BIRDWATCH

The Diversity of Life from Space

D5.2 Description of the work plan for the study cases

Deliverable for the Horizon Europe Project BirdWatch

Version 2.0

Funded by the European Union

Legal Disclaimer

Funded by
the European Union

Document Information

GA Number	101082634	Type of Action	Horizon-IA
Full Title	BirdWatch - a Copernicus-based service for the improvement of habitat suitability of farmland birds via satellite-enabled monitoring, evaluation and optimisation of CAP greening measures		
Project Acronym	BirdWatch		
Start Date	February 1st, 2023	Duration	36 Months
Project URL	https://birdwatch-europe.org/		
Deliverable	D5.2: Description of the work plan for the study cases		
Work Package	WP 5000 – BirdWatch optimisation algorithm		
Project Month of Delivery	Contractual: M18	Actual	M18
Nature	Report	Dissemination Level	PUB
Lead Beneficiary	VITO		
Responsible Author	Ine Rosier (VITO)		
Contributions from	Annelies De Meyer (VITO) Ruben Guisson (VITO) Rik Hendrix (VITO) Tomas Orlickas (NPA – National Paying Agency of Lithuania) Martynas Rimgaila (NPA – National Paying Agency of Lithuania) Nastasja Scholz (LUP – Luftbild Umwelt Planung)		

Funded by the European Union

History of Changes

Version	Issue Date	Stage	Description	Comments	Contributor
0.1	09.04.2024	Draft	First draft		Ine Rosier
0.2	01.07.2024	Draft	Second draft		Ine Rosier
0.2	04.07.2024	Draft	Review	Review of section 3.2	Nastasja Scholz
0.3	05.07.2024	Draft	Review	Review of section 1, section 2 and section 3.1	Rik Hendrix
0.3	10.07.2024	Draft	Third draft	Adjustments made based on version 0.3 and 0.4	Ine Rosier
0.4	17.07.2024	Draft	Fourth draft	Review of document. Adjustments within section 3.2 based on information provided through email	Ine Rosier
0.4	23.07.2024	Draft	Review	Review of document	Nastasja Scholz
1.0	23.07.2024		First version	Adjustments made based on review	Ine Rosier
2.0			Second version	Adjustments made based on external review	Ine Rosier

Funded by the European Union

Table of contents

Funded by the European Union

Funded by
the European Union

1. Introduction

Farmland biodiversity has been declining in Europe since the 1950s. This decline can be observed over all taxa but is most apparent in farmland birds (Donald *et al.*, 2006; Inger *et al.*, 2015; Heldbjerg *et al.*, 2018) and can be correlated to agricultural intensification (Aebischer *et al.*, 2000; Peach *et al.*, 2001; Donald *et al.*, 2006; Tarjuelo *et al.*, 2020). The EU has so far failed to stop biodiversity loss in its farmlands (Tryjanowski *et al.*, 2011) and additional efforts are needed to conserve and restore the farmland habitats (Reif and Vermouzek, 2019; Traba and Morales, 2019; Rigal *et al.*, 2023).

When assessing which approach should be taken to protect bird species in Europe, not only should the differences between the conservation status of specific birds and their habitat requirements be accounted for, but also regional differences between bird population dynamics need consideration. In the intensive agricultural landscapes of Western Europe (incl. Belgium, Germany and Italy), the Red-backed shrike for example has a high site fidelity, possibly due to the patchy, isolated character of the breeding habitats (Tryjanowski *et al.*, 2011). In Central-Eastern Europe (incl. Lithuania), the site fidelity of this bird was found to be low which could be explained by the widespread availability of breeding sites (Tryjanowski *et al.*, 2011). Further, because there are regional differences in the conservation measures farmers can be compensated for, the likelihood of the uptake of specific measures is not the same around the EU. This also became apparent when analysing the responses to the questionnaire sent out to farmers and farming organisations in the context of the BirdWatch project. Financial considerations were pointed out as the primary reason for wanting to protect farmland birds by 56% of the farmers who responded. Eighty percent of the farming organisations indicated that financial considerations were the primary motivation of its members. To develop truly efficient and large-scale conservation strategies that cover the whole of the EU territory, researchers and policymakers need to understand the regional differences in socio-economic and ecological systems and how these are linked to farmland biodiversity (Tryjanowski *et al.*, 2011).

