



# Conducting an ecological choir

UNDERGROUND BIODIVERSITY HAS BEEN FOUND TO BE IMPORTANT IN HOW THE ECOLOGY RESPONDS TO CLIMATE CHANGE, WRITES S ANANTHANARAYANAN

iodiversity is now recognised as a vital factor in the resilience of the environment. The nine "planetary boundaries", or the limits within which the world would have to stay to avoid irreversible environmental damage, developed by the Stockholm Resilience Centre in 2009, listed the loss of biodiversity as one, along with climate change, chemical pollution and land use. Biodiversity has, however, been understood more in terms of the plant and animal species in forests and grasslands and even in agriculture and aquaculture. A paper in the journal *Nature Communications* now turns the focus on lesser studied varieties of life forms to be found

group of plants when grown either together or separately in small plots to demonstrate the value of diversity. But an ecosystem is seen as consisting of several different inter-related functions, a property that is termed Ecosystem multifunctionality, or EMF, and studies have shown that this EMF is dependent, even more than individual functions, on biodiversity, or the presence of a variety of species. Within biodiversity, however, analysis and separation of the effect of a variety of species either above or below ground has not been possible,



How biodiversity adds up



Multifunctionality can be seen to increase with diversity in soil bacteria, fauna and total diversity and also with diverse plant species. Diversity un fungi and archaea do not seem to affect EMF.



hence, the composition of biotic communities. There have even been studies that combine variations of climate with different levels of biodiversity to see how these affect different things, like the productivity or resilience and the way the whole, integrated ecosystem works. The studies have made use of changes in climatic conditions as one moves over a landscape, and also the changes in the kind of vegetation, but mainly the over-ground plant cover. Carrying out a study of how changing geographic, climatic and also biodiversity, both above and says. below ground, affect the ecology would help identify and quantify the effect of different components, the Nature Communications paper says. The study hence covered 60 sites spanning a gradual variation of climate along alpine grasslands on the Tibetan plateau, spread over nearly 1,000 km, to examine how the EMF, the combined "suite" of environmental functions, behaved under different levels of climate as well as biodiversity, both above and below ground. For quantification of multifunctionality, eight key ecosystem features: (1) over-ground biomass, (2) root biomass, (3) soil organic carbon, (4) soil nitrogen, (5) soil available nitrogen, (6) soil phos-

phorus, (7) plant nitrogen (nitrogen pools in aboveground biomass), and (8) plant phosphorus (phosphorus pools in aboveground biomass) were estimated at each of the sites and averaged. As for the levels of biodiversity at the same sites, estimates were made of the different kinds of (1) bacteria in the soil, (2) another variety of living cells called archaea, (3) of other animal life in the soil, (4) of fungi in the soil and (5)

plant species to compute a "soil biodiversity index". The method used to count the kinds of soil organisms was by analysis of DNA extracted from soil samples.

The levels of multifunctionality at the various sites, as the five elements and the combined index of biodiversity increased or fell, were then analysed statistically and the results are shown in the graphs displayed. The levels of EMF can be seen to increase with the increase in diversity in soil bacteria and fauna, and total soil biodiversity, while diversity in fungi and archaea do not seem to have an effect.

Non-biotic influences were also assessed by relating EMF levels with rainfall, temperature and the soil content of moisture, acidity and calcium carbonate (limestone or chalk). The relationship is shown in the second picture and, on further statistical analysis, it is found that the strongest single driver of EMF is soil moisture.

Plant species' richness and below-ground biodiversity are seen to have about an equal effect and the two factors, taken together, accounted for a large fraction, about 45 per

# **PLUS POINTS**



### 'Delete' tourists

Adobe has revealed a new camera app that can delete unwanted tourists from photographs, easily and automatically. The new app works by using an algorithm to look at a scene and analyse what is moving and what isn't. It will then produce a photo with the moving things cut out — allowing people to take a picture of a monument or other sight in full, even though there might have been people in front of it the whole time.

