Science in action:

Watching the **birds**

How the UK's birds of prey were saved from the malign effects of 20th-century pesticides is a great example of scientific detective work – and it also shows the immense value of monitoring the natural environment over long periods. Tom Marshall tells the story.

In the mid-1950s, newly-sown cornfields across Britain started turning into avian mass graveyards each spring. The victims were strewn in their thousands; they included both small seed-eaters like finches and pigeons, and in turn the birds of prey that eat them.

They died in convulsions, but otherwise most seemed in good condition. The cause was a mystery, but the effects were all too clear; within a few years, sparrowhawks and peregrine falcons had vanished across much of the country. By 1961 more than half of the peregrine nests that had been recorded as occupied during the 1930s were empty.

The obvious suspects were new organochlorine pesticides such as aldrin and dieldrin. These were being used to protect cereal crops from insect pests at sowing time, and most heavily affected fields had recently been sown with chemically-dressed seed.

Scientists already knew these compounds could harm seed-eating birds, and it wasn't too much of a leap to imagine how sparrowhawks could suffer after catching prey that had dined on treated grain. But how were peregrine falcons that lived far away in the hills being affected?

Scientists at the Monks Wood Experimental Station, later absorbed into NERC's Centre for Ecology & Hydrology (CEH), started investigating the problem in the early 1960s, working closely with other researchers, volunteer birdwatchers, museums and government chemists, and drawing on newly-developed analytical methods to detect tiny quantities of chemicals in animals' bodies.

They eventually succeeded in showing how aldrin and dieldrin were affecting the peregrines even though they nested far away from affected farmland – through pigeons, among the raptors' favourite prey. None of these pigeons had been exposed to enough pesticide to kill it, but over time the chemicals built up in their predators' bodies.

The researchers found traces of the pesticides in peregrine eggs, and in corpses found long distances from farmland that had been exposed to organochlorines. They succeeded in establishing that the pesticides weren't just directly toxic to seed-eating birds; they can also dissolve and accumulate in the body fat of animals further up the food chain – potentially even in humans.

The team shared its findings with the farming industry and with policymakers, leading eventually to the phased withdrawal of aldrin and dieldrin. This led to some recovery in populations.

Some species were still suffering badly, though. Aldrin and dieldrin take effect quickly, so tracing the blame for mass poisonings to them was comparatively straightforward. But several birds of prey

1956	1961	1964	1975	1984
Springtime mass bird deaths begin	Voluntary moratoria on use of aldrin and dieldrin	Some recovery in raptor populations	Dieldrin banned	DDT banned

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– most notably peregrines – were still declining, and the cause was more insidious and harder to pin down.

Following the restrictions on aldrin and dieldrin, farmers were turning in greater numbers to another organochlorine, DDT. Monks Wood researcher Derek Ratcliffe suspected this could be interfering with the peregrines' breeding, and might be behind the increasing reports of their eggs being found broken in nests.

He tested the shells of modern bird eggs against those from years before, taken from museums and private collections, and found clear evidence that they were becoming thinner and more fragile. His work on the subject, published in 1967, also showed that this change started in the late 1940s – just as DDT was being introduced.

Further experiments strengthened the link. By 1969 the evidence was overwhelming, leading to tighter restrictions on aldrin and dieldrin, and to pressure to ban DDT. Organochlorine pesticides were eventually banned across the UK and EU in 1984. Peregrine falcon populations at last started to recover, although slowly at first due to these chemicals' long life in the environment, and by 1991 a survey showed they were around 145 per cent of pre-war levels.

Finding out how DDT accumulated as it moved up the food chain was a new discovery – one which a later commentator suggested may have been the most important scientific contribution to nature conservation in Britain. The episode was a turning-point in UK science's contribution to reducing pollution, protecting nature and raising public awareness about environmental issues.

All this meant pesticides started to face much more stringent testing before being cleared for use. Until then, proposed new chemicals were tested only for direct capacity to harm selected birds; afterwards, scientists also took into account questions like how long a chemical could linger in the environment, how readily it could accumulate in animals' bodies and how it could affect their success in breeding. Ultimately this work influenced the Stockholm Convention on Persistent Organic Pollutants in 2004, which recommended DDT never be used unless there was no viable alternative.

More broadly, the findings also demonstrated that evaluating pesticides' effects is a complex business – to do it, you don't just have to look at the impact on pest numbers, but also at what chemicals do to biodiversity across the whole landscape.

The implications of the research go beyond the health of wild species and ecosystems, too. Over the years plenty of evidence has built up to suggest that organochlorines can harm human health after travelling along similar environmental pathways and accumulating in our bodies, and may be associated with problems including cancer and diabetes.

Work to understand how the chemicals we produce are affecting wildlife carries on to this day. NERC continues to invest in the Predatory Bird Monitoring Scheme and the Wildlife Disease and Contamination Surveillance Network, both run by CEH. Both are essential to continuing to protect wild animals from new threats.

For instance, long-term monitoring has suggested that rat poisons are having a serious impact on barn owls and other rodent-eating birds and mammals. Increasing numbers of corpses are being found with high and in some cases lethal concentrations; the effects on individuals are clear, but scientists aren't yet sure how this is affecting whole populations. What is certain is that there is a potentially serious threat to a group of animals that's both much-loved by the public and vitally important in nature. NERC-supported science continues to influence government policy, helping protect the natural environment and the vital benefits with which it provides us.

1991

Peregrine falcons in excess of pre-war levels

2004

Stockholm Convention on Persistent Organic Pollutants recommends permanent ban on DDT except for disease control where no alternatives are available

- Predatory Bird Monitoring Scheme: http://pbms.ceh.ac.uk
- Wildlife Disease and Contamination Surveillance Network: www.wildcoms.org.uk