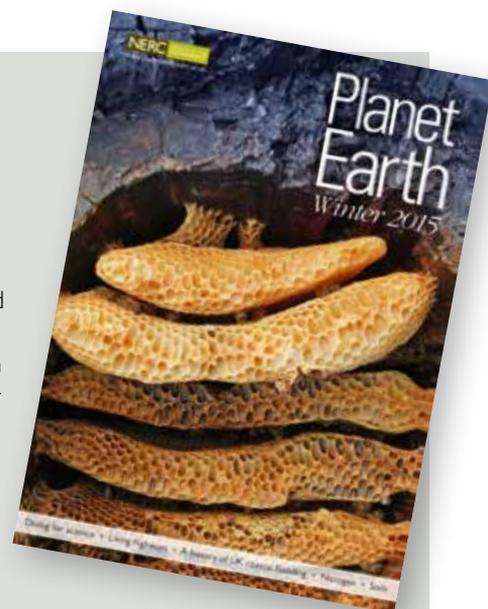# Editorial

It's that time of year again; as *Planet Earth* goes to press, heavy winter rain has once more left great swathes of Britain underwater, bringing misery to thousands of families and causing damage that's already being valued at several billion pounds.

The science NERC supports is vital to understanding and managing flood risk. On page 22, Ivan Haigh and Elizabeth Bradshaw describe their new database of coastal floods around the UK, and what it can tell us about these devastating events. It can be hard to take the long view when water's flowing down the high street, but doing so gives us invaluable insights into where flooding is likeliest in future, and where we should be spending scarce resources to defend against it.

Floods are going to happen; we need ways to limit the damage they do. In the long term, walls and other hard defences can only achieve so much, and we can't afford to build them everywhere. We need to think more widely and creatively about the problem to make our communities more resilient; options range from improving how we manage upland landscapes to designing more sustainable urban drainage systems. Later in 2016 we'll be taking an in-depth look at the big picture on flooding, and exploring some of the ways we could address it.

On an administrative note, there will now be a short break in this magazine's schedule, so you won't be receiving a spring issue. We're planning a few changes to the magazine that we hope will make it even more interesting and relevant; the new and improved *Planet Earth* will be back in summer.

New £200m polar research vessel on its way

A shipyard has been selected as the preferred supplier of a £200m new polar research vessel.

Cammell Laird in Birkenhead will build the state-of-the-art ship, which will be ready for action in 2019.

The ice-strengthened vessel, which will operate in Antarctic and Arctic waters for up to 60 days at a time, will be one of the most sophisticated floating research laboratories working in the polar regions. Tonne for tonne, the UK will have the most advanced research fleet in the world.

The ship will have a helipad and will be able to deploy the latest marine research technology, like robotic submarines and gliders that collect data beneath the waves.

Announcing the news while on board the RRS *Discovery* in October, Universities and Science Minister Jo Johnson said, 'This £200m investment secures the UK's position as a world leader in polar research and provides a major boost to shipbuilding in the North-west.'

The British Antarctic Survey (BAS) will operate the vessel on NERC's behalf, and it will be available to the whole UK research community.

'This new research ship will be a tremendous asset to the UK polar science community,' explains Professor Jane Francis, director of BAS. It will be able to deploy the latest advanced technologies being developed in the UK, allowing scientists to capture ocean and ice data from places that would otherwise be inaccessible.

The observations made by instruments on the new ship will help scientists more accurately predict future climate and sea-level rise, as well as the impact of environmental change on marine ecosystems.

Sand-scaping could protect **UK coastline**

Could wider beaches help reduce coastal flooding and erosion? That's the thinking behind new research led by the National Oceanography Centre (NOC) in partnership with the University of Liverpool. It's the UK's first investigation into the use of beach widening to protect the coastline.

Beach widening, or 'sand-scaping', involves replacing sand lost through erosion by drawing on outside sources, creating wider beaches. This could reduce the impact of waves on coastal defences by causing them to break further offshore. It could also protect coastal features like beaches and cliffs from erosion, as well as creating new habitats for wildlife and perhaps generating economic growth.

The Dutch have been using this method since 2011, but now scientists are investigating whether it could be used in the UK.