The habitat optimisation model that is being developed within the context of the BirdWatch project can provide an answer to the specific regional requirements of farmland bird species. The model is developed in such a way that it can consider constraints that capture the local context. This enables us to account for both local socio-economic and ecological requirements. Further, as the habitat optimisation model uses regional habitat suitability models as input, regional differences in bird population dynamics are also being considered. Therefore, the habitat suitability model allows us to suggest changes in the agrarian landscape tailored to the local requirements instead of using management solutions developed for one region as a blanket prescription for other regions.

The goal of this deliverable is to develop a work plan for the optimisation of the habitat suitability in the four test cases. The basis of this work plan is the current status of the BirdWatch bird species within the test case regions and the requirements of the local stakeholders. These elements will

Funded by
the European Union

give context to the locally developed habitat optimisation scenarios. Therefore, the following objectives were defined:

- Summarisation of the status of the ten BirdWatch species in the four test regions;
- Assessment of the past and ongoing conservation efforts and identification of potential (subsidised) measures that could aid in this conservation;
- Description of the habitat optimisation scenarios in the four test regions, including the optimisation objectives and constraints.

The definition of the scenarios is being done in consultation with local stakeholders and the local partners within the BirdWatch project to ensure their relevance. By discussing the results with local stakeholders during demonstrator activities, an assessment will be made of how well these scenarios can provide an answer to the local stakeholder requirements. This will allow us to finetune the optimisation objectives and constraints to be fully aligned with the regional needs.

Funded by
the European Union

2. BirdWatch habitat optimisation model

The BirdWatch habitat optimisation model has the objective of determining at which location land use should be adapted to maximise the habitat suitability of farmland bird species. Such spatial optimisation models have been applied before to identify locations for the conservation or restoration of habitats (Stralberg *et al.*, 2009; Duchardt *et al.*, 2021; de Zwaan *et al.*, 2022; Wesemeyer *et al.*, 2023). The BirdWatch habitat optimisation model is built around the MooV core developed at VITO. The MooV service combines linear programming and advanced (geo)analytics to define, design and optimise resource allocation for complex network configurations. MooV is configured in a core/shell architecture. The MooV-core is generic and entails the universal logic of network optimisation – based on facility location-allocation algorithms. However, the MooV-shell is also customisable to capture case specifics and their descriptives. The MooV service is validated and has been applied with success in various sectors (e.g. bio-based sector, building sector, package delivery, pharma sector). Within Birdwatch, the MooV-shell is tailored to consider the output of the habitat suitability modelling and is supplemented with a resource allocation model with resources being (funds needed for) biodiversity-improving measures. This allows us to use the MooV service as a habitat optimisation model. The BirdWatch habitat optimisation model is a polygon-based, parcel-level model, and the outputs generated will thus also be available at the parcel-level. The optimisation algorithm only considers farmland bird habitat suitability when analysing land use configurations. As birds are high in the food chain, they are considered a good indicator of the overall state of biodiversity (Mekonen, 2017; Fraixedas *et al.*, 2020). The search space for finding the optimal configuration of land use within these agricultural regions is further limited by a set of predefined constraints described in Deliverable 5.1 (Description of the Land Use Allocation Algorithm) of the BirdWatch project.

The BirdWatch habitat optimisation model interlinks with models and algorithms developed in other work packages (WP) of the project. First of all, the optimisation model uses the existing landscape characteristics as a starting point (Figure 1, 1). These characteristics are derived in WP3 of the BirdWatch project using open-source satellite data and regionally available datasets such as digital elevation models and crop type information. Further, to optimise the landscape for farmland birds, the relationship between these landscape characteristics and habitat suitability will be used (Figure 1, 2). This relationship is based on the habitat suitability models created in WP4 of the BirdWatch project. The optimisation scenarios (Figure 1, 4) will be developed based on habitat conservation targets and constraints described in WP5 of the project (Figure 1, 3). These scenarios will be evaluated by relevant local stakeholders (WP7). The output of the optimisation scenarios, i.e. recommendations on the type and location of landscape conservation implementation (Figure 1, 5), will serve as an input for the BirdWatch web platform (WP6).

Funded by
the European Union

