NEWS

A word in your shell-like

A much wider range of baby shellfish can hear and react to underwater noise than scientists previously thought. These tiny crustaceans use noise to avoid predators that lie in wait around busy coral reefs, researchers have found.

Even though the creatures are as small as a flea, they clearly have some sort of hearing system that lets them pick up the pops, grunts and gurgles made by fish, shrimps, urchins and other coral reef dwellers.

Scientists have only relatively recently found that tiny fish larvae can also hear, and use the noise of the reef to figure out where to set up home. Now this is the first time scientists have found evidence that many crustaceans hear too, but in this research, the scientists found that noise deters them away from reefs. The researchers don't yet know how they manage this, but suspect they may have the same simple hearing system that fish have.

Fish have both hair-like receptors that detect the movement of water particles and membrane receptors that pick up oscillating particles.

Many crustacean larvae need to avoid coral reefs – they come out to feed at night, when predators are on the prowl. Their natural enemies include soldierfish, squirrelfish, and millions of corals and filter feeders attached to the reef.

The coral reef is like a 'wall of mouths' to these animals, so when they hear noise, they avoid it.

Steve Simpson, University of Bristol

'The coral reef is like a "wall of mouths" to these animals, so when they hear noise, they avoid it,' says Dr Steve Simpson, a marine biologist at the University of Bristol, and lead author of the research, published in *PLoS ONE*.

This means that underwater noise from human activities like dynamite fishing, drilling and boats could affect all sorts of marine creatures much more than previously suspected.

'These crustaceans are major groups in tropical waters and underpin many food webs. Anthropogenic noise could lead to maladaptive behaviour and leave them swimming towards sounds they should be moving away from,' explains Simpson.

Waste not want not

Organic refuse from households and industry can help turn polluted soils back into rich and varied habitats. But a shift in public and government attitudes is needed before this can happen, scientists say.

A recent paper published in *Elements* describes how researchers managed to restore heavily contaminated sites by applying specially designed mixes of organic waste, which would otherwise often end up in landfill sites.

'Remediating land with waste has gained more interest recently, but the science is still in its early stages,' says Professor Davey Jones of Bangor University, who led the research. 'What's unusual here is that we managed to end up with high-biodiversity grassland, whereas in the past people have often been content to remove the most harmful pollution and end up with a site covered in something like football turf.'

Jones and his colleagues worked on two sites in north Wales. The first was an area of slate-mining waste and the second an old industrial site contaminated with heavy metals and organic chemicals.

The team added different compost mixes to the two areas and after 18 months diverse grassland had established on the sites.

Each site needs a particular blend of waste materials, with different plants seeded on top.

Jones says the technique has great potential, but the major hurdle is acceptance, both from the general public and from regulators and policy-makers. Many people dislike the idea of spreading sewage and other waste on the land, even if it's not dangerous.

The researchers say they still need to understand how the process works over the long term and which kinds of waste work best in each situation, as well as how far it's worth transporting different types of organic material before the financial costs and carbon footprint start to outweigh the benefits.

Mona Makela/Shutterstock

Keeping Europe's lights on when space weather strikes

NASA/Goddard Space Flight Centre

We take reliable lighting and heating for granted. But imagine if we had no electricity for days on end – what would happen to our telephone system, our schools, hospitals and food distribution networks? How long could you last without your fridge, or with no fresh food on supermarket shelves?

In the last few decades scientists have learned that our electrical supply is at risk from space weather. Solar storms, flung into space by the Sun, can play havoc with the Earth's magnetic field, causing large and rapid magnetic variations that induce damaging electrical currents in power systems across the world. In 1989 the Hydro-Quebec grid failed when protective measures were tripped by space weather, and the same storm caused transformer damage to Britain's grid.

Now a consortium of European scientists including researchers from the British Geological Survey (BGS) have come together to study this risk, in the EU-funded programme European Risk from Geomagnetically Induced Currents (EURISGIC).

