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Editorial

Welcome to the first *Planet Earth* of 2015 – and to NERC's 50th anniversary year. The Natural Environment Research Council was created by Royal Charter in 1965 and over the year we'll be marking half a century of exciting and world-leading science – science that reveals how our planet works and helps us live healthier and more prosperous lives while we manage our environment responsibly.

The first anniversary event this year was in January – our inaugural Impact Awards. These recognise and reward the researchers whose work has made the biggest difference to the UK's economy, society, wellbeing and international reputation. Physicist and broadcaster Jim Al-Khalili hosted the awards ceremony and you can read about the winners' brilliant work here in *Planet Earth*.

Other features in the magazine range from the unique grassland ecosystems of Salisbury Plain to the importance of the UK's peatlands and one simple action we can all take to help preserve them. From farther afield, researcher Mark Vardy tells us how the hidden landscape of riverbeds impacts the complex relationship of the people and their rivers in Bangladesh.

Lydia Bach tells us why some overlooked creatures deserve more of the limelight – in science as well as the media – and another feature reveals how this bias has led us to overlook what moths can tell us about biodiversity and the effects of environmental change.

Jason Hall-Spencer describes his work investigating the effects of carbon dioxide on our oceans, by studying underwater volcanoes where CO_2 bubbles up through the sea floor. Meanwhile our Podcast Q&A talks to researchers who purposefully pumped CO_2 into the sea floor to see what would happen as it leaks out, testing the potential of carbon capture and storage facilities for mitigating climate change.

We hear from Mark Viney on the critical next step in genomics that will mean we can finally understand the DNA we've been reading for so long. And Grant Allen tells us how he eschewed exotic fieldwork locations to spend two weeks in a landfill site, measuring how much methane it was emitting. Dirty work, but someone has to do it.

Lunar Mission One kicks off

Lunar Missions Ltd

The science funding model has been turned on its head by crowdfunding platform Kickstarter which has passed its first funding milestone to put a lander on the Moon by 2024.

The lander will drill a borehole to retrieve and analyse samples from 100m below the lunar south pole.

Kickstarter exceeded its goal of $1 million (£600k) by 17 December, with more than 7,000 backers on board. In return, investors get the chance to preserve a little bit of themselves in a time capsule that will fill the borehole.

Europe has never sent a lander to the surface of the Moon and no nation has ever visited its south pole – permanently shadowed craters there are thought to contain water.

The project will use pioneering technology to drill to at least 20m below the lunar surface, reaching rock as old as 4.5bn years which could answer countless questions about the Moon's history. It could also reveal the relationship of the Moon with planet Earth and improve scientific understanding of the early solar system, the formation of our own Planet and the conditions that enabled life on Earth.

RAL Space, part of the Science and Technology Facilities Council, will be project managing and advising on the technical requirements for the mission as well as advising on the technical issues and risks phases of the project over the next year. NERC's British Geological Survey (BGS) has staff on the mission team and the science team, and early concepts of the lunar drilling system are based on BGS's sea-floor drilling system.

Public engagement will continue to be critical to the mission and the project will be launching a community section on their website: www.lunarmissionone.com

Deep-sea asphalt mounds found off west African coast

Scientists have discovered a large area of the deep seabed off the Angolan coast strewn with mounds of asphalt hosting rich animal life.

The discovery – the first in the southern hemisphere and the first time the creatures living around them have been studied in detail – arises from a long-term collaboration between energy company BP and scientists at NERC's National Oceanography Centre (NOC).

The researchers found at least 21 kinds of deep-water creature living around the tarry structures, including octopuses, blobfish, sea stars and coral-like sea fans.

'It seems to be a very rich animal community – the asphalt provides a hard surface for them to attach themselves to, so animals like sponges can get a foothold,' says Dr Daniel Jones of NOC, lead author of the open access study in *Deep Sea Research 1*.

These rare habitats may be important for animal distribution across the ocean floor, perhaps acting as stepping stones for species to move into new areas and enable genetic material to flow across widely-dispersed populations.

BP experts first noticed the structures while searching the seabed for signs of energy deposits and closer investigation with remotely-operated subs revealed more than 2,000 mounds, some just centimetres from side to side, others hundreds of metres across.

The BP staff alerted researchers at NOC who examined the geological data and the images from BP's robots.

'We get access to BP's high-quality data while BP gets information that can support its efforts to improve the environmental management of its operations,' says Jones.

The mounds form when heavy, tarry hydrocarbons ooze up from beneath the sea floor and harden into asphalt much like the stuff that's used to surface roads. They are related to cold seeps – best known as places on the seabed where lighter hydrocarbons like methane leak into the water.

