Newsletter Nr. 2

A service to measure and improve biodiversity using satellite data for monitoring, evaluation and optimization of CAP greening initiatives

Horizon Europe
Research and Innovation Programme

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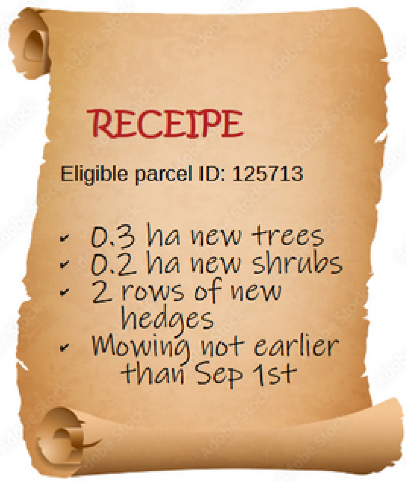

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In BirdWatch, we will establish species-specific habitat models to derive the suitability of agricultural land for farmland birds, which is spearheaded by the Ecology & Macro-ecology group of the University of Potsdam, Germany.
In the first part of the newsletter we introduce you to our target bird species and how we selected them.

BirdWatch started in February of this year. Since then, lots of discussions have led to a first idea how BirdWatch will operate and what it needs to bring value to its users.
Here, we provide a glimpse into how BirdWatch will derive habitat suitability and what components it needs to accomplish this.

Finally, VITO shares insights into how BirdWatch will identify optimal pathways to ecologically improved habitats for our birds, thereby highlighting the importance to include clear goals and constraints to ensure viable results.

Please don't hesitate to get in touch! Contact details are at the end of the newsletter.

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INTRODUCING THE BIRDS

It all starts with the birds. This does not just refer to the motivation behind the project but also its implementation. In BirdWatch, farmland bird habitat suitability is at the front and centre. However, to determine and subsequently improve habitat suitability, we need to know what farmland birds need and before we know what they need, we should know who they are.

This is why our first task after the project kick-off, was to identify which bird species we would establish our first habitat models for.

As BirdWatch is currently developed in four European regions (i.e., Flanders, Germany, Lithuania, South Tyrol), we decided that each bird species should breed in at least two of the four regions.

And as we want to help birds which are impacted negatively by agricultural intensification, we picked bird species, whose numbers are at various states of decline.

We oriented ourselves at the so-called Common Farmland Bird Index of the EU*. This index measures changes in population abundance of all common farmland bird species (39 species in total). Each year, 26 EU countries provide the results of their annual national breeding bird surveys to the Pan-European Common Bird Monitoring Scheme (PECBMS)**, which then calculates the index.

Apart from farmland birds, this is also done for all common bird species (168 species) and separately for the forest bird species (34 species).

In the next few pages, we want to introduce you to the resulting selection of our ten initial bird species.

We decided to start with a subset of the common farmland bird species to be able to reach the necessary quality of the habitat models within the timeframe of this three-year project. Suffice to say that we don't aim to stop at ten species in the long run.

The overview includes a subset of a species' most central requirements in regard to farmland as well as indications in which of our test regions the bird is present and how endangered it is.

Increasing threat level →

Does not breed in this region

*: On the Common Bird Indices of the EU

**:The Pan-European Common Bird Moniitoring Scheme

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Eurasian Skylark
(Alauda arvensis)

The skylark forages and breeds on the ground, making it susceptible to mowing activities. It likes open, mosaicked land but avoids trees, shrubs or hedges.

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Yellowhammer
(Emberiza citrinella)

The yellowhammer likes to breed close to the ground, hiding the nest in vegetation. It picks mosaics of crop-free plots, stubble fields and even manure heaps. It also likes trees or shrubs.

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Meadow Pipit
(Anthus pratensis)

Similar to the Yellowhammer, the Meadow pipit breeds close to the ground, hidden in vegetation. But it avoids high trees. Grazing is fine for the Meadow pipit, especially if performed by sheep.

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Whinchat
(Saxicola rubetra)

The Whinchat is more of a generalist, able to make use of different agricultural landscapes. Nonetheless, it doesn't like intensive farm management, as it breed close to the ground and prefers dense vegetation.