This is the most ambitious programme of its kind. No one knows how the inter-connected European grid responds to space weather impacts. National networks have been studied, but no one has tried to put all the national pieces together before.

EURISGIC will develop mathematical models of how the European system responds to space weather. The programme will find the worst cases in the archives, identify 'hot spots' in the system, and develop monitoring and forecasting capabilities. An advisory group of power-industry experts will help develop new strategies for the operation and adaptation of Europe's power networks in the light of the findings.

EURISGIC kicked-off in March 2011 and will run for three years. Dr Alan Thomson, head of Geomagnetism at BGS, is leading Britain's input.

'The project represents a fantastic opportunity to really push space weather and geomagnetism science and to make a difference in everyday life,' he explains.

EURISGIC comes at an appropriate time. Solar activity has started to pick up again after an extended period in the doldrums. Peak activity is expected around 2013, and the threat from solar storms will then be at its greatest.

For further information contact Alan Thomson – awpt@bgs.ac.uk

NEWS

Low-carbon future? You have to play the game

How would you make the UK's energy system low carbon, secure and affordable if you were in charge?

A new game at the Science Museum London's recently opened *atmosphere* gallery gives you a chance to have a go. Researchers from the UK Energy Research Centre (UKERC) helped create Carbon Minister, a game that gives you 40 years to transform a fictional country's energy system.

At each turn you choose how to invest in new technologies, research and development, energy-efficiency measures, and retiring dirty old power plants. But the budget is finite, so you have to think ahead if you're going to meet the stiff carbon targets without bankrupting the country or letting the lights go out.

UKERC provided information on cost, availability and carbon emissions for the energy technologies that underpin the game, and also advised on the narrative.

Dr Jeff Hardy, UKERC knowledge exchange manager, led the UKERC input.

'The *atmosphere* gallery brings the science of the Earth's changing climate to the public at a level of detail normally reserved for scientists and policy-makers. It's vital that we help people understand the challenges and choices ahead as we move to a low-carbon society. The game helps you understand the difficult choices we face – it's far from easy and despite having designed the rules I still failed first time I played it!'

In *atmosphere* you can discover some key instruments used by scientists, learn about the latest climate news, and dig deeper into the story of our changing climate. The gallery has its own land, oceans, ice and atmosphere, and Carbon Minister is just one of five interactive games that allow you to see your actions played out before your eyes.

During 2011 National Science and Engineering Week UKERC will also be putting groups of university students through their low-carbon paces in a game called Energy Islands. Students are in charge of three islands. Each group has to decide how to decarbonise their own island and negotiate with their neighbours for the technology and resources to do it.

UKERC is the hub of UK energy research and the gateway between the UK and the international energy research communities.

www.ukerc.ac.uk

Humans reach rock bottom

Clicks/istockphoto.com

Human activities are affecting large areas of the deep seabed, according to a recent study – and trawling does the most widespread damage.

More regulation is needed before the ocean floor suffers even more, the scientists say. Better data on human activities – where they're taking place and how much harm they are causing – is also vital to let us manage the whole ecosystem.

'Human activities are expanding into the deep sea at an unprecedented rate, and these ecosystems are under more pressure than ever before with new activities like carbon capture and storage, mining for minerals and deeper drilling for oil and gas,' says Angela Benn of the National Oceanography Centre, who led the study.

Benn analysed and combined the available information on the location of different human activities during 2005 on the deep seafloor in the OSPAR (Oslo Paris Commission) area of the northeast Atlantic. The area is heavily exploited and contains important fisheries and oil and gas fields.

Until recently, many countries just dumped unwanted material into the abyss and forgot about it. That's left an alarming legacy of contamination, ranging from scuttled ships, old ordnance, chemical weaponry and even radioactive waste.

But the study, published in *PLoS ONE*, makes it clear that deep-sea trawling – a fishing method in which boats drag nets across the seabed to catch bottom-dwelling prey – is currently the biggest source of harm to the deep ocean floor. Trawlers plough up and disrupt coral reefs and other sensitive habitats, and they could affect as much as 37,160km^2 of seabed.