'Rising sea levels and the expansion of built-up areas around the coast is causing beaches to become "squeezed" into thinner strips,' says project lead Dr Jenny Brown from NOC. 'By assessing the possibility of protecting coastlines using wider beaches, our aim is to help coastal authorities better understand the changing vulnerability of more natural approaches to coastal defence.'

The team are using computer models to simulate how waves and currents move beach sediment along the Dungeness coastline in Kent.

This will help determine whether beach-widening techniques could be applied to the UK to combat erosion and increase coastal resilience to floods and storms.

Half of plant specimens wrongly named

As much as 50 per cent of all natural history specimens in the world's museums could be incorrectly named, a new study claims.

This can cause headaches for biologists, so researchers from the University of Oxford and the Royal Botanic Gardens Edinburgh set out to assess the accuracy of current naming practices.

'Many areas of biological sciences, including academic studies of evolution and applied conservation, as well as achieving the 2020 targets under the Convention on Biological Diversity are underpinned by accurate naming,' explains Dr Robert Scotland from the University of Oxford.

'Without accurate names on specimens, the records held in collections around the world would make no sense, as they don't respond to the reality outside,' he adds.

In one example, the team scoured the records of the genus which includes the sweet potato. Examining 49,500 specimens from the Americas, they found that 40 per cent of names were outdated synonyms. A further 16 per cent were unrecognisable or invalid. The situation is probably similar for other groups.

Yet there could be an even more worrying problem around the corner. Of 1.8 million different species described on Earth, 0.35 million are flowering plants and 0.95 million are insects. So while names of flowering plants are often wrong, the situation in the insect kingdom could be even worse.

The research is published in *Current Biology.*

Discovery
in London

To celebrate NERC's 50th anniversary, the Royal Research Ship *Discovery* made a unique visit to London for a series of events in early October.

Leaving its usual berth at the National Oceanography Centre in Southampton, the *Discovery* travelled up the Thames and under Tower Bridge, mooring alongside HMS *Belfast* for six days.

Visitors from science, government, business, local primary schools and members of the public came on board to look around and discover some of the exciting research that NERC scientists do.

They could see everything from marine robots and a 'beesocosm' displaying live insects to a simulator of NERC's atmospheric research aircraft and a model of how groundwater moves beneath our feet. On the bank, scientists performed live experiments and talked about *Discovery* to those not lucky enough to get on board.

After leaving London, she only had a few days to recover before departing for the Bahamas to contribute to the RAPID project – find out more on page 26.

Discovery is NERC's state-of-the-art oceanographic research vessel, providing access to the world's seas, from the tropics to the poles. As well as carrying out more traditional marine research, she can deploy innovative underwater technology, such as autonomous submersibles and remotely-operated vehicles to explore the deep oceans, of which we still know very little.

Early warning for **aquaculture**

NERC-supported scientists are helping protect salmon and shellfish farmers around Shetland from harmful algal blooms (HABs).

The islands produce 77 per cent of Scotland's rope-grown mussels and their seafood sector is worth some £350m a year. But these stocks are threatened by masses of algae that form off the coast; these blooms can kill farmed fish and their toxins can be absorbed by shellfish, posing a health risk to anyone who eats them.

Scientists at Exeter University, Marine Scotland, the North Atlantic Fisheries College Marine Centre, Plymouth Marine Laboratory (PML) and the Scottish Association for Marine Science (SAMS) have worked together to set up an early-warning system. It comprises 16 floating 'drifter' buoys that track shifts in ocean currents. Alongside satellite images, this will help predict when harmful blooms may strike. The data will be used to check and improve an existing model of HAB risk, funded by NERC and the Biotechnology and Biological Sciences Research Council (BBSRC).

Fish and shellfish farmers will benefit from a more reliable early warning system, letting them act more effectively to protect their operations.

PML scientists are now leading a project alongside researchers and technicians at Exeter, the Centre for Environment, Fisheries and Aquaculture Science (Cefas) and SAMS that will seek to improve HAB forecasting even further. The ShellEye project (www.shelleye.org) will work with Cornish and Scottish aquaculture companies to make sure its results are as useful as possible to the sector.

Managed bees give wild ones diseases

Large-scale beekeeping is an important part of modern farming; many crops couldn't be grown if managed bee populations weren't brought onto the land to pollinate them.