Adobe showed off a prototype of the new app at its Max Conference in San Francisco this week. It demonstrated the app on an Android phone, showing how it can simply cut out all of the obstructions in a photo and take a picture of the Taj Mahal or Eiffel Tower without any people in the way. It works in just a few seconds, according to the on-stage demonstration, using the phone's processing power to quickly remove all of the obstructions.

The app seems to require that the phone stays absolutely still, which would mean that it needs to be left on a tripod or another stable surface. Adobe didn't say when the new tool would be released, admitting only that it had "been working" on the app.

ANDREW GRIFFIN/THE INDEPENDENT

#### Inflatable incubator



Nathan J Sanders and Aimee T Classen. University of Copenhagen.

underground and within the soil. Xin Jing, Yu Shi, Haiyan Chu, Ke Zhao, Litong Chen, Yue Shi, Youxu Jiang and Jin-Sheng He from the University of Peking and the Chinese Academy of Sciences at Nanjing, Xining and Beijing, and Nathan J Sanders and Aimée T Classen from the University of Copenhagen report that soil bacteria and below-ground plant and animal species form an important part of a complex that regulates relations between parts of the ecosystem and how it responds to climate change. Although there is debate regarding the mechanism of the action of biodiversity, the fact that a variety of species living together makes for stability and efficient recycling of resources in an ecosystem is understood with some clarity. The studies, however, have been in the form of measuring the productivity, for instance, of a

The Peking University team

the paper in *Nature Communications* says, perhaps because of the great complexity and variability underground, even within a short distance. "... Pick up a handful of soil and you might find more species there

than all of the vertebrates on the planet," says co-author Aimee T Classen in a news release from the university. The study, in fact, cites an 1881 paper, "The Formation of Vegetable Mould, Through the Action of Worms, with Observations on Their Habits" by Charles Darwin, to illustrate that the diversity and importance of underground species has been long recognised. There have also been a number of investigations, the study says, of the effect that climate has on the constituents of an ecosystem, like plants, animals, earthworms, microbes and,



Soil Biodiversity regulates a suite of functions in ecosystems.



The Tibetan plateau in China where the study was carried out at 60 different sites

cent, of the variation in EMF across sites. The finding, overall, is that non-biotic conditions of rainfall, moisture and soil chemistry influence the effects of biodiversity, which, in turn, mediate the effect of non-biotic conditions on EMF.

The study represents investigation into how different conditions affect the way an ecosystem responds to climate change. The findings suggest ways of influencing levels and the nature of the components of the ecosystem to help the system adapt to changing conditions, the study

A significant finding, for instance, was that soil biodiversity may have stronger effects on the ecosystem in areas of higher rainfall. "That is important because scientific studies often focus on temperature – not precipitation – when predicting how ecosystems will respond to future changes such as climate change," Aimée Classen said. "As climates change and species are lost and gained from ecosystems, predicting how ecosystems will function in the future will require experiments and observations that link biodiversity above and below ground to EMF," the paper says.

THE WRITER CAN BE CONTACTED AT simplescience@gmail.com

Fast have been used in the discoveries

The construction of the telescope also

represents a huge advance for China's

native space programme. Despite the

country's peaceful explorations into

Chinese have already sent a human

the launch of a space station and a

space only beginning in the 1990s, the

into orbit and are currently planning

of new planets, comets and pulsars.

**CONTROLLING DISEASES** 

## **TAPAN KUMAR MAITRA EXPLAINS THE ANTI-FUNGAL** ACTIONS OF SULPHUR AND ITS **COMPOUNDS ON PLANTS**

**(**) ulphur formulations are highly effective fungicides against powdery mildew fungi and various spots and blights— they inhibit the development of scab and have acaricidal properties. They have a protective and curative action against diseases whereas spores treated with sulphur lose their ability of sprouting.