Tar on the ROV arm.

Brisingid sea star on an asphalt mound.

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Fur seal evolution outpaced by climate change

Antarctic fur seals are struggling to evolve quickly enough to keep up with the effects of climate change, according to research published in *Nature*.

The new research finds that only the very fittest females now make it to breeding age but the genetic traits that help them survive are not being passed on to their offspring.

The researchers, led by Dr Jaume Forcada of NERC's British Antarctic Survey (BAS), say rising sea-surface temperatures in the seals' feeding grounds are affecting the availability of krill – their main food source.

This is forcing the females to work harder to feed their young and only the strongest are now surviving long enough to produce offspring. But it seems this fitness is not passed on through the generations.

'We have found that these animals cannot evolve to be more genetically diverse,' says Forcada. 'Effectively, climate change is outpacing their ability to evolve.'

Hunted nearly to extinction by the early 20th century, a small breeding population was discovered on Bird Island, off the coast of South Georgia, in the 1930s. The colony grew rapidly but in the early 1990s numbers began to decline.

Long-term monitoring by BAS shows that, compared to the early nineties, females are now breeding on average a year later and their offspring are eight per cent smaller.

There has also been a shift in their diet towards smaller krill.

According to Forcada, these are all signs that the seals are finding it increasingly difficult to find food. He says large-scale changes in the region's climate are affecting the movements of the enormous krill swarms on which they depend.

'The pressure on their food source is driving a process of selection from birth to breeding which favours the most genetically diverse seals,' says Forcada. 'But there is no inheritance of this genetic diversity, so with each new generation the clock resets and the process repeats itself.'

The research, carried out with partners at Bielefeld University, demonstrates the value of long-term monitoring programmes.

'Building this picture has taken many different lines of evidence, collected over a number of decades,' says Forcada. 'If we had only looked at the genetic diversity of breeding females, we might have assumed that they were becoming fitter.'

Bottlenose dolphins use specific whistles as names

Bottlenose dolphins in Africa use signature whistles to identify each other, say scientists investigating the animals' communication.

Data gathered in a new study will be used to better understand the impact of human activity on the dolphins' behaviour.

Bottlenose dolphins are one of the best-studied dolphin species worldwide, but African populations have had less attention until now.

A new study, published in *Plos One*, has found that both the Indo-Pacific bottlenose (*Tursiops aduncus*) and the common bottlenose (*Tursiops truncatus*) use a communication system based on signature whistles, which they use to greet each other in a similar way to human names.

'The population we study in Walvis Bay, Namibia, is isolated and currently has only around 100 animals. Walvis Bay has lots of man-made pressures, including coastal construction, shipping and marine tourism. So we are concerned for their long-term welfare,' explains project lead Dr Tess Gridley of the University of Pretoria, the Namibian Dolphin Project and Sea Search.

Gridley and colleagues used an underwater microphone to collect more than 79 hours of recordings of signature whistles, alongside identification photos of the dolphins who made them.

'We found that the number of different signature whistles recorded increased when group sizes were larger and when calves were present – something you might expect if signature whistles are used to address each other and help maintain contact between animals, particularly between mothers and calves,' explains Gridley.

The catalogue of whistles from this study will help researchers understand how human activity is affecting the dolphins.

Bats use polarised light to navigate

Scientists have discovered that greater mouse-eared bats use polarisation patterns in the sky to navigate – the first mammal that's known to do this.

A new study, published in *Nature Communications*, reveals that the bats use the scattering of the Sun's light at sunset to calibrate their internal magnetic compass.

A diverse range of creatures use polarisation patterns to navigate, but despite this new breakthrough researchers have no idea how the bats detect polarised light.

'We have at least some idea how other animals do it: bees have specially-adapted photoreceptors in their eyes, and birds, fish, amphibians and reptiles all have cone-cell structures in their eyes which may help them to detect polarisation,' says Dr Richard Holland of Queen's University Belfast, co-author of the study.

'But we don't know which structure these bats might be using.'

Polarisation patterns depend on where the Sun is in the sky and are clearest in a strip 90° from the position of the Sun at sunset or sunrise. But animals can see the patterns long after sunset so they can orient themselves even when they can't see the sun itself, including when it's cloudy.

Scientists have even shown that dung beetles use the polarisation pattern of moonlight for orientation.

'Every night bats leave their roosts to search for prey. They might range hundreds of kilometres but return before sunrise to avoid predators. But until now, how they achieved such feats of navigation wasn't clear,' says Stefan Greif of Queen's University Belfast, lead author of the study.