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Red-backed Shrike
(Lanius collurio)

This bird hides its nest in bushes and trees. You can find it also in different types of farmland. His favourite habitat has mosaic-like grassy vegetation with alternating areas of tall and short growth and bare areas, with perches.

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Black-tailed Godwit
(Limosa limosa)

The Godwit does all its business on the ground and it stays away from anything tall. However, tall grass is nice to hide from predators. Also, it likes moist, flooded areas for its favourite food.

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Northern Lapwing
(Vanellus Vanellus)

The lapwing is also found on the ground. It feeds on insects and other small invertebraes in and above the soil. So, fertilisation of the soil is really not good for it. And please, no trees.

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Eurasian Tree Sparrow
(Passer montanus)

Suprise, surprise, the Tree sparrow likes trees. Shrubs and hedges are fine, too. It likes its vegetation dense and its habitat dry. The Godwit and the Tree sparrow will probably never meet.

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Turtle Dove
(Streptopelia turtur)

If the Turtle Dove could use apps for apartment searching, it might respond to this ad: “Mosaic of low intensity arable landscapes with fallow fields or low-input crops that provide accessible abundant seed and with a heterogeneous sward structure with at least one-third bare ground.”

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Common Starling
(Sturnus Vulgaris)

The Starling is an omnivore and habitat generalist. This is why it doesn’t even mind built-up areas. However, finding food on farmland is becoming increasingly difficult, so it doesn’t like fertilisers either.

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In the past few months, the picture of how Bird-Watch will operate „under the hood“ gradually took shape. Lots of discussions in internal meetings brought us to an understanding of the methodological approaches including their capabilities and limitations. We learned that the quality and quantity of the available bird observations (including information of a bird's absence!) forms the base of all what comes next. Only if there is sufficient data, habitat models can be generated and the number of environmental parameters to account for, strongly depends on the number of observations.

Thus, if we want to explore the impact of several different environmental and climate variables, we need a sufficient number of species-specific bird observations. The rule of thumb tells us „ten bird observations for one variable“.

While some of us are busily collecting bird observation data for our test regions, others are setting up the workflows for data processing and analysis as well as the necessary software architecture to let them run.

In the following, we focus on introducing the data processing and analysis, which will provide us with the environmental parameters for Bird-Watch.

Environmental Parameters

What do we mean when we speak of environmental parameters? In Bird-Watch, these parameters reflect the habitat conditions of farmland birds and can be used to describe under which circumstances a bird species would encounter its most suitable habitat.
For example, some birds like a wet environment while others prefer it dry. The soil moisture can thus be used to explore if a habitat is wet or dry enough for a certain species. Structural variability and the presence of different small-scale land cover features are often cited as to be beneficial for biodiversity and can be quantified by the presence of land cover types together with the spatial variability.

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Apart from soil moisture conditions, landcover type, landscape elements and structural variability, we identified crop types, the first mowing day of the season and mowing frequency as important explanatory variables to be tested.

Which of them will shed light on the reasons behind the occurrence of birds will later be explored, once the habitat models have been set up.