But a review of the evidence in the *International Journal for Parasitology* suggests importing large populations of honeybees and bumblebees and moving them around the country to pollinate crops may be having unwelcome side-effects – they seem to be giving wild bees parasites and diseases. Even when the managed bees aren't themselves infected, they still cause stress to wild populations, making them more vulnerable.

'The use of managed honeybees and bumblebees is linked with several cases of increased disease and population declines in wild bees. This is shown in various countries around the world and is not always because the managed bees are carrying a disease,' says lead author Dr Peter Graystock, who's now at University of California, Riverside, after completing a NERC-funded PhD at the University of Leeds. 'Loss of wild pollinators will ultimately either reduce crop yields or increase the reliance on and cost of shipping in more managed bees. This increased cost will cascade down to consumers, raising the price of food we put on our tables.'

The researchers came up with a list of recommendations to help protect wild bees. These include better and more frequent screening for disease in managed bees, creating better barriers on farm glasshouses and poly tunnels to minimise mixing between managed and wild populations, and promoting hedgerows and wildflower margins around fields to boost wild pollinators and reduce dependence on managed bees.
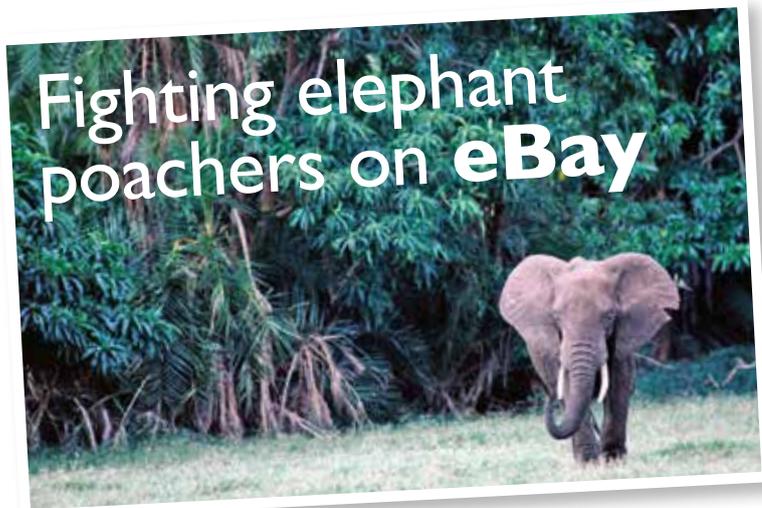
In early 2015 Graystock was runner-up in the Early Career category of NERC's inaugural Impact Awards for his research on bee parasites and diseases.

DOI: 10.1016/j.ijppaw.2015.10.001

Bumblebee foraging on cardoon (*Cyanara cardunculus*).

Fighting elephant poachers on **eBay**

Scientists have created a computer system that can help detect illegal ivory sales on the web.

The ivory black market is what drives poaching, a grave threat to wild elephants. Governments have committed to eliminate it, but that's very hard to do.

Many sales now take place online, and picking them out from all the legal transactions is a big challenge. 'Ivory' doesn't just refer to elephant tusks; it's also an off-white colour and a generic term for anything made from an animal's teeth, so a simple keyword search doesn't narrow the field down very much.

At the moment officials have to go through online listings one by one, looking for distinctive marks that appear in elephant ivory but not in similar materials such as walrus tusk. Now NERC-supported researchers at the University of Kent have managed to teach a computer to scan the auction website eBay and automatically highlight potentially illegal listings. The idea is to reduce the number of items that humans need to look at, streamlining the process of screening for illicit ivory.

'The current way of doing this is tedious and inefficient,' says Dr David Roberts, co-author of the paper, published in *PeerJ Computer Science*. 'We hope that using machine learning will let law enforcement identify illegal ivory and build a case more quickly.'

Two former law-enforcement experts spent time looked at the items in eBay's Antiques section that mentioned ivory over eight weeks, classifying them according to whether they were elephant ivory and whether they seemed potentially illegal.

The scientists then used data-mining software to analyse the sale items alongside the expert judgements, seeking to deduce rules that would allow a computer to draw the same conclusions. The system looked at 37 pieces of 'metadata' about each item, including its price, postage cost and number of bids received.