This is ten times greater than the area affected by all the other activities in the study put together. In some areas of the northeast Atlantic, it would mean most sections of seabed get trawled at least once a year.

Benn says this study is a step forward, but that much more information is needed if appropriate regulations are to be introduced so these deep-sea ecosystems can be managed for the long term.

'Traditionally human activities in the marine environment have only been managed on an industry-by-industry basis. New approaches are now turning towards managing whole ecosystems and multiple impacts from different industries. From the point of view of fisheries, the aim has been to preserve individual fish stocks,' she explains. 'It's only recently that regulations are being developed to protect vulnerable marine ecosystems taken as bycatch in trawls.'

Humans not always to blame for coral reef decline

The decline of coral reefs over the last few decades is often squarely blamed on human activity. But a recent study suggests the picture is a little more complex.

Researchers have found that some reefs stop growing simply because they've reached the end of their natural life cycle.

The UK and Australian researchers found that some parts of Australia's Great Barrier Reef stopped growing between 4,000 and 5,000 years ago without any kind of human influence. In other places new reefs have established themselves only in the last 1,000 to 2,000 years.

'There's an assumption that degraded reef states are a function of environmental stress, linked to anthropogenic activity,' says Professor Chris Perry, an expert in coral reefs at Manchester Metropolitan University, who led the latest study, published in *Global Change Biology*.

'Whilst this is often the case, the picture is not as simple as that. Some degradation is natural and not the result of anthropogenic stress. It may simply be that a reef has gone through its natural evolutionary life cycle and then shut down.'

They might look a bit worse for wear, but this is normal; you'd expect them to look like that.

Professor Chris Perry, Manchester Metropolitan University

'Some of these reefs clearly have degraded surfaces and patchy veneers of living coral,' explains Perry. 'They might look a bit worse for wear, but this is normal; you'd expect them to look like that.'

In many areas of the world, reef degradation is clearly down to human activities. In the Caribbean reef decline since the mid-1970s is almost certainly down to pollution and overfishing.

But this latest study reveals that, in some cases, it's normal for reefs to decline.

The team's findings mean that, 'conservationists should start to include considerations of the evolutionary state of a reef and its age, as well as focusing efforts on younger and actively growing reefs that can harbour a wider range of habitat types,' says Perry.

NEWS

Flu pandemic threatens British sewage works

A severe flu pandemic would send a pulse of drugs into sewage works that could endanger the UK's water treatment system, according to new research.

Sewage works rely on bacteria to break down waste so it's safe to release into rivers. If antibiotics and antiviral drugs make their way through our sewers during an influenza pandemic in the quantity predicted by recent studies, they could have a devastating effect on these bacteria.

An underperforming sewage works would release inadequately-treated sewage into a nearby river, with potentially deadly consequences for fish and other aquatic life. In many areas of southern England, drinking water itself comes from these 'at risk' rivers, so the risk of sewage works failure is immediately relevant to human health.

'The UK's massive antiviral stockpile will expose all UK sewage works and rivers to high concentrations of the drug during a moderate to severe influenza pandemic,' says Dr Andrew Singer at the Centre for Ecology & Hydrology, one of the authors of the report, which is published in *FEMS Microbiology Letters*.

In the first study of its kind, the team exposed a model sewage works to a simulated pandemic, which included an eight-week course of antibiotics and the antiviral drug Tamiflu. They then monitored the sewage works to see how well it kept functioning.

The initial few weeks of the pandemic were manageable, but as the drug onslaught continued, the 'friendly' bacteria lost much of their ability to remove nutrients and clean the water. At the peak of the pandemic the sewage works showed signs of instability and reduced treatment.

Antibiotics were probably the main reason for the bacterial community's decline. These drugs do nothing to cure flu themselves, but can be needed if sufferers develop secondary bacterial infections like pneumonia or bronchitis.