Data Sources

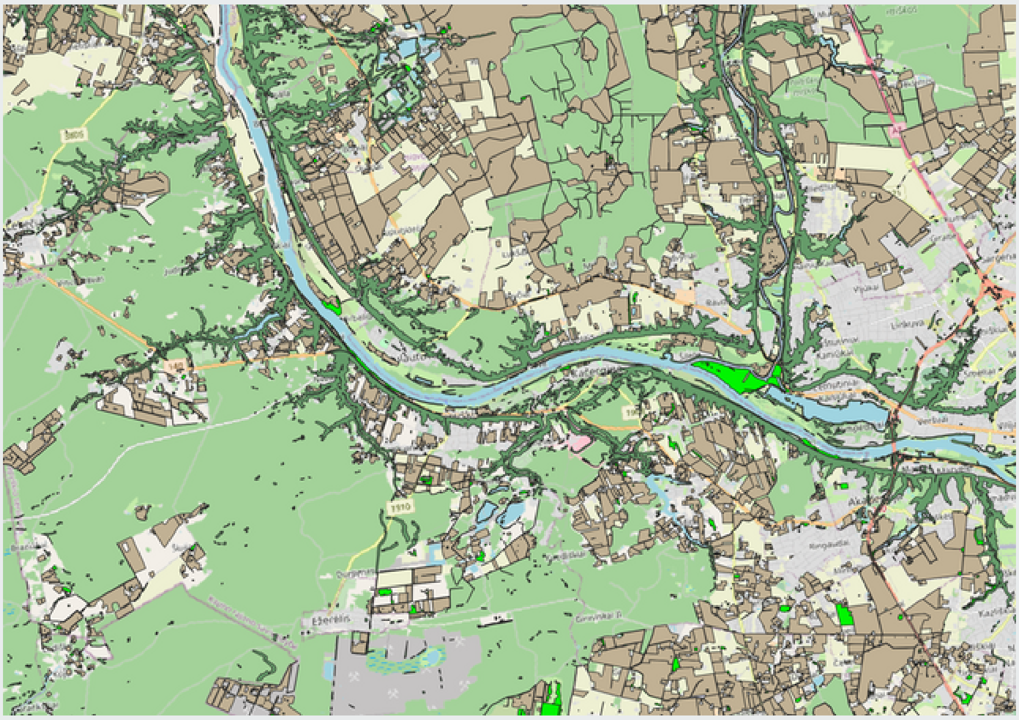
Along with the environmental parameters, we also identified the data sources to use in each test region. The main ingredients will be imagery of the Sentinel-1 and -2 satellites of the ESA's Copernicus programe as well as data coming from the Land Parcel Identification System (LPIS).

LPIS data provide the location of the boundaries of agricultural parcels along with parcel-based information on crop type. LPIS data are not yet openly available for all Member States of the EU, but will be required to become opensource by 2024.

Data Processing & Analysis

Some parameters need more effort to derive than others.

Among the complicated ones are the mowing-related parameters. Here, Sinergise's pixel-based mowing marker can be used.



An example of agricultural parcels, here visualized as vector polygons, derived from Lithuanian LPIS data.
Image source: *Sinergise*

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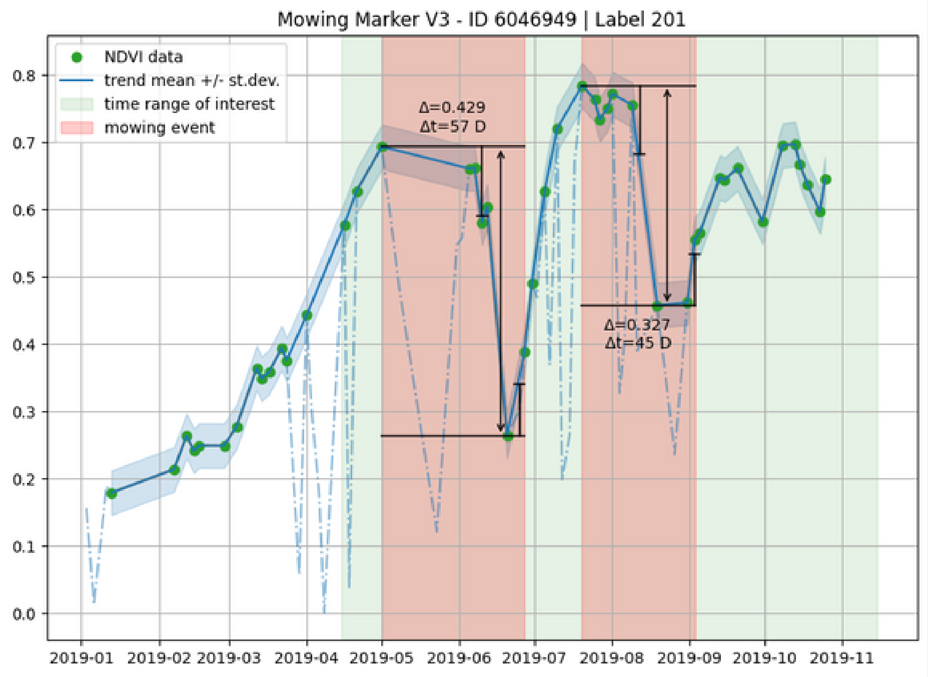
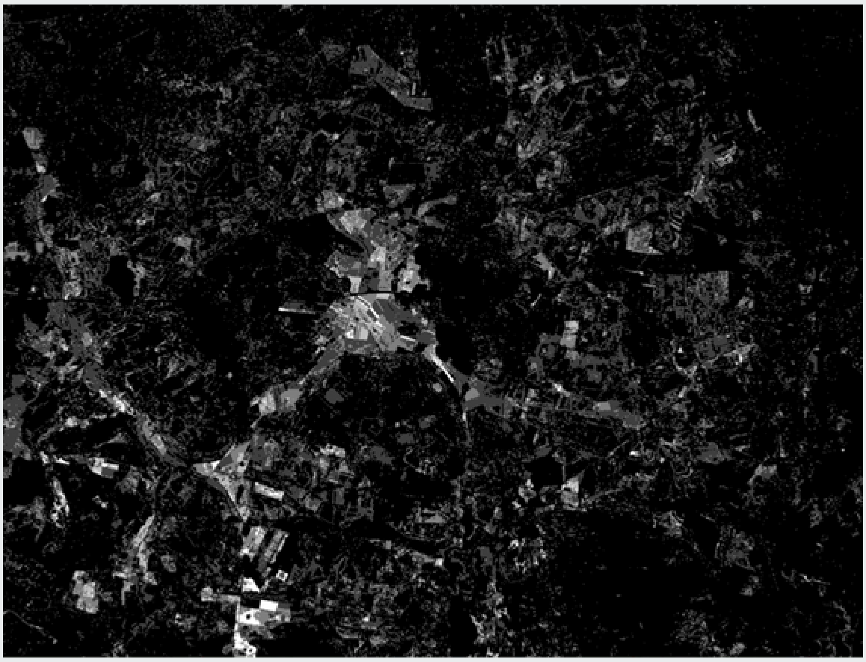
BIRDWATCH - UNDER THE HOOD