The results were impressive; the computer matched the experts' opinion 93 per cent of the time. It did this without looking at various other information sources that people would use, including the images and text accompanying the sale listings, suggesting the approach could be improved further by extending it to take these into account. The scientists say a similar approach could be used to monitor other illegal markets – in guns or stolen goods, for instance.

DOI: 10.7717/peerj-cs.10

in brief . . .

New strategic research announced

NERC is funding the first set of projects under the new highlight topics route, which is designed to give the science community a greater role in identifying important areas that need strategic funding to help solve environmental challenges.

The eight projects that have received funding cover subjects ranging from why the climate is warming at an uneven rate with pronounced pauses and surges, what happens to nanoparticles as they move through the environment and break down, and how we can use new genetic techniques to measure biodiversity.

Blue whale spotted in English waters

In late August scientists on the RRS *James Cook* made the incredibly rare sighting of a blue whale around 400km south-west of the Cornish coast, on the northern margin of the Bay of Biscay.

Professor Russell Wynn of the National Oceanography Centre spotted the rare visitor while watching a group of fin whales, the runners-up to the blue in the biggest-animal-on-Earth stakes. Scientists rushed to the deck to catch the spectacle – for many, it was the first time they'd ever seen this gigantic creature.

Another blue was photographed off the Irish coast in 2008; the species was hunted to near-extinction in the north-east Atlantic in the early 20th century, but these sightings may suggest it's starting to make a slow recovery.

Securing supplies of elements for low-carbon tech

NERC is investing more than £8m in research that will ensure we have access to so-called e-tech elements that are essential for technologies that will provide cleaner energy and let us use it more efficiently.

Elements like cobalt, tellurium and neodymium are used in applications like lithium batteries, solar panels and wind turbines. But currently they are just by-products of producing more common minerals, and aren't mined on a commercial scale. Now population growth, greater resource consumption and efforts to cut carbon emissions are pushing demand to new heights.

The Security of Supply of Minerals programme will help us cope, supporting innovative geoscience that illuminates how these rare minerals form and circulate within the Earth's crust, and where we should look for them.

Tracking **ocean currents** from space

The National Oceanography Centre (NOC) and NASA have developed a new way of monitoring ocean circulation with satellites.

The project uses the gravitational sensors on the twin satellites of NASA's Gravity Recovery and Climate Experiment (GRACE) mission to measure how quickly deep ocean currents are flowing by detecting the tiny changes they cause in the Earth's gravity field.

This let the scientists calculate the flow rate of one of the major current systems in the region, known as the Atlantic Meridional Overturning Circulation (AMOC). This moves heat from the tropics to north-west Europe, giving us our mild climate.

The measurements were checked using data from the NERC-funded RAPID array of oceanographic instruments across the Atlantic, which monitors AMOC and is maintained by NOC. (See p26 for an

article about what we've learned from a decade of RAPID measurements.)

'It's awesome that GRACE can see variations of deep-water transport, but this signal might never have been detected or verified without the RAPID array,' says Eric Lindstrom of NASA's Physical Oceanography Program. 'We will continue to need both *in situ* and space-based systems to monitor the subtle but significant variations of the ocean circulation.'

Scientists to probe **El Niño** fires in Indonesia

NERC has awarded scientists at King's College London £55,000 to use drones to measure how wildfires currently raging in Indonesia affect the atmosphere.

The grant will let the researchers assess greenhouse gas emissions from fires around the Berbak National Park, Sumatra. 'We know these extreme fires have a major impact on the Earth's atmosphere, and that this is one of the most important ways in which El Niño affects the climate,' says project leader Professor Martin Wooster of King's and NERC's National Centre for Earth Observation. 'But we need to find out more about how much material is being burned and what is being released into the air, and studying fires in this Indonesian region gives us a unique opportunity to do this.'

Farmers in Indonesia traditionally burn vegetation to manage the land, but corporations and government-supported initiatives have taken this further, clearing huge areas of forest and draining peatlands for agriculture. This makes the affected areas dry out much more quickly. Fires can then get out of control and, when they are burning on carbon-rich peat, the soil itself can ignite and burn down into the ground.

The current strong El Niño has caused droughts across the region. Areas of forest normally too wet to burn have turned into tinderboxes, leading to extremely widespread and severe fires. These threaten endangered species like orang-utans and tigers, and the smoke they produce harms local people's health.