Singer argues that as many people as possible ought to be immunised not just against flu, but also against secondary infectious diseases like bacterial pneumonia, which account for a significant proportion of the sickness and death associated with a pandemic.

Brachiosaurus had the body of a hoover

Dinosaurs like Brachiosaurus, Diplodocus and Brontosaurus may have evolved long necks so they could eat without having to move their massive bodies around so much.

That's the conclusion UK scientists reached after they realised that 1950s-style vacuum cleaners were designed in exactly the same way.

The cylinder vacuum cleaners that were commonplace until the 1970s had heavy bodies with long hoses. They were meant to be positioned in the middle of a room while the operator moved a light head-part at the end of the hose across the surrounding carpet.

All of the sauropod dinosaurs that lived from 200 million years ago until they went extinct 65 million years ago also had heavy bodies with long necks.

'The general assumption in the scientific community was that long necks would have been useful for reaching hard-to-reach foliage, just like a giraffe,' says Professor Graeme Ruxton from the University of Glasgow, who led the study published in *Biology Letters*.

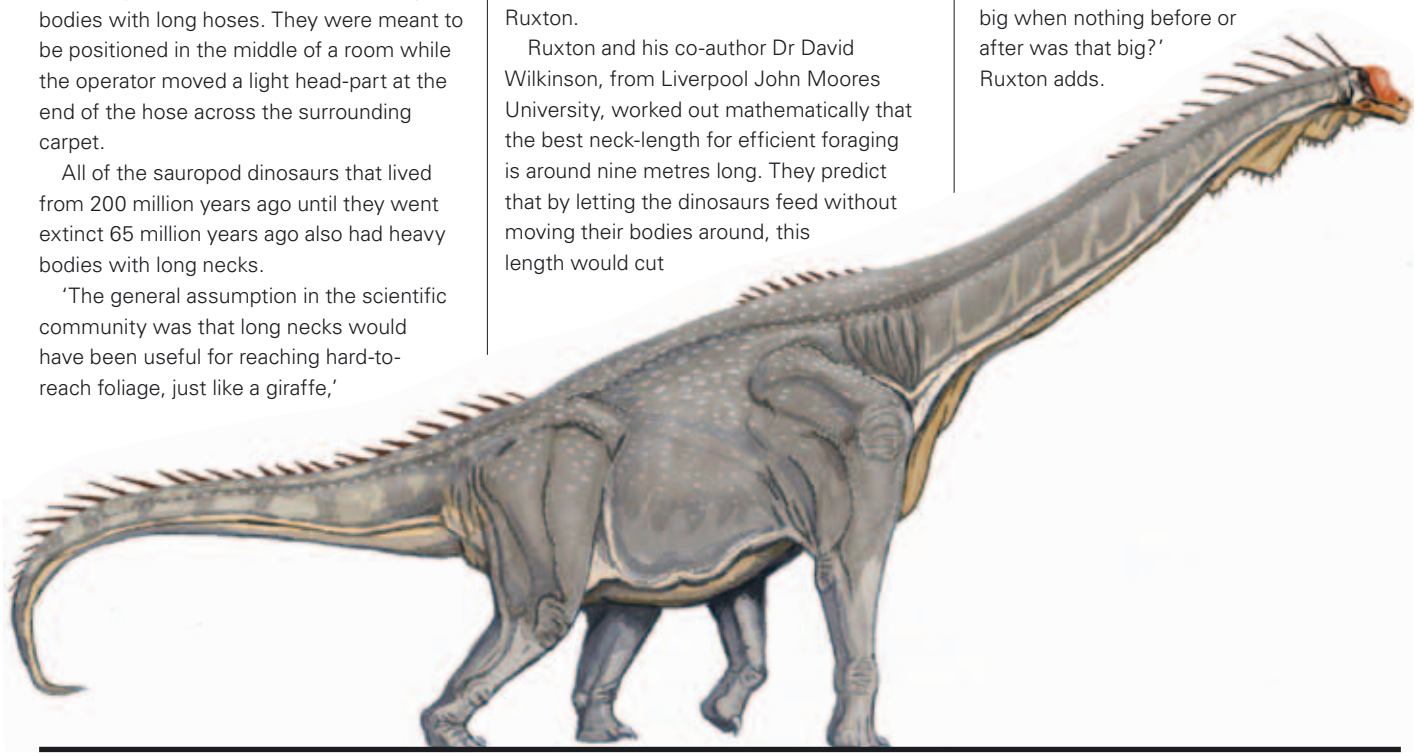
But some palaeontologists think the dinosaurs' blood pressure couldn't have been high enough to get blood along its eight-metre-long neck to its brain if it was feeding like this.