'Most people are familiar with bats using echolocation to get around. But that only works up to about 50 metres, so we knew they had to be using another of their senses for longer range navigation,' says Greif.

Greif and colleagues from Tel Aviv University showed mouse-eared bats one of two polarisation patterns at sunset, then released them at two sites, at 1.00am when no polarisation was visible.

Small radio transmitters attached to the bats' backs tracked the direction the animals set off. The bats' direction of travel differed according to the polarised light they had been shown.

Bats probably use a suite of senses, including the position of the Sun or the stars, the Earth's magnetic field, smells, sight, and, of course, echolocation to navigate.

Many bat species are declining across Europe, despite being protected. They provide a vital service that tends to be overlooked – they're natural pest controllers. It's estimated that they save us millions of pounds in pesticides by eating insects.

'Anything we can do to understand how they move and navigate will be step forward in helping to protect them,' adds Holland.

in brief . . .

Paper Makers

NERC and the British Ecological Society are supporting an exciting new project call Paper Makers, which brings together early-career scientists and artists to interpret a scientific paper about changes in the marine environment. Project lead Lydia Bach hopes the endeavour will result in seven unique artworks reflecting different human impacts on marine biodiversity. The project should be completed by July 2015 and we plan to bring you the results in a future edition of *Planet Earth*.

Bach also hopes to get the public involved. She'll be inviting people to draw, photograph or sculpt marine animals, plants, algae and fungus species. The idea is to make cards from the artwork photos and create a game (like Phylogame: http://phylogame.org/diy-cards/) to introduce people to the wonderful fauna and flora that characterise British marine biodiversity.

A website where people can upload their artworks will launch in January 2015. In the meantime follow the Paper Makers project blog: http://the-paper-makers.blogspot.co.uk/p/project.html

DNA reveals seabed diversity

Tiny seabed creatures are far more genetically varied than we thought, according to a paper in *Global Ecology and Biogeography*.

Understanding how ocean life is adapting to environmental change is important because changes in the communities of these animals will ultimately affect larger species, many of which are economically and socially important.

An international team of scientists carried out genetic analysis on creatures from beach sediments around the north Atlantic.

'Our work shows that some species are local, preferring a particular set of environmental conditions, while others are distributed far more widely,' says Dr Vera Fonseca of the Zoological Research Museum Alexander Koenig in Bonn, lead author of the study.

DNA analysis let the researchers distinguish between thousands of species near-instantaneously; it would have taken a team of specialists years to seek out anatomical differences through a microscope.

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Young smooth snakes rely on reptiles

A new way of using DNA analysis to find out what reptiles have been eating has revealed that the UK's rarest snake species may be under pressure.

A paper in *Molecular Ecology* shows that young smooth snakes depend on reptiles such as small slow worms and other lizards until they get big enough to tackle mice, voles and other mammalian quarry.

Scientists from Cardiff University analysed snake faeces for genetic traces of their prey. They found that only 28 per cent had recently eaten mammals and none of that group were juveniles; the likelihood of having eaten mammals grew with age and experience.

The results may explain why smooth snakes are confined to a few relatively small areas in south-west England – they may need abundant reptiles to make it to adulthood and only a few British habitats offer this.

'It's been claimed that smooth snakes are restricted to heathland, and that the loss of this habitat is what is affecting their numbers,' says Dr David Brown, who did the research while working on his PhD at Cardiff. 'But on the continent you find them in all kinds of habitats, so that theory doesn't stack up.'

This is the first time molecular analysis of faeces has been applied to reptiles. The researchers weren't sure it would work because snakes digest their prey very thoroughly, but this work clears the way for a much better understanding of the ecology of many members of the family.

Save the **seagrass**

Richard Unsworth

Seagrass meadows provide the ideal place for young fish to thrive, say NERC-funded scientists researching the importance of these habitats for commercial fishing.

Globally, seagrasses are being lost at the same rate as Amazon rainforests and little is being done to conserve these habitats as their importance isn't fully understood.

Scientists at Swansea University have just published two studies in the journals *Marine Pollution Bulletin* and *Marine Biodiversity* showing these areas are vital to the wellbeing of juvenile fish and, consequently, the fishing industry.

'If you're a small fish you need food and shelter. Seagrass meadows provide both,' explains Dr Richard Unsworth, lead researcher on the project.

Frog fish Photography

Over 12 months the team assessed the size and number of fish from various species in seagrass meadows around Britain and compared the results with nearby sand habitats.

'We were surprised to find so many fish with a commercial value, like plaice, cod, pollock and herring, using the seagrass meadows. In one site in Wales we found 42 species and 11 of these were commercially important,' Unsworth says.