Fires during the last strong El Niño in 1997-1998 raged across tens of thousands of square kilometres, releasing carbon equivalent to an estimated 13-40 per cent of that year's total global carbon emissions from fossil fuels.

Wooster and colleagues will use drones equipped with LIDAR sensors, which use lasers to scan the land surface below. This will provide unprecedented insights into how far down into the peat the fires reach. They expect to illuminate how much organic matter is being burned, what is being emitted and what the effects will be. This should improve atmospheric and climate models and contribute to efforts to preserve the region's forests.

New app to track **UK dragonflies**

A free new mobile app lets members of the public identify dragonflies and damselflies they spot around the UK. They can then add these sightings to a national database that will help scientists understand how these stunning insects are coping with changes in the climate and their habitats.

Dragonflies and damselflies don't just add colour to our ponds and streams in summer; they also play an important ecological role, eating other insects and helping control pests like mosquitoes. They're a sign of a healthy ecosystem and of unpolluted water; many species have expanded their ranges in recent years and others are arriving from continental Europe.

The Dragonfly Recording Network, run by the British Dragonfly Society, has helped track the presence of different species all over the UK since 1999 using reports from volunteers. The new app, produced by a team at the Biological Records Centre at NERC's Centre for Ecology & Hydrology, makes it easier to find dragonflies, to tell what species you're looking at when you do and to let the experts know about it. The information collected will help protect dragonflies from the pressures they face.

The app works on almost any phone, tablet or computer; you can find it at http://irecord.org.uk/dragonflies.

Steve Cham

From top: common darter, scarce chaser, hairy dragonfly.

Finding the **Sahara's lost rivers**

Scientists have found a 500km-long ancient river network buried under the parched sands of Mauritania.

This river supplied sediment to a deep-sea canyon, which was discovered and mapped in 3D in 2003 by a team including researchers from NERC's National Oceanography Centre.

They analysed the sediment found in the canyon and found signs that it originally came from a major river system. No rivers emerge into the Atlantic on the coast of Western Sahara nowadays, though, so the exact course of these watercourses wasn't clear and we had no direct evidence of their existence.

Now a group of French researchers, writing in *Nature Communications*, found the traces of the river system by analysing data from satellites equipped with synthetic aperture radar sensors that can look through the sands that have built up since its demise. They think the river flowed during the wet periods that have periodically visited the region; the last of these periods was between around 11,700 and 5,000 years ago.

DOI:10.1038/ncomms9751

Science minister opens new
Marine Robotics Innovation Centre

Jo Johnson, the Universities and Science Minister, in November opened the UK's new £3m centre aimed at developing new technology for the emerging marine robotics sector.

'The UK is leading the way in marine science and this new facility will help to put wind in the sales of our marine industry,' he commented at the official opening event.

Based at NERC's National Oceanography Centre (NOC), the Marine Robotics Innovation Centre will be a hub for businesses developing new autonomous platforms and sensors that can be used to gather data cost-effectively from the world's oceans. It will connect the private sector with scientific expertise to promote innovation and support economic growth.

Autonomous robotic submarines are one of the most exciting areas of marine science. They can stay at sea for months at a time, covering vast areas, and can go to places traditionally considered too difficult or dangerous for humans to work, potentially opening up whole new fields of inquiry. They're also a very cheap way of gathering data compared to research ships. There are potential applications in sectors ranging from renewable energy and oil and gas to deep-sea mining and aquaculture.

NERC also recently announced a new £2.5m Centre for Doctoral Training that will teach the next generation of scientists to design, build and operate autonomous sensor platforms – both waterborne and aerial ones. Known as NEXUSS – 'NEXt generation Unmanned System Science' – it will provide specialised training in this increasingly vital area, creating a community of highly skilled people whose expertise will contribute both to scientific breakthroughs and to economic growth.

Collected here are just a few recent highlights of the science NERC-supported marine robots are enabling.

Working with the WWF

NOC is partnering with the World Wildlife Fund (WWF) to use marine robots to find out why the deep parts of the Celtic Sea are so attractive to marine predators like dolphins and seabirds.

Scientists deployed a submarine glider and an Autonomous Surface Vehicle to the Celtic Deep area; the two will work together to explore the region's ecosystems.