It relies on Sentinel-2 imagery and identifies the points in time when there is a sharp drop in the vegetation index (i.e., the Normalised Difference Vegetation Index or NDVI) *.

The approach relies on the fact that a mowing event itself cannot be detected via satellite imagery, but that its consequences are observable.



An example of a detected mowing event between April 15th and Oct 15th. The dashed line represents the whole downloaded NDVI timeseries before filtering steps.
Image source: *Sinergise*



An example of the mowing marker mowing intensity raster data for a region in Brandenburg. The brighter pixels represent where higher mowing intensity was detected.
Image source: *Sinergise*

Soil moisture is another parameter, which requires an elaborate workflow.

BirdWatch can rely on the approach developed at Eurac which is based on a combination of SAR and optical imagery.

*: Area Monitoring — Mowing Marker

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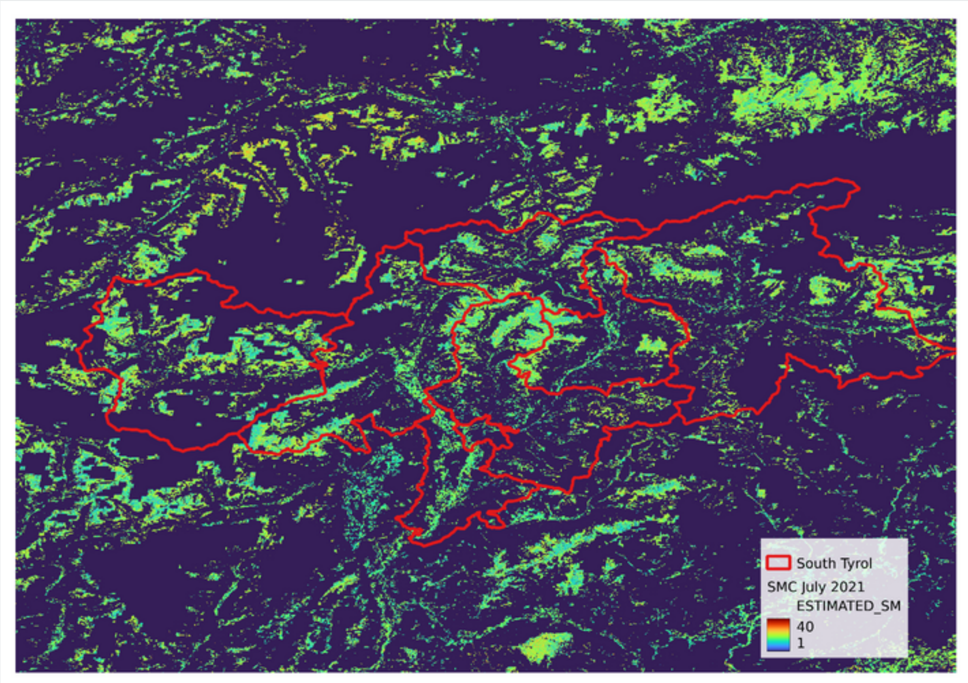
It uses a machine learning approach for the estimation of high spatial resolution surface soil moisture.
The training of the model is based on data coming from the International Soil Moisture Network (ISMN), with measurements from hundreds of monitoring stations worldwide *.



