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Satellites help chart a future for Europe's disappearing farmland birds

Farmland birds have declined dramatically across Europe, signalling wider ecological problems. Researchers are using satellite data and AI to identify where conservation efforts could have the greatest impact.

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Farmland biodiversity plays a crucial role in maintaining healthy ecosystems and productive agricultural landscapes. Yet across Europe, farmland birds – key indicators of environmental health – have suffered sharp declines as farming has intensified.

As they pass over the fields of Brandenburg in eastern Germany, two satellites are doing work that an army of ornithologists never could. Every few days, the EU's Sentinel-2 satellites capture high-resolution images of millions of agricultural fields across Europe, building a constantly updated picture of the continent's landscapes.

Dr Annett Frick, head of Remote Sensing at the German environmental consultancy LUP, has spent the past three years helping turn this stream of data into a practical conservation tool.

Through the EU-funded BirdWatch project, managed by the European Union Agency for the Space Programme, she and her colleagues have developed a system that uses satellite observations and AI to assess the suitability of farmland habitats for birds and identify where conservation measures are likely to have the greatest impact.

Falling bird populations

The need is urgent. According to the Pan-European Common Bird Monitoring Scheme, common bird populations in Europe have declined by 19% since 1980. For farmland species such as yellowhammers, swallows and turtle doves, the decline is as high as 58%.

These losses reflect decades of agricultural intensification. Landscapes once rich in hedgerows, grasslands, small woodlands and wildflowers have increasingly given way to vast expanses of monoculture crops, leaving less space for wildlife to thrive.

According to Frick, the decline of farmland birds is a warning sign that many agricultural landscapes are no longer functioning as healthy ecosystems.

Many farmland birds are considered umbrella species, she explained. Their presence or absence can reveal a great deal about the overall state of an ecosystem. If conditions are suitable for these birds, they are often suitable for many other plants and animals, too.

This matters not only for wildlife conservation, but also for people. Healthy ecosystems help maintain fertile soils, support pollinators, regulate water and provide natural protection against pests and disease.

“To have food stability and security, you need stable ecosystems that are resilient, for instance to climate change, pests and plant disease,” Frick said. “Therefore, you need diverse, not monocultural landscapes.”

Protecting biodiversity has become a central objective of European environmental policy. The EU Biodiversity Strategy for 2030 aims to restore degraded ecosystems and increase the amount of high-diversity landscape features on agricultural land.

The Birds and Habitats Directives provide the legal framework for protecting Europe’s most vulnerable species and habitats.

Achieving these goals, however, requires accurate information about where biodiversity is thriving, where it is under pressure and which forms of intervention will deliver the greatest benefit.

Satellite precision

The BirdWatch initiative, which ended in January 2026, was designed to help answer those questions. Conservation assessments have traditionally relied on field surveys, with researchers recording species observations on the ground. While these remain essential, they are often time-consuming, costly and hard to scale across large regions.

“It has been done in the past, but not at the spatial scale that’s really needed to change things,” Frick explained.

The BirdWatch team combined Earth observation data from the EU’s Sentinel satellite programme with habitat suitability models to build a broader picture of agricultural landscapes.

The satellite imagery provided information on canopy cover, crop types and surrounding land uses such as grasslands, forests and urban areas for millions of parcels of land. The researchers also incorporated local land-use information from municipalities and other organisations to validate and refine this data.

The system goes beyond conventional photography. Using radar observations from the Sentinel-1 satellite, which passes over Europe every six days, the team was also able to estimate soil moisture.

“When the radar is looking at areas that are rich in water, the signal it gets back is easily recognised as land covered by water, or land particularly rich in water,” explained Dr Bartolomeo Ventura, a remote sensing researcher at Eurac Research in Italy and a member of the BirdWatch team.

Combined with optical imagery, these measurements allowed researchers to build detailed maps showing how soil moisture varies across different landscapes and land uses.

The resulting information on crop cover, vegetation structure, land use and moisture conditions was then combined with habitat models for 10 indicator farmland bird species. The outcome is a detailed assessment of where conditions are suitable – or could become suitable – for each species.

Making every euro count

But the BirdWatch team did more than just identify habitat. The platform also tackles a practical question faced by policymakers, conservation organisations and funding bodies: where should limited resources be invested to deliver the greatest ecological return?

To answer this, the researchers developed an optimisation system powered by AI. Users can test different conservation scenarios and budgets, allowing the platform to identify the measures most likely to improve bird habitats.

Possible options include planting hedgerows and flower strips, converting arable land to pasture, and diversifying crop rotations.

The system was tested in four pilot regions: Brandenburg in Germany, Flanders in Belgium, Lithuania, and South Tyrol in Italy.

In Brandenburg, the researchers compared different conservation strategies using a hypothetical budget of €1 million. They tried focusing investments on protected areas, focusing on EU-designated protected areas for birds only, or allowing the system to identify priority sites across the entire region.

The work also revealed the importance of local knowledge. Although the researchers initially hoped to create habitat models covering all of Europe, they found that regional conditions were simply too different.

“We found out that it’s really important to have regionalised knowledge,” said Frick. “A one-size-fits-all model doesn’t really work, especially for the habitat models.”

This, she explained, is because habitat conditions vary widely across Europe and bird species tend to adapt to local conditions. As a result, continent-wide habitat models for individual species are not detailed enough. To get useful results, species need different models for different areas.

Targeting biodiversity

Today, the BirdWatch platform is publicly accessible and provides habitat suitability maps and conservation scenarios for its pilot regions. Regional authorities and conservation organisations from across Europe have already expressed interest in adapting the approach to their own landscapes and species.

The idea is that the work carried out could help policymakers meet the goals of the EU Biodiversity Strategy for 2030. The Strategy aims to halt biodiversity loss and restore degraded ecosystems, including a target for at least 10% of agricultural land to contain high-diversity landscape features.

The challenge is considerable. In Brandenburg, where almost half the land is used for agriculture, a recent study found that 94% of farmland falls short of the 10% target. The BirdWatch platform is designed to help identify where conservation measures could deliver the greatest benefit, helping authorities and funding bodies direct resources more effectively.

For Frick, the project’s key contribution is demonstrating that modern Earth observation technology can support biodiversity planning at an unprecedented scale.

“Our biggest achievement was showing that spatial optimisation works at scale, across millions of parcels, in real landscapes,” she said. “We can see, for the whole of Germany, for every field, whether the conditions are suitable for the birds we want to protect. And for most of them, right now, they are not.”

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More info

- BirdWatch (CORDIS)
- BirdWatch project website
- EU Biodiversity Strategy 2030
- Birds and Habitats Directives
- EUSPA