'The Celtic Sea contains known hotspots for iconic and highly mobile marine animals such as the mighty fin whale and the globally threatened Balearic shearwater,' says NOC's Professor Russell Wynn, who's coordinating the research. 'However, we need a greater density of observations to really understand why these hotspots are so attractive to these animals, and how stable they are in space and time. Marine robotic technologies give us the opportunity to have a persistent presence in these areas, and are changing the way we conduct science in the marine environment.'

'WWF is excited to support this innovative technology in order to get a clearer picture of what's out there in our seas,' adds Dr Lyndsey Dodds, head of marine policy at WWF-UK. 'Only through increased understanding can we identify what needs to be done to ensure good management and protection. By ensuring our seas are healthy and productive we can ensure a strong marine economy and prosperous coastal communities that depend on the resources and business opportunities the seas provide.'

Scientists work with BP to use robots for **oil-spill monitoring**

Underwater robotic technology could play a key role in oil-spill response planning, according to new research by the Scottish Association for Marine Science (SAMS).

Scientists at SAMS have been working with oil and gas company BP to use robots known as Seagliders to remotely monitor oceanographic conditions up to a kilometre beneath the surface. They aim to enable better situational awareness during oil spills in order to improve response time and minimise environmental damage.

Earlier this year they tested a Seaglider as part of a major emergency response exercise coordinated by BP from its North Sea headquarters in Aberdeen. It involved more than 150 participants from BP and partner agencies responding to a simulated incident in the Clair oilfield west of Shetland.

During the exercise, SAMS launched a Seaglider from the research vessel MRV *Scotia* in the Faroe-Shetland Channel. It was then directed towards the Clair field, providing real-time oceanographic data to aid decision-making by role-playing responders onshore.

The gliders are energy-efficient autonomous vehicles that can continuously measure water properties for months on end, sending the data back to base over a satellite link.

Fraser Macdonald, a knowledge exchange fellow in marine physics and autonomous systems at SAMS, has been working with members of BP's global response team to look at how to apply scientific knowledge to oil and gas operations. 'The use of autonomous systems has brought about a paradigm shift in how we measure the marine environment,' he says. 'Working with BP, SAMS is starting to push the boundaries in developing how we integrate this cutting-edge science into the oil and gas sector.'

'Recent developments in autonomous technologies have provided an opportunity to establish rapid 3D situational awareness which is critical to aid science-based response decision-making for any potential major incident,' adds Peter Collinson, an expert in global environmental response at BP.

SAMS has been developing the use of gliders in oceanography research since the North Atlantic Glider Base (NAGB) was established in 2012. This is part of the wider NERC Marine Autonomous Robotic Systems group, based at the National Oceanography Centre (NOC).

Macdonald now aims to explore how autonomous technology could help minimise the harm done to marine environments during the removal of offshore oil and gas installations.

SAMS

Mapping deep-water canyons

NOC marine robots have also helped survey fascinating and unusual habitats in the Whittard Canyon, deep beneath the waters of the Bay of Biscay. Ocean canyons host a huge variety of living things because of the complex landscape they provide, creating a wide range of conditions that suit different plants and animals.

The Autosub 6000 autonomous submersible worked alongside sensors aboard the RRS *James Cook* to create a nested set of maps of the area, ranging in scale from one covering the whole 200km-long canyon down to one that includes individual cold-water polyps. This will inform the management of England's only deep-water Marine Conservation Zone.

News

Fishing discards could increase prevalence of **turtle disease**

Fishermen in the Turks and Caicos Islands could be making a global turtle disease more common by selectively catching healthy animals and throwing back infected ones.

Researchers at the University of Exeter, the Marine Conservation Society and the Turks and Caicos Department of Environment and Maritime Affairs surveyed green turtles in the Caribbean waters around the islands, a UK overseas territory. The animals are globally endangered after centuries of excessive hunting, yet their numbers are recovering well around the islands, so the country permits a small, regulated fishery.

The disease, called 'fibropapillomatosis', creates unsightly pink tumours. Although benign, these can impede turtles' vision and movement, as well as interfering with feeding, swimming and organ function.

Over two years, around 13 per cent of green turtles found in waters had the disease. In contrast, fishermen did not land any diseased animals during this time. 'Most of the fishermen we spoke to said they had caught diseased turtles, but they didn't want to eat turtles with tumours, so they threw them back,' says lead author Dr Tom Stringell from the University of Exeter. 'We know a lot about the consequences of culling diseased creatures to take them out of the general population, and this practice has the opposite effect, effectively increasing the proportion of diseased animals in the population,' he adds.