The soil moisture content layer over the province of South Tyrol.
image source: *Eurac Research*

Birds are sensitive to the presence of small-scale features like shrubs or hedgerows, which can be described by the variability of the landscape. So-called texture features, which can be derived from remote sensing imagery, give an overview of the structure of the landscape along with its homogeneity.

From a theoretical point of view, texture features involve information from neighboring pixels, representing intensity variations in an image by way of the Gray Level Co-occurrence Matrix or GLCM. The GLCM is a measure of the probability of occurrence of two grey levels separated by a given distance in a given direction.

Several different texture features can be computed via the GLCM matrix, as you can see in the image on the next page. Each feature produces different properties of the statistical relation of pixel co-occurrence of estimated within a given moving window, along predefined directions and inter-pixel distances.

*: International Soil Moisture Network

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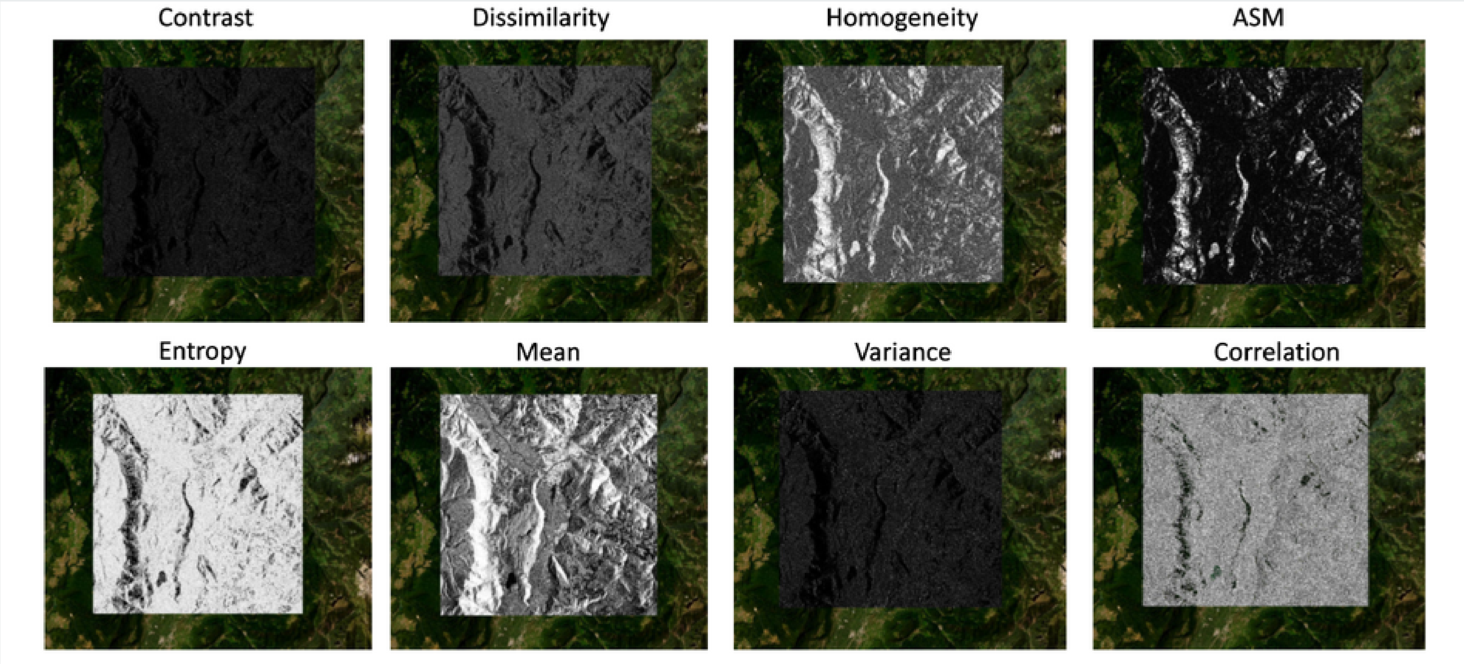