The fungicidal activity of sulphur formulations is explained by their ability to liberate a vapour of elementary sulphur that penetrates into spores or mycelia of a fungus. Most probably the lipids sulphur, being an acceptor of hydrogen, disrupts the normal course of hydrogenation and dehydrogenation reactions, with the formation of hydrogen sulphide. The latter is closely associated with the growth of spores and the vitality of the fungus. Spores that have lost their ability of growing cannot form hydrogen sulphide from sulphur

Consequently, the formation of hydrogen sulphide can be considered as detoxification of the elementary sulphur. But hydrogen sulphide is fungi-toxic and ren-



It is presumed that the specific nature of the action of sulphur formulations is explained by the different ability of spores to absorb the sulphur and detoxify it with the formation of hydrogen sulphide.

In view of the above notions on the nature of the fungi-toxic action of sulphur for the successful control of diseases, it is essential that the formulations gradually (during a long time) evolve an amount of sulphur vapour sufficient for action in a region as close as possible to the mycelium and conidia of a fungus. It is ensured by the uniform coating by the fungicide of the surface being protected, and by the use of formulations having good retention and persistence.

Ground sulphur formulations consisting of coarse particles are retained poorly on the surface of plants, and have a smaller and non-uniform evaporation surface. Colloidal sulphur formulations have the largest surface area and intensity of evaporation owing to their structure containing very minute particles, but the duration of their action is brief. Formulations of highly dispersed sulphur consisting of particles from 1 to 20 um in size have the best fungicidal action. They are retained well and are uniformly distributed over a plant, and have a sufficiently large evaporation surface and duration of action.

The fungicidal action of lime sulphur is also associated with the evolution of elementary sulphur. The action

of sulphur formulations is greatly affected by the ambient temperature. At a temperature below 20 °C, they are only slightly effective, while above 35 °C they harm plants. Many varieties of gooseberPaving the Fast track THE SEARCH FOR ALIEN LIFE HAS GOTTEN BIGGER WITH CHINA BUILDING THE BIGGEST EVER RADIO TELESCOPE FOR THE PURPOSE, WRITES DOUG BOLTON

C hinese scientists are constructing the world's biggest radio telescope The Search for Extraterrestrial Intelligence or Seti Institute, which that will be more effective than leads humanity's search any other at picking up weak messages for extraterrestrial life, has never from outer space that could be linked picked up any message that to intelligent life. The assembly of the conclusively comes from an alien Five hundred-metre Aperture civilisation, despite having a number of earth- and space-based telescopes at its Spherical Telescope, or Fast, began in July and is expected to be completed in disposal. 2016. Once finished, the reflector dish However, even if aliens don't make contact, radio telescopes smaller than

of the telescope will be 500 metres in diameter, replacing Puerto Rico's Arecibo Observatory, only 300 metres in diameter, as the world's largest. The wider the dish, the more effective the telescope becomes at picking up weak messages from outer space. Nan Rendong, the chief scientist of the Fast

project, told Xinhua news agency, "A radio telescope is like a sensitive ear, listening to tell meaningful radio



Last week, James Roberts, a 23-year-old

Briton, designed a cheap, inflatable incubator that could save premature



babies in remote locations and won a prize that boosts the chances of the device reaching the market. Built in the course of his engineering degree to assist Syrian refugees, he has since won two awards and associated cash prizes that will help him turn his prototype into a commercial product by 2018. The MOM incubator will cost just a fraction of the usual £30,000 price tag for conventional devices, according to the product's website.

The incubator is designed to be easy to carry and operate in isolated locations such as refugee camps and hospitals in developing countries. "Conventional incubators are incredibly cumbersome and difficult to transport and also difficult to use," Roberts says, while his device is light and can be packed away when not in use. It can also be powered from different electricity sources; for example, it can run on a car battery for 24 hours, he says. The device, he says, is superior to others of its kind because it provides an enclosed, warmed microenvironment that helps prevent infection.

SCIDEV.NET

## **Fighting disease**

Chytridiomycosis, a skin disease caused by the chytrid fungus Batrachochytrium *dendrobatidis*, currently threatens approximately 500 amphibian species worldwide. Researchers led by a team from Virginia Tech demonstrated that the



of microbes on bullfrogs skin could indirectly affect the disease symptoms: the results

composition

were published on 7 October 7 in PLOS ONE.