Not only that, but 'most sauropods have shorter front legs than back legs – it doesn't seem to fit with high browsing,' says Ruxton.

Ruxton and his co-author Dr David Wilkinson, from Liverpool John Moores University, worked out mathematically that the best neck-length for efficient foraging is around nine metres long. They predict that by letting the dinosaurs feed without moving their bodies around, this length would cut the energy costs of foraging by a huge 80 per cent.

The tough, fern-like plants the dinosaurs ate would have needed a lot of digesting and the sauropods' small heads couldn't have held enough teeth to pre-process their food by chewing. So their large bodies may partly be the result of needing a lot of space for digestion.

'But the bigger question we've yet to answer is why did these dinosaurs get so big when nothing before or after was that big?' Ruxton adds.



NEWS

Protein remains revealed in ancient reptile skin

Scientists have produced unique images of protein residues in 50-million-year-old fossilised reptile skin.

University of Manchester geochemists and palaeontologists used a technique called infra-red spectroscopy to produce the stunning images of the molecules called amides, which are only found in proteins.

The residues – in a sample of 50-million-year-old rock from the Green River Formation in Utah, USA – are in the same place that you'd find them in modern-day reptile skin.

'If you compare these infra-red images with the same images of gecko skin, it's hard to tell the difference,' says Dr Roy Wogelius from the University of Manchester, who led the research.

The two areas of science are so different that no one had ever thought to use infra-red mapping to analyse fossils before.

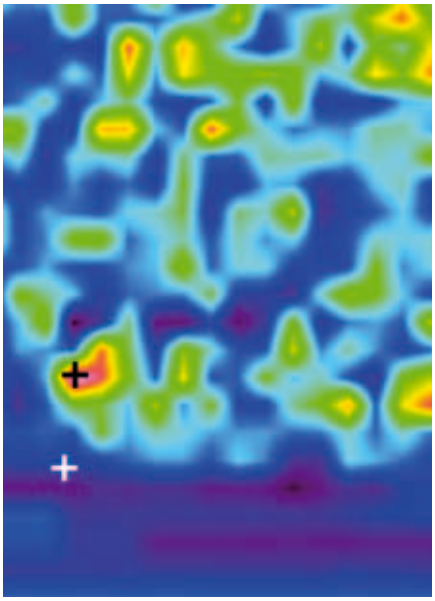
'This technique is perfect for identifying functional groups in proteins like we've got here,' says Wogelius.

Until now, most palaeontologists would have assumed that these organic compounds probably came from bacteria. But the compounds the team found were dominated by material from the original organism.

'We found amides and it's also chock-full of trace metals, which tells us how these protein residues must have been preserved,' Wogelius explains.