Extracted texture features using the GLCM matrix over parts of South Tyrol
Image source: *Eurac Research*

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MAXIMISING FARMLAND HABITAT SUITABILITY

Significant efforts have been undertaken over the past decades to safeguard birds across Europe. However, despite the conservation measures, farmland bird populations still show a general decline.

A major problem is that farmland practices are not always compatible with the birds which depend on these areas. Also, different bird species at times have opposing needs. This should be taken into consideration when planning conservation measures.

For example, while the Red-backed Shrike thrives in areas with abundant small-scale landscape elements, the Black-tailed Godwit prefers open grasslands. This has to be taken into account, if both species are to be protected.

Thus, designing bird-friendly agricultural landscapes is not straightforward.

Apart from the habitat requirements, other factors. such as regional policy targets or budget limitations have to be considered.

To increase the impact of the budget available for farmland bird conservation measures while taking into account the various accompanying factors, a habitat optimisation model can be used to design such landscapes.

We are currently in the process of creating such a model, based on the logic of the MooV* supply chain optimisation service, developed at VITO.

Our habitat optimisation model is capable of accounting for the specific, partly opposing, requirements of the birds we introduced in part I of this newsletter.

This model will identify the optimal location for the implementation of conservation measures to reach one or more predefined targets, driven by changes in habitat suitability due to changes in the land cover.

The latter is the result of a set of applied conservation measures with which a certain implementation and management cost is associated.

By considering both economic and ecologic implications, our habitat optimisation model identifies the optimal location and type of measure needed to reach a specific target (e.g., 500 ha of additional highly suitable habitat for the Red-backed shrike in the region 'de Moeren'), while

*: MooV

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minimising the implementation and management costs.

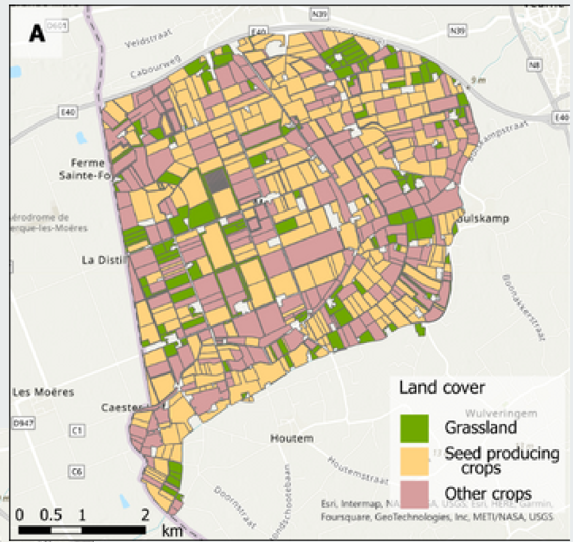
Additionally, the habitat optimisation model will be capable of maximising the habitat suitability of one or multiple species in a region, while ensuring the adherence to the constraints of the implementation and management budget.

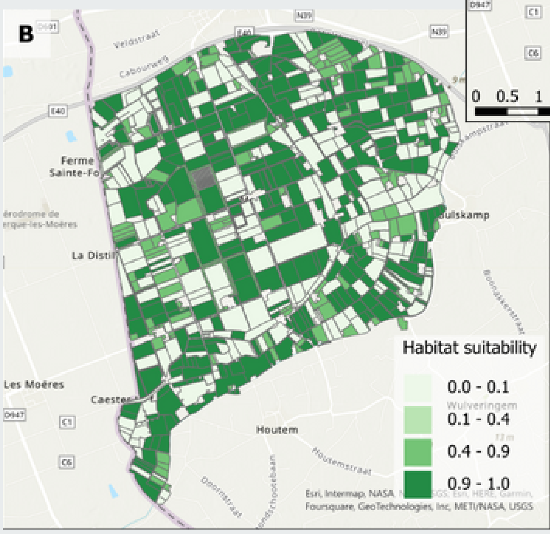
These regional, quantitative targets and constraints are required to implement the habitat optimisation model and thus give relevant region-specific advice on which actions should be taken and where.