UK seagrasses are mostly at threat from poor water quality and damage from boats. Discussions are under way on whether certain meadows, such as Studland Bay in Dorset, should become marine protected areas.

'If the seagrasses weren't there the fish could find another nursery but their chances of survival would be much reduced,' Unsworth says.


Taking rock samples.

More snow won't save melting Antarctic glaciers

Antarctica's inland glaciers will shrink quickly as the atmosphere warms, scientists suggest. More snowfall won't be enough to compensate for greater melting due to warmer weather, and the likely result is accelerating sea-level rise.

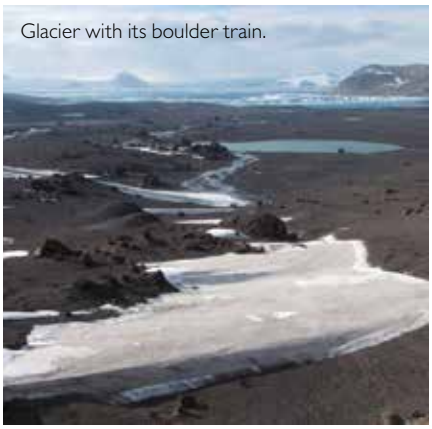
That's the conclusion of a new study, published in *Nature Climate Change*. Its authors used rock samples, ice cores and computer climate and glacier models to understand how Antarctic glacier IJR45 had responded to changes in the climate over the last few thousand years. The goal was to improve predictions of its future behaviour.

The scientists say the Antarctic Peninsula could lose many of its smaller glaciers within a couple of centuries, even though there will be more snowfall to top them up.
The area's glaciers are already melting fast, and eventually they could be left smaller and thinner than at any time in the last 10,000 years.

'Our work shows these glaciers can respond incredibly quickly to changes in air temperature – even quite small changes, and even if there are big increases in snowfall,' says glaciologist Dr Bethan Davies of Royal Holloway, University of London, the paper's lead author.

The Antarctic is heating up but it's also getting more snow, because warmer air can hold more water vapour. In some places, precipitation is up 50 per cent over the last half-century, and this trend is expected to continue. While some studies have suggested glaciers could remain stable or even grow as a result, this new research suggests otherwise.

'We've ended up with a consistent, coherent story – the ice shelves and glaciers both advance in cold periods and melt back when conditions become warmer,' says Davies.


Glacier with its boulder train.

Davies says IJR45 is typical of glaciers in the area that end on land rather than in the sea – known as 'mountain glaciers' – so the study's conclusions should apply much more widely. She adds that the failure of greater precipitation to counteract warmer temperatures may be because more of that precipitation starts falling as rain rather than snow, and so fails to replenish the glaciers.

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Microscope hack could offer cheap disease testing


Schistosoma mansoni.

A new way of measuring cell movement could save scientists hundreds of thousands of pounds and protect human health.

A team from Brunel University was studying snails that may be infected with schistosomiasis, otherwise known as bilharzia – a disease that can infect humans through parasites in contaminated water in subtropical and tropical regions.

The researchers were looking at cell motility – how fast cells move – in this case to see whether snail cells move towards or away from polluted water. But cell motility is expensive to test, ranging from a few hundred pounds for a special microscope slide to hundreds of thousands for an inverted microscope.

So the researchers hacked a cheap microscope bought online to produce similar images for a fraction of the cost.

'When you're looking at motility in cells you're only interested in how fast the cell gets from A to B rather than a high-resolution image. Even with a high-cost microscope you reduce the image down so it's just a black dot on a white background that it's easy for a computer to read,' explains PhD student Adam Lynch who pioneered the new technique.

Lynch realised a USB microscope he'd bought online could be clamped upside down on a table to produce the same images as the much more expensive inverted microscope.

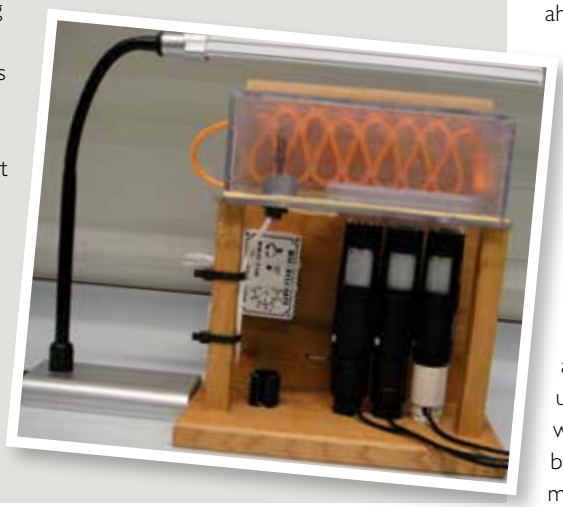
To scale up the experiment Lynch used three cheap microscopes together, trebling his output – something the university couldn't have afforded with the inverted microscopes.

