deep water culture. But the nutrient film technique saved 64% water.

'Both approaches yield more and better lettuce. But the nutrient film technique is better for water deficient regions,' says Maliqa Majid.

Hydroponics can help grow lettuce and other crops profitably when there is little or no access to soil.

DOI: 10.1016/j.agwat.2020.106572

### Irrigation Management In sugarcane

Sugarcane is a high water requiring crop. But water scarcity in semiarid regions makes growing sugarcane a challenge. Irrigating the crop at critical growth phases can maximise production under limited water resources.

S. K. Dingre and S. D. Gorantiwar from the Mahatma Phule Krishi Vidyapeeth, Maharashtra varied the water as per the needs at different stages of the crop.

'The growth stage, when the sugarcane stem elongates, is most critical. Adequate water at this stage can increase yield,' explains S. K. Dingre, Mahatma Phule Krishi Vidyapeeth.

'Restricting irrigation at germination and maturity stages doesn't affect crop yield. In fact, we can reduce water use by 13 per cent,' adds S. D. Gorantiwar.

The researchers hope that, in Maharashtra, farmers will optimize sugarcane yield using deficit irrigation.

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### Effect of Shade Intensities Intercropping mango and pineapple



Image: Zainab37 via Wikimedia Commons

Mango monocrop orchards are a common sight in the north and south of India. The orchards spring into action from February till the monsoon drenches roots. And that is when the pineapple monoculture in the north-eastern states becomes active.

Researchers from the ICAR-Indian Institute of Horticultural Research now suggest intercropping pineapple with mango. Both regions may then benefit fruitfully.

Kundan Kishore and colleagues planted pineapples in four different light environments. A monoculture plot acted as control. In the other three plots, they planted pineapples as intercrop in a low density mango plantation. Mango canopies were pruned to provide low, moderate and high shade intensities on pineapple plants.

The team studied plant growth, yield, nutrient content and other

physiological parameters for two years. In monoculture, sunburn was more intense. Pineapple, they found, performed better with a shade intensity of about 50%.

Intercropping mango with pineapple can improve the income of both mango and pineapple growers, say the researchers.

DOI: 10.1016/j.scienta.2020.109868

### Micro-Irrigation Solar photovoltaic pump

High horsepower photovoltaic pumps dot landscapes in arid zones. This can spell doom for meagre groundwater resources. Priyabrata Santra from the ICAR-Central Arid Zone Research Institute, Jodhpur decided to innovate. He tried micro-irrigation from surface water using a one horsepower photovoltaic pump.

He set up solar panels, a pump unit and a manual tracking system. In solar pumps, water discharge increases with solar irradiance. But, in spite of variations in sunlight through the day and in different seasons, his pump provided adequate water. However, the discharge reduced with increase in delivery head and the pump unit's suction head.

Priyabrata then used the interrelations between the solar-pump's head and discharge to operate micro/mini sprinklers and drippers. This optimised the distribution efficiency and water discharge of the micro-irrigation systems.

For uniform irrigation and maximum coverage, Priyabrata designed a web of spatially distributed sprinklers and drippers. The system could lift harvested runoff water in farm ponds with minimum seepage and evaporation loss to irrigate crops according to water requirement.

When the pump is not operational, electricity generated can be routed to other purposes in the farm and for household demands, using circuit breakers, says the researcher.

The installation cost of solar pumps is more than that of electric and diesel pumps. But the life cycle cost is low and such pumps reduce a farm's carbon footprint.

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## Heart Health

### *A phone call away?*

High blood pressure is a silent killer, predisposing people to cardiovascular diseases. Yet, many fail to keep blood pressure under control, miss follow-up appointments and do not adhere to medication schedules.

Can phone calls persuade patients to follow up?

As part of the Mumbai Hypertension Project, researchers led by Kanure Mandar from the Program for Appropriate Technology in Health conducted a study in Mumbai slums. Previous studies showed that the prevalence of hypertension is higher in slums.

The team enrolled around 13,000 patients from 160 private clinics and recorded their details and family history of blood pressure. A treatment coordinator from the clinic made monthly or quarterly phone calls to patients who missed appointments. The coordinator reminded such patients to attend the follow up appointments, stressing the importance of blood pressure control.

Blood pressure control increased from 25% to 49% in these patients. But some patients did not answer the calls and some phones did not connect. However, many who did not attend to the phone calls also visited the clinics for follow up. Among these, blood pressure control increased from 22% to 44%. Statistical analysis showed a linear relation between the monthly or quarterly phone calls and blood pressure control in the sample population.

These results can now be used by the public health system to reduce cardiovascular diseases in the country.

DOI: 10.1111/jch.14221

## Machine Interprets Heartbeats

### *Arrhythmia detection*

The heart flutters when it sees a loved one. Most irregular heartbeats or arrhythmias are harmless; however, some carry the risk of cardiac arrest.

The best way to diagnose arrhythmia is using an electrocardiogram. But analysing heart signals is daunting and requires expertise.

So, Hemalatha Karnan and Sivakumar Natarajan from NIT Trichy developed a machine learning model to ease the task.

To train the model, they downloaded 600 samples of electrocardiogram signals from an arrhythmia database.

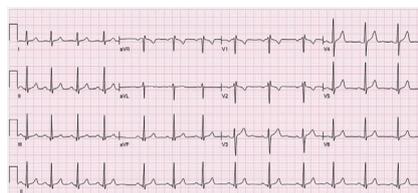


Image: Ewingdo via Wikimedia Commons

They used a ranking selection algorithm to characterize relevant parts of the cardiogram signals. With support from Dr Rajajeyakumar Manivel, SRM Medical Hospital, Trichy, the researchers marked the parts that signalled arrhythmia. They fed this information to the algorithm to focus only on useful subsets of the data.

To further filter the input, the team needed an algorithm that clusters the data. They used a support vector machine, an algorithm, to create boundaries between input points and to segregate them.

Finally, to extract the output, the researchers took inspiration from the pack hunting style of wolves. The mean grey wolf algorithm is an iterative process that converges on the best solution.

The machine learning model can determine patterns between all the inputs and help clinicians detect arrhythmia early. Now comes the bigger task – acceptance of the technology in clinical practice.

DOI: 10.1002/cpe.5001

## Scientific Temper in Colleges

### *Insulating from fake news*

Scientific temper is influenced by politics, socio-economics, culture and technology. All these have changed since the time the notion of scientific temper was enshrined in the Constitution of India.

How has this impacted scientific temper among youngsters who have just reached voting age? Do students who study science have better scientific temper than those who do not?

Does spending more time on social media and instant messaging influence scientific temper?

Sreeram Gopalkrishnan and Snehal Galande from the Symbiosis Centre for Media and Communication, Pune designed a questionnaire with ten statements based on recent claims of the superiority of ancient Indian science in news and social media and ten more based on superstitious cultural practices. The participants had to agree or disagree with these statements.

The duo administered the questionnaire to 135 students from the same college, taking care to avoid students they were teaching. The respondents were 18 to 22-year-olds and represented 18 states and a wide variety of mother tongues, but all accessed English language media.

Based on their answers, the researchers tried to gauge the students' scientific temper. Scientific temper among this age group did not depend on the subject studied, and use of social media or instant messaging. But some students believed in superstitions or mixed mythology with science in spite of urban environments, with good education and access to technology.

'Most students are able to insulate themselves from fake news coming via WhatsApp and social media,' says Snehal Galande.

'The lack of difference between data from science students and non-science students shows that scientific temper is about a way of thinking rather than knowledge of scientific theories and laws,' says S. Gopalkrishnan, her colleague.

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