A demo model is currently being prepared in order to demonstrate the intended functionalities and outputs of the habitat optimisation model.

This demo model already contains the model logic, while the relationship between land cover and species-specific habitat suitability values will remain fictional until the regional habitat suitability models, which are being developed by our partners from the University of Potsdam, are available.

The two figures below visualise the currently assumed, fictional relationship between land cover and habitat suitability.





Land cover in the region 'de Moeren' (A) and the corresponding habitat suitability of species A , based on a fictional relationship between land cover and habitat suitability (B).

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MAXIMISING FARMLAND HABITAT SUITABILITY

The relationship between land cover and habitat suitability differs among bird species. This is why a certain conservation measure might have a positive effect on one bird species, the same effect is not necessarily observed for another bird species.

It is therefore important that targets and constraints are described in detail for each region:

To what extent should the status of a particular bird increase?

What budget is available to reach this increased habitat suitability?

Can the habitat of other species deteriorate as a consequence of the proposed measures?

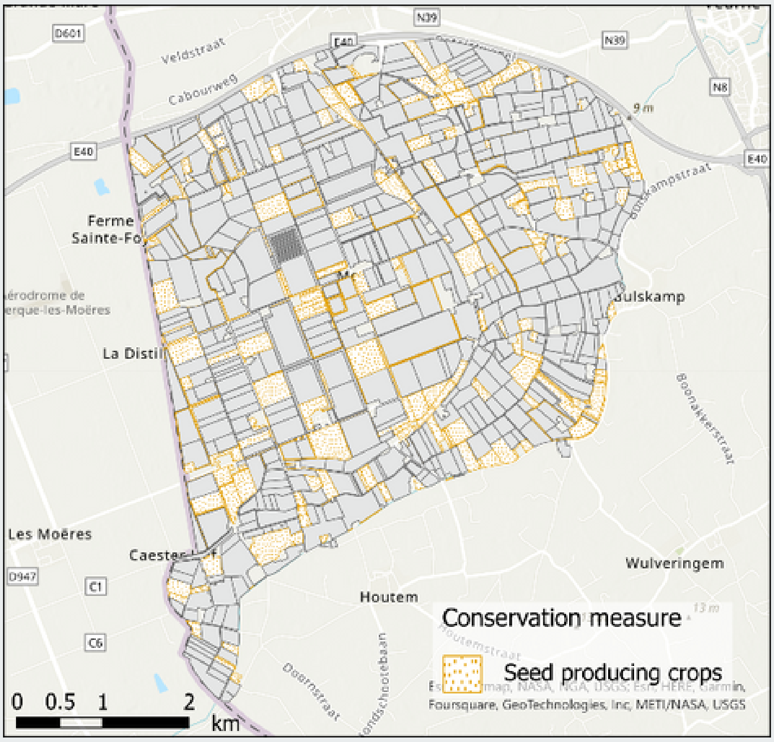
Does there have to be a particular share of certain crop types in the area?

Should certain features such as hedgerows be conserved?

The answer to questions like these will not only help us make relevant suggestions of measures necessary to increase the habitat suitability of farmland bird species. Because of the inherent logic of the model used to make these suggestions, they will also be more cost-effective.

Therefore, for a given budget, we can increase the improvement of farmland bird habitats with our habitat optimisation logic, compared to a less targeted allocation of agri-environmental conservation measures.

Proposed conservation measures to reach the target 500 ha of additional high suitability habitat at minimal cost for bird species A, for which a positive (fictional) relationship between area of seed producing crops and habitat suitability was assumed.



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LINKS

BirdWatch will also soon have its own little film. Please stay tuned and check out our website: https://birdwatch-europe.org/

Stay tuned to find out how farmer Maurice tackles declining habitat suitability!
Image source: *Susanne Seidel, Rémy Schaepman*

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Don't hesitate to get in touch with us!

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