They collected 60 juvenile bullfrogs (*Lithobates catesbieanus*) from a pond in

Virginia where the fungus had previously

been detected and sampled the frogs'

randomly assigning them to one of six

microbiomes were either reduced with

antibiotics, augmented with a probiotic,

experimental groups: the frogs' skin

naturally occurring skin microbes,

Mechanism of action of sulphur fungicide (rnicronised wettable sulphur) on powdery mildew.

ders vitally important enzymes inactive like catalase, cytochromoxidase, and lactase. Elementary sulphur can also bind the metals (iron, copper, manganese, zinc) contained in the enzymes and form sulphides. All this upsets the normal metabolism of fungi and causes them to perish.

ries and cucurbit crops are distinguished by their high sensitivity to sulphur formulations— when treated with the same, burns may occur, as well as roughening and frangibility of the leaves and sometimes even defoliation. Sulphur formulations must never be used on crops suffering from drought (if necessary, the crops must be watered before treatment). Sulphur formulations may not be mixed with oils and therefore treatment with sulphur may be performed 15 days before or after spraying with oils.

Sulphur formulations are generally used from the moment of a disease's appearance and treatments are repeated every week or so. The proper application of sulphur formulations facilitates an increase in the yield of crops and an improvement in their quality.

Sulphur formulations have a low toxicity to human beings and other warm blooded animals. The prolonged inhalation of sulphur dust may lead to an ailment of the lungs, therefore when working with formulations of elementary sulphur, one must use anti-dust respirators.

Formulations of elementary sulphur may be used without any restrictions. The harvest time for all crops except medicinal ones is one day and cucumbers in greenhouses must be washed before harvesting them. No tolerance levels have been established for the sulphur content in food products though.

THE WRITER IS ASSOCIATE PROFESSOR, HEAD, DEPARTMENT OF BOTANY, ANANDA MOHAN COLLEGE, KOLKATA, AND ALSO FELLOW, BOTANICAL SOCIETY OF BENGAL, AND CAN BE CONTACTED AT tapanmaitra59@yahoo.co.in messages from white noise in the universe. It is like identifying the sound of cicadas in a thunderstorm."

Rather than sitting above ground, the telescope's dish is sunken into a natural bowl-shaped valley in China's Guizhou province. The geography of the surrounding hills and the remoteness of the site mean that there will be less interference from earth-

based radio signals. The dish will be suspended slightly above ground level by a series of strong pillars and cables, allowing operators to move it and listen in to noises coming from different parts of space. Although the dish is huge, the scientists may have a long wait if they want to pick up on alien radio signals.



manned mission to the moon, both scheduled to take place at some point in the 2020s.

The development of the telescope will allow Chinese scientists to have their own first-hand data and equipment, rather than having to rely on information supplied by foreign space telescopes.

Wu Xiangping, director-general of the Chinese Astronomical Society, told Xinhua. "Having a more sensitive telescope, we can recieve weaker and more distant radio messages. It will help us to search for intelligent life outside the galaxy and explore the origins of the universe.

or left alone. They were then either exposed to the fungus or used as a control over the 42-day experiment.

frogs, they discovered that simply augmenting or reducing the skin microbiome did not affect the intensity of the fungal infection — but the antibiotictreated frogs grew less than their counterparts when exposed to the fungus. The microbes differed in composition among the exposed frog groups, depending on their skin treatment. "The normal microbiota of bullfrogs is important for disease outcome, and potentially host fitness," the authors concluded in their report.

"Factors that contribute to microbial community assembly and maintenance on amphibian skin, including host factors, habitat, diet and the available microbial species pool, may ultimate influence disease dynamics," study co-author Lisa Belden of Virginia Tech said.

#### KAREN ZUSI/THE SCIENTIST









THE INDEPENDENT



When the researchers analysed the resulting microbial communities on the