The study was published in *Frontiers in Marine Science*.
DOI: 10.3389/fmars.2015.00057

Atmospheric testing understates diesel pollution

Emissions from diesel vehicles have been in the headlines lately after the revelation that Volkswagen set up some of its cars to cheat emissions tests. Now new research suggests that emissions from diesel engines in general may be higher than we'd thought, and that the monitoring regimes governments have put in place are missing pollutants that could be doing serious harm to our health.

Atmospheric chemists at the University of York and NERC's National Centre for Atmospheric Science examined measurements of air quality in London, focusing on long-chain hydrocarbon molecules.

Hydrocarbon emissions lead to the production of two priority pollutants, ozone and particulate matter; both of these cause serious lung problems and are the targets of government emissions-control regimes. But neither air-quality strategies nor the measurement programmes they depend on have focused on long-chain hydrocarbons from diesel vehicles. The study suggests this may need to change; long-chain molecules turn out to be a major component of the hydrocarbons in London's atmosphere and may account for up to half of ozone production in London. Levels of some types of hydrocarbon in emissions inventories may have been understated by as much as 70 times.

If diesels are producing more long-chain hydrocarbons than previously thought, this could be a serious problem. These engines' popularity has rocketed in recent years because of their greater fuel efficiency; in the UK, diesel rose from 52 to 62 per cent of total fuel used between 2005 and 2012. 'The shift towards diesel vehicles means we probably need tighter regulations on the pollution they produce,' says Dr Jacqui Hamilton of the University of York, the paper's senior author. 'A first step towards doing this would be to improve monitoring of long-chain hydrocarbon levels.'

The study appears in *Atmospheric Chemistry and Physics*.
DOI: 10.5194/acp-15-9983-2015

Are pesticides harming **butterflies?**

The controversy over the impact neonicotinoid pesticides are having on bees continues to rumble on, with a growing number of studies suggesting there are harmful effects.

Now a group of scientists have taken a look at the consequences of widespread neonicotinoid use for another group of pollinators – butterflies. Like bees, these insects are vital to many wild and cultivated plants; they're also widely loved by the public and of serious concern to conservationists. Total abundance of widespread butterfly species on English farmland declined by 58 per cent between 2000 and 2009, even though UK conservation spending more than doubled over the same period.

The role of pesticides in this has until now received comparatively little attention. Researchers at Butterfly Conservation, the Universities of Stirling and Sussex and the Biological Records Centre at NERC's Centre for Ecology & Hydrology examined data on populations of 17 butterfly species that are widespread on farmland. This information was gathered by volunteers at more than 1,000 sites across the UK.

They found evidence that having more land nearby on which neonicotinoids are used is strongly associated with declining populations in 15 of the species examined. These results are suggestive but the scientists say more work is needed to prove that neonicotinoids are responsible; it's possible that some common factor, such as more general intensification of farming, is causing both increased pesticide use and butterfly decline.

DOI: 10.7717/peerj.1402

Ocean acidification threatens cold-water coral reefs

Close up of the common cold-water coral *Lophelia.*

Sebastian Hennige

The skeletons of corals growing in the deep, cold ocean will change shape and get 20 to 30 per cent weaker, according to the longest-ever simulation of future ocean conditions on corals.

This will put cold-water reefs, which form oases of biodiversity on the North Atlantic seabed, at severe risk. By the end of the century many of these unique habitats could be collapsing.

The ocean absorbs much of the carbon dioxide we emit. In a way this is good, as it removes a lot of carbon dioxide from our atmosphere, but it also makes seawater more acidic. In the long term this is a huge threat to many marine species.

Scientists simulated the process in lab conditions over a year, reducing seawater's pH (that is, making it more acidic) and observing the effect on the common corals that form the cold-water reefs off Scotland. Superficially the subjects seemed to cope, but beneath the surface the way their skeletons form underwent major changes. While the live coral grew in a different way, the dead skeleton, which forms most of the reef and supports the live coral, became much more brittle. In the long term this would put a reef's whole structure at risk.