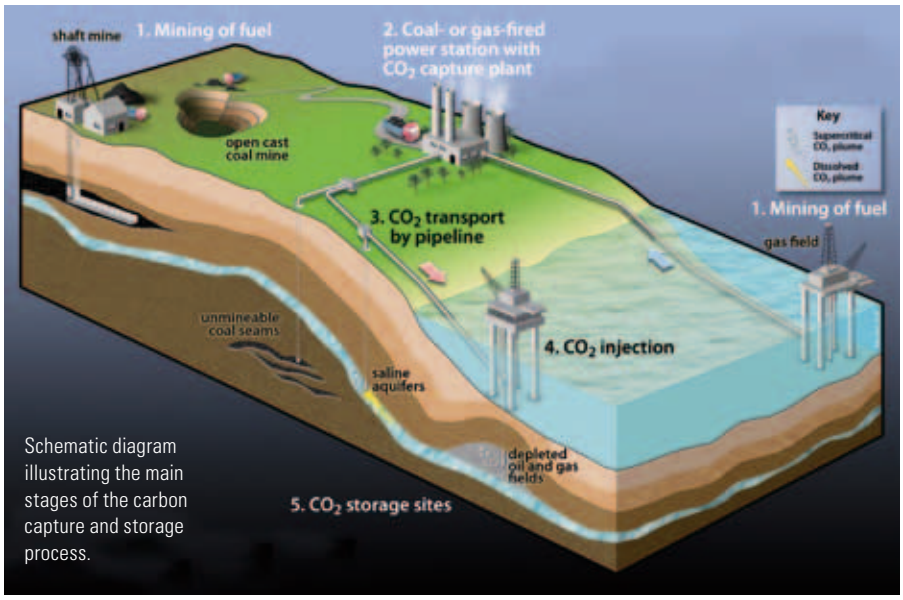
When proteins start disintegrating they bind to minerals in the rock, which makes them stable and unlikely to get washed away by water.

Another advantage of the technique is that you don't need to destroy the precious sample you're analysing to get a result. The study is published in the *Proceedings of the Royal Society B*.



Infra-red mapping of the skin suggests how the sample was preserved.

Study reveals Scotland's carbon capture and storage potential



Schematic diagram illustrating the main stages of the carbon capture and storage process.

Scottish Centre for Carbon Storage, School of GeoSciences, University of Edinburgh

The rocks deep beneath the Moray Firth could store decades' worth of carbon dioxide from Scotland's power stations, a report reveals.

This emerging carbon capture and storage industry could create thousands of new jobs within the next few years, and bring many economic and environmental benefits to the UK.

The research calculates that rock buried more than half a mile beneath the Moray Firth and known as 'the Captain Sandstone' could store at least 15 years' worth of CO_2, and more likely as much as a century's worth.

Dr Maxine Akhurst from the British Geological Survey is the project leader for the research, carried out by Scottish Carbon Capture and Storage (SCCS).

'Even if you apply the most stringent geological conditions, the worst case scenario will mean that we could store 15 years' worth in a single sandstone, and there are a number of the Captain Sandstones suitable for storing CO_2 beneath the North Sea,' she says.

'The sandstones are huge,' adds Akhurst. 'A small sandstone would be the size of a county such as Hampshire, and a large sandstone would be about the size of Belgium.'

Professor Eric Mackay from SCCS agrees the site would help the UK meet its targets for reducing its carbon emissions. 'This is an exciting and landmark moment in the development of carbon capture and storage.' he says. 'The future potential for this and other areas of the North Sea is immense.'

The research showed that carbon capture and storage could create around 13,000 jobs in Scotland by 2020 and another 14,000 elsewhere in the UK, spread across a wide range of skills. Properly developed, the UK's share of worldwide carbon capture and storage business could be worth more than £10 billion a year by about 2025.

Per H. Olsen

Hawk-like plumage gives cuckoos an advantage

Scientists have found that as well as craftily laying their eggs in other birds' nests, cuckoos have another trick up their sleeves. If a cuckoo's plumage looks like a hawk's, hosts like the reed warbler are less likely to attack them as they try to lay eggs in their nests.

Cuckoos are so-called brood parasites – they lay their eggs in other birds' nests to avoid the trouble of raising their own chicks. A newly-hatched cuckoo chick then turfs the hosts' eggs or young out of the nest.

But how does the cuckoo manage to lay its eggs in reed warblers' nests in the first place?

'Reed warblers are afraid of sparrowhawks, which are lethal birds of prey, and cuckoos exploit this by mimicking the sparrowhawk's barred underparts,' says Dr Justin Welbergen from the University of Cambridge, lead author of the study, published in *Behavioral Ecology*.

