An eye in the sky

Mapping what lives in the British countryside means spending hours tramping through bogs, up and down hills and through some of our most rugged landscapes. Tom Marshall found out how drones are helping.

Dr Paul Scholefield of NERC's Centre for Ecology & Hydrology (CEH) is one of the experts behind the Countryside Survey, working in remote areas to map the landscape and the ecosystems it contains – from big features like fields and woodlands to details like ditches and hedgerows.

It's the definitive record of Britain's countryside and how it's changing over time. It lets policymakers, regulators and industry understand the natural resources available to us and how we can use them sustainably.

Producing it takes huge amounts of fieldwork. Trained surveyors drive around the countryside with tablets, trudging to hard-to-reach areas and cataloguing the major landscape features and the vegetation found there.

The work on the ground isn't going away, but the aerial perspective that drones add to the fieldwork allows Scholefield and his colleagues to gain more scientific insight from it. It gives them thousands of high-resolution aerial photos that can be assembled into intricate 3D maps, providing an unprecedented wealth of information on the mosaic of different habitats that make up the countryside.

Until recently scientists relied on satellite images and photographs taken from research aircraft for the big picture on how the landscape's changing. But satellite photos can't give much detail – one pixel can represent an area of 25m^2 or more. Planes, meanwhile, are expensive to run and have to be booked months in advance. Even

Sand dunes at Sandscale Haws National Nature Reserve, Cumbria.

then, bad weather can mean that on the day they can't take off, ruining scientists' plans.

Drones, in contrast, are cheap and can be launched at short notice. 'With the UAV, we can just go along to the site on the same day the surveyors are there, fly the drone and end up with a detailed 3D picture of that bit of the countryside,' says Scholefield. This eliminates any doubt over whether things have changed in the time between the work on the ground and a plane being available to fly overhead. And because they're cheap to run, they can visit an area repeatedly to get a handle on how it's changing over time.

Scholefield uses an off-the-shelf fixed-wing drone, equipped with a high-resolution camera that can pick up details just centimetres across. 'You can see which patches of heather are flowering, and which channels in a salt marsh have water in them. You can make out individual blades of grass,' Scholefield says. This means scientists can start to look at the microclimates within a landscape, for example making out erosion gullies, quad bike tracks and areas of bare mud due to overgrazing.

This kind of information is invaluable in understanding how a landscape is changing over time – for instance, how a beautiful or scientifically valuable area is being affected by what people are doing there. Knowing this is the first step towards being able to predict its future and make better decisions about how to preserve it.
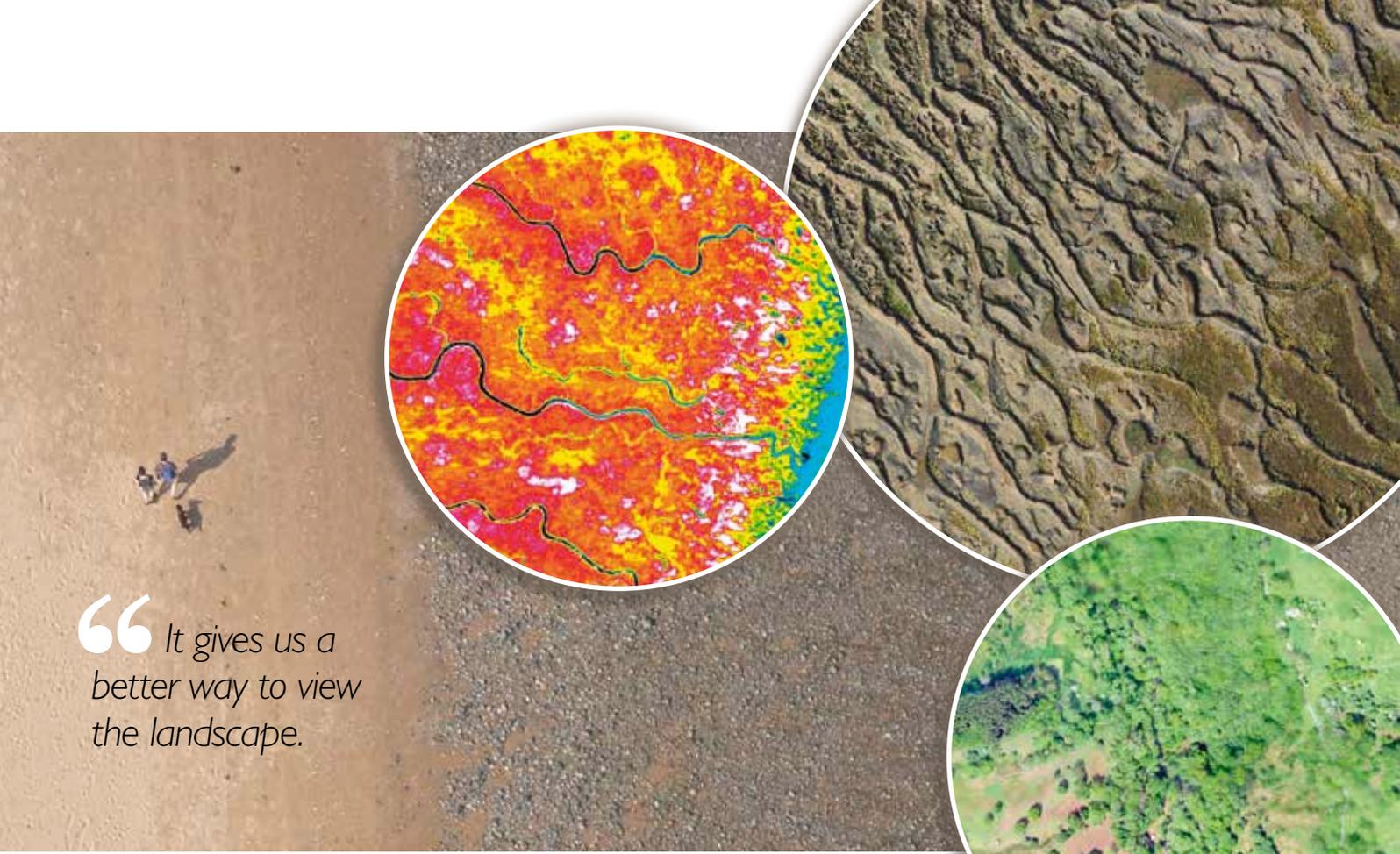
A better view of the lie of the land