'Live corals are standing on the shoulders of their dead parents and grandparents, and we see that ocean acidification can start to dissolve dead coral skeleton,' explains Dr Sebastian Hennige of Heriot-Watt University, lead author of the study in *Proceedings of the Royal Society B.* 'This makes them weaker and more brittle, like bones with osteoporosis, and means they may not be able to support the large reefs above them in the future.' So many species depend on reefs that their disappearance would have enormous knock-on effects throughout marine ecosystems.

DOI: 10.1098/rspb.2015.0990

Europe's first farmers exploited **honeybees**

A honeybee hive in a hollow log in the Cévennes, France, showing circular comb architecture.

Neolithic people were harvesting from honeybee nests at least 8,500 years ago, research in *Nature* shows.

The scientists, partly NERC-funded, analysed the residues on more than 6,000 samples of prehistoric pottery from more than 150 archaeological sites spread across Europe and the Near East. The distinctive chemical signature of beeswax appears in around 83 of them; only 33 of these were known before this paper. This is the first unequivocal evidence of a close and long-lived relationship between early farmers and honeybees.

We don't know if the wax came from wild or domesticated bees. But the findings provide remarkable insights into how people lived in early farming communities thousands of years ago – during the seventh millennium BC at the oldest site examined, in modern-day Turkey, through to the fourth millennium BC at sites in France and southern England.

'The most obvious reason for exploiting the honeybee would be for honey, which would have been a rare sweetener for prehistoric people,' says lead author Dr Mélanie Roffet-Salque of the University of Bristol. 'However, beeswax could have been used in its own right, for various technological, ritual, cosmetic and medicinal purposes – for example, to waterproof ceramic vessels.'

This isn't the first use of chemical analysis to find traces of early honeybee exploitation by farmers, but these results push back the earliest date at which we know this was happening by at least a millennium. The study also provides the first insights into where honeybees were found in the period; insects don't fossilise well so this kind of indirect approach is needed to detect them.

Protecting forests
saves lives…

Brazil's successful efforts to slow deforestation have saved thousands of lives by improving air quality, new research shows.

About 15 per cent of the Brazilian Amazon forest was cleared between 1976 and 2010, and much of this was done with fire. This sent soot and other particles into the atmosphere, degrading air quality and endangering the health of local people. Since 2004, Brazil has managed to cut deforestation rates by about 40 per cent – around 70 per cent in the Amazon. This has had many environmental and social benefits; among them, fewer fires.

Researchers from the Universities of Leeds, Manchester and Sao Paulo, and from the Massachusetts Institute of Technology, used measurements of air quality from satellites and sensors on the ground to assess the impact of lower deforestation rates on air quality and human health in non-drought years between 2001 and 2012. Drought years were excluded because they tend to have many more fires irrespective of deforestation rates.

They estimate that Brazil's success in reducing deforestation has cut concentrations of particulate matter in the air by about 30 per cent in the dry season. This is saving an estimated 400-1,700 premature adult deaths every year across South America.

The authors note that cleaner air benefits people all over the continent, but that changes in Brazil's forest policy risk increasing deforestation rates again, which would jeopardise improvements in the region's air quality. Their paper appears in *Nature Geoscience*. DOI: 10.1038/NGEO2535

…and not protecting them could trigger drought

Another recent study shows increased deforestation could cause droughts across the Amazon. After falling over the first decade of the century, Brazilian deforestation rates have shown worrying increases lately, rising in 2013 and 2014 from 2012's level.

If this continues, researchers say it could reduce rainfall in the Amazon Basin, affecting the region's climate, ecosystems and economies. They predict that if deforestation returns to a pre-2004 rate, nearly half the Amazon's original forest cover will be gone by mid-century, and that annual rainfall could fall below drought levels.

'Essentially, drought years could become the norm for the Amazon by 2050 if deforestation rates rebound,' says project lead Dr Dominick Spracklen from the University of Leeds, who was also a co-author on the air-pollution paper in *Nature Geoscience*. 'This significant drop in rainfall could affect ecosystems and wildlife throughout the entire Amazon basin, which covers roughly 40 per cent of South America.'

Forests are an important route for water, energy and gases to move between the Earth's surface and the atmosphere. This means clearing them affects temperature, humidity and rainfall. The study was published in *Geophysical Research Letters*. DOI: 10.1002/2015GL066063