If parent reed warblers think a sparrowhawk is near their nest they keep out of the way – so the intruding cuckoo is free to lay her egg without being mobbed by the hosts.

'Ironically, having a cuckoo lay its egg in your nest is very costly and compares to being attacked by a hawk,' says Welbergen.

The researchers showed taxidermic models of sparrowhawks and cuckoos to wild reed warblers, either with their barred plumage showing or covered with white fabric. They then recorded the sounds the birds made and watched to see if they mobbed.

They found the reed warblers were more reluctant to mob the cuckoos which had their barred bellies showing – so the cuckoos' hawk mimicry does give them easier access to reed warblers' nests.

in brief . . .

Sharks visit personal hygienists

For the first time, thresher sharks have been seen in shallow waters near the Philippines, being groomed by small fish known as cleaner wrasse.

The sharks swim in slow circles in a particular area to attract the wrasse.

'On the reef there are fixed stations, or focal points, where cleaner wrasse can be found,' Simon Oliver from Bangor University explains. 'These fish are very selective about their clients so we think the sharks recognise the focal points where their particular cleaners operate.'

'The sharks come in with cuts and scrapes and are treated by the cleaner wrasse, which remove dead tissue from the wound area and any parasites from the skin. These stations are quite critical to the health of reef communities,' says Oliver.

The research is published in *PloS ONE*.

Leeds project to tackle virus

Scientists at the University of Leeds are to investigate how lethal viruses attack moths and butterflies, in research that could lead to better ways to control pests and manage invasive species.

Dr Steve Sait from the University of Leeds and Professor Rosie Hails from the Centre for Ecology & Hydrology will study the grain-infesting Indian meal moth (*Plodia interpunctella*) and a virus it carries that is sometimes deadly to its host and sometimes not.

The Indian meal moth is a significant problem around the world, attacking harvested crops such as cereals, rice, nuts and seeds and manufactured foods such as chocolate.

The art of ancient oceans

A new exhibition at University College London aims to make the complexities of palaeo-oceanography accessible to a wider audience.

The discipline involves reconstructing ancient oceans and climates through the traces they've left behind, such as the remains of tiny single-celled organisms, built up over millennia into thick rock deposits.

The exhibition brings art and science together, explaining how different research methods contribute to understanding past environments with clear text and striking images that show the beauty and diversity of the microfossils on which much of the team's science is based. It stems from work done on the Tanzania Drilling Project.

The Hidden World of Past Oceans runs until 11 August, and is open to the public in UCL's South Cloisters; admission is free.

NEWS

Ozone damage to vegetation influences global warming

Pollutants from cars and paints can warm the Earth's atmosphere when they turn into ozone and damage plants, a new study has found.

These short-lived pollutants – like nitrogen oxides and volatile organic compounds – have little direct impact on temperature, but they react in the atmosphere to form the greenhouse gas ozone. Among other things, too much ozone damages plants, making them less good at photosynthesising carbon dioxide from the atmosphere and storing – or sequestering – it in the ground.

'It's been well known for a long time that ozone damages plants,' says Dr Bill Collins of the Met Office Hadley Centre, who led the research, 'but no one has made the connection with ozone damage and the effects on the movement of carbon between the earth and the atmosphere.'

The team ran a sequence of models to predict the effects of three pollutants – nitrogen oxides (NOx), carbon monoxide (CO) and volatile organic compounds (VOC) – on the Earth's temperature. They looked at how these chemicals affect vegetation across the northern hemisphere.

One of the most surprising effects was for NOx, which scientists usually think of as a cooling pollutant because it reduces the warming effect of methane in the atmosphere. But under some conditions the contribution of plant damage was strong enough to turn this around, and this meant the gas warmed the atmosphere overall.

Ozone damage on a clover leaf.

In combination, reducing emissions of all the pollutants cooled the climate. Significantly, this cooling effect is 30-40 per cent greater than when plant damage is excluded from the calculations. 'This gives us another good reason to control air pollution,' comments Collins.