When Lynch struggled to get his computer's imaging software to respond to three identical instruments he asked for advice on an online coding forum and found Junian Triajianto; instead of offering a workaround, Triajinto wrote new software that enabled Lynch to run all three microscopes on one laptop.

The whole thing cost about £100.

By keeping costs down and keeping the system portable Lynch hopes his solution will help developing countries to study and test for schistosomiasis.

'These diseases are in the places with the lowest resources. They might not have expensive equipment but people do have laptops. This doesn't need top-of-the-range stuff to run, it's pretty simple. People could make use of a low-cost system compatible with basic technology,' he says.



Pollen on birds shows feeding grounds

Encrusted pollen on migrating birds' heads can shed light on where they've taken a break from migration to refuel, scientists say.

They found that many warblers carry traces of pollen from the eucalyptus and citrus plantations of Spain and Portugal – a food source that hasn't been there until recently.

The findings may help protect threatened songbirds as they suggest that commercial and garden tree species may be more important as a food source for migrating birds than previously suspected. Many of these birds are already under pressure from changes in climate and habitat, so planting the right species along migration routes could help them feed and reproduce.

The warblers winter in the Mediterranean and north Africa; if they forage for nectar and insects along the way they get pollen grains stuck to their plumage.

'We think some of the birds that are stopping off to feed in Iberia may be migrating suboptimally, whether because they haven't managed to find enough food ahead of migration or just because of bad weather,' says Dr Matt Wood of the University of Gloucestershire, lead author of the paper in *Bird Study*. 'So these are birds that might not make it to Britain if this food source wasn't available to them.'

The researchers examined 113 birds from four warbler species – chiffchaffs, willow warblers, blackcaps and garden warblers – by clipping small feathers from around their beaks and looking for pollen under a microscope. Pollen from 19 species were present, mostly eucalyptus and citrus but also other trees including pines and maples.

Parenthood stresses banded mongooses out

As every parent knows, bringing up children can be a draining business. Now researchers have found that banded mongoose parents find it so stressful, they have no energy left to care for the next litter.

It seems the energetic demands of caring for pups pushes up the mongooses' stress hormone levels.

These high levels continue so long they affect the animals' ability to look after their next batch of offspring. Instead, they have to rely on their brothers and sisters to take the reins.

'Most parents will be able to relate to this. It's a big investment and hard work bringing up pups – the parents often go without food, because any food they find they give to the pups. Understandably this is stressful for them, and they can't work so hard next time,' says Dr Jenni Sanderson of the University of Exeter, lead author of the study, published in *Functional Ecology*.

Sanderson and colleagues from Exeter and the Banded Mongoose Research Project followed a group of banded mongooses from Queen Elizabeth National Park in Uganda from dawn to dusk, noting their behaviour and taking samples of their droppings.

'We have to collect faeces so we can measure their hormone levels. I had to be a faeces-collecting ninja, because they overmark each other's faeces very quickly,' says Sanderson.

The mongooses are wild, but researchers have been studying them for 20 years so they're completely used to people.

'We can weigh them and they just ignore you. We recognise them, because they all have different patterns shaved on their backs,' says Sanderson.

The researchers sent the droppings for analysis to Sue Walker at Chester Zoo Wildlife Endocrinology Laboratory, to see if they could link behaviour with glucocorticoid hormone levels.

Banded mongooses live in groups of around 20 individuals on average – sometimes as many as 70. They breed cooperatively – everyone helps with childcare even if they don't have their own offspring.

Analysis of faeces and animal behaviour showed a clear link between energy expenditure and stress hormone levels: mongooses with low glucocorticoid levels fed pups more often than those with higher levels.

'This suggests that elevated glucocorticoid levels inhibit offspring care,' says Sanderson.

High investment in offspring care increased stress hormone levels. And it seems high glucocorticoid levels last long enough to affect the mongooses' behaviour.

These so-called carry-over effects are common, because it takes a long time to recover from caring for pups, or anything that uses up your energy.

'It's the same for us. If you work hard for days on end, it catches up with you, leaving you feeling over tired and less able to work consistently hard,' says Sanderson.

When she and her colleagues gave the mongooses extra food, their hormone levels dropped, confirming that the rise in stress hormone is down to a loss of energy.

This is the first time anyone has shown how such carry-over effects are linked to hormone levels.

Anup Shah/Nature Picture Library