The drone means the team can work to their own schedule rather than depending on the availability of a research aircraft, so they can gather much more aerial imagery. Already they've produced highly detailed maps of terrain ranging from uplands like Moor House Nature Reserve in the Pennines to the intricate sand dune systems at Sandscale Haws in Cumbria and the saltmarshes at Dengie in Essex.

The drone is launched by catapult. It can be programmed with waypoints that take it in a series of passes over the area of interest; after a couple of hours its controller lands it in a field or other open area. The team retrieves it, downloads the images it's taken and feeds them into a powerful computer back in the office that spends days stitching them together into a composite image the size of a tennis court, representing several square kilometres of countryside.

'It gives us a better way to view the landscape,' Scholefield says. 'At Moorhouse, we mapped 4km^2 in an afternoon. Doing that on foot would have taken several days. We already had the very large-scale picture that satellite images provide, and the detailed information from surveys on the ground. But the drones give us a middle ground between these extremes, and this really increases the insight we can get from the fieldwork our surveyors do.' The surveyors see the reality of what's on the ground, but only over a small area; imagery from drones means their insights can be scaled up and applied more widely.

He's now looking at putting more sensors on the drone – for example, infra-red cameras and LiDAR instruments that use lasers to scan the landscape beneath, letting scientists do things like map the detailed structure of forest canopies.

This is only the start of using drones to gain new insights into Britain's natural landscapes, though. Other projects in their early stages include flying drones around at night to find bats by picking up their ultrasonic calls.

In the longer term, Scholefield is thinking about the possibilities of involving the public with collecting drone imagery. As more people start owning and flying drones, the amount of aerial imagery will grow. If scientists could get hold of this information – perhaps hosting it at a central database managed by CEH – they could assemble it into a gigantic, exquisitely detailed map covering an ever-growing proportion of the UK.

Like many tools that were once confined to professional researchers, drones are now available cheaply to the public; this vision of citizen science from the air points towards new ways we could bring the information they produce together to create something that helps us all.

Dr Paul Scholefield works in large-scale ecological modelling at NERC's Centre for Ecology & Hydrology in Lancaster. You can see some of the landscape maps he's produced with drone imagery at **www.gigapan.com/profiles/Fieldstitcher/gigapans.**

> **It gives us a better way to view the landscape.**

Top left:
False colour image of salt marsh at Dengie National Nature Reserve, Essex, used to estimate plant productivity.

Top right:
Mud flats at Dengie National Nature Reserve, Essex.

Bottom right:
Afon Rhaeadr Fawr in north Wales.