The study's results, published in the *Journal of Geophysical Research*, are for a global average temperature.

Parasite competition offers new insight into malaria

Scientists have shown how parasites change behaviour when confronted by other strains of the malaria infection in their host.

The study, published in *American Naturalist*, shows how the malaria parasite focuses on producing cells that replicate quickly to cause infection, rather than cells that can be taken up by a feeding mosquito and spread the disease.

Since malaria infections usually consist of multiple, competing strains of the parasite, this attack strategy is the best way to beat the competition.

Explaining how parasites behave inside their host helps us understand the severity of a disease and how it will spread – particularly important for malaria which kills about a million people each year and threatens half the world's population.

'If the mechanisms underlying these behavioural changes in malaria parasites can be identified,' say the researchers, 'it may be possible to manipulate their behaviour in clinically beneficial ways.'

Malaria is caused by single-celled parasites which replicate in the red blood cells of their host, and are taken up and spread by mosquitoes. Malaria parasites replicate asexually in the host but must reproduce sexually to move between them.

All organisms must balance resources between, for example, finding food and reproducing. In malaria's case this means a trade-off between replicating within one host or spreading to a new one.

... it may be possible to manipulate their behaviour in clinically beneficial ways.

The international team of researchers studied the malaria parasite *Plasmodium chabaudi*. They found that, when more than one strain of the parasite was present, they chose to safeguard their long-term survival.

'They opt to fight it out in the bloodstream rather than risk everything on the chance of infecting mosquitoes in the short term,' said Laura Pollitt of the University of Edinburgh's School of Biological Sciences, who led the study.

Red blood cell bursting after infection of malaria.

Albert Bonniers Forlag

Climate change increased the odds of autumn 2000 UK floods

Chris Ison/PA Archive/Press Association Images

Climate change substantially increased the likelihood of the autumn floods in 2000, which damaged almost 10,000 properties and led to insured losses worth an estimated £1.3 billion, according to a study published in *Nature*.

By running a Met Office climate model thousands of times researchers simulated the weather patterns seen during 2000 and compared them with simulations of those we would have experienced that year if atmospheric carbon dioxide had stayed at 1900 levels.

In nine out of ten comparisons, the presence of 20th-century greenhouse gas emissions increased the risk of floods in England and Wales by 20 per cent or more. And in two thirds of cases, the increase was 90 per cent or more.

Until now scientists have only been able to suggest in general terms that climate change will bring more episodes of extreme weather, simply because a warmer atmosphere can hold more water. This is the first study to look in detail at how much greenhouse gas emissions increased the risk of flooding over a particular period.

'It's like rolling a die,' explains Dr Pardeep Pall, an atmospheric physicist at the University of Oxford and the paper's lead author. 'You might roll it once and get a six, but it's very difficult to say why this happened, or how likely it was. To start building up a picture of how probable a particular outcome is, you need to roll the dice again and again, and that's what we are effectively doing by running the climate model thousands of times.'

The resulting range of rainfall values was then fed into a model from Risk Management Solutions Ltd, a company that develops risk models for the insurance industry. This model simulates how water drains off the land and into watercourses, to estimate the risk of flooding.

The team drew on computing power supplied by volunteers all over the world, using the infrastructure of the climate*prediction*.net project, which uses so-called 'distributed computing' to improve predictions of the future climate.

Climate*prediction*.net has now launched a follow-up project called weatherathome.net that will look at trends in the weather over many decades, and will focus on particular regions including Europe, north-western America and southern Africa.

Climate models are only now starting to simulate the atmosphere at fine enough resolutions to allow this kind of regional simulation, and to let researchers link the results with other models to simulate the impact of weather, Pall explains.

One of his co-authors, Dr Peter Stott of the Met Office, is now looking at the possibility of running this kind of 'climate attribution' analysis constantly, like a weather forecast. This would give researchers a sense of how climate change is affecting the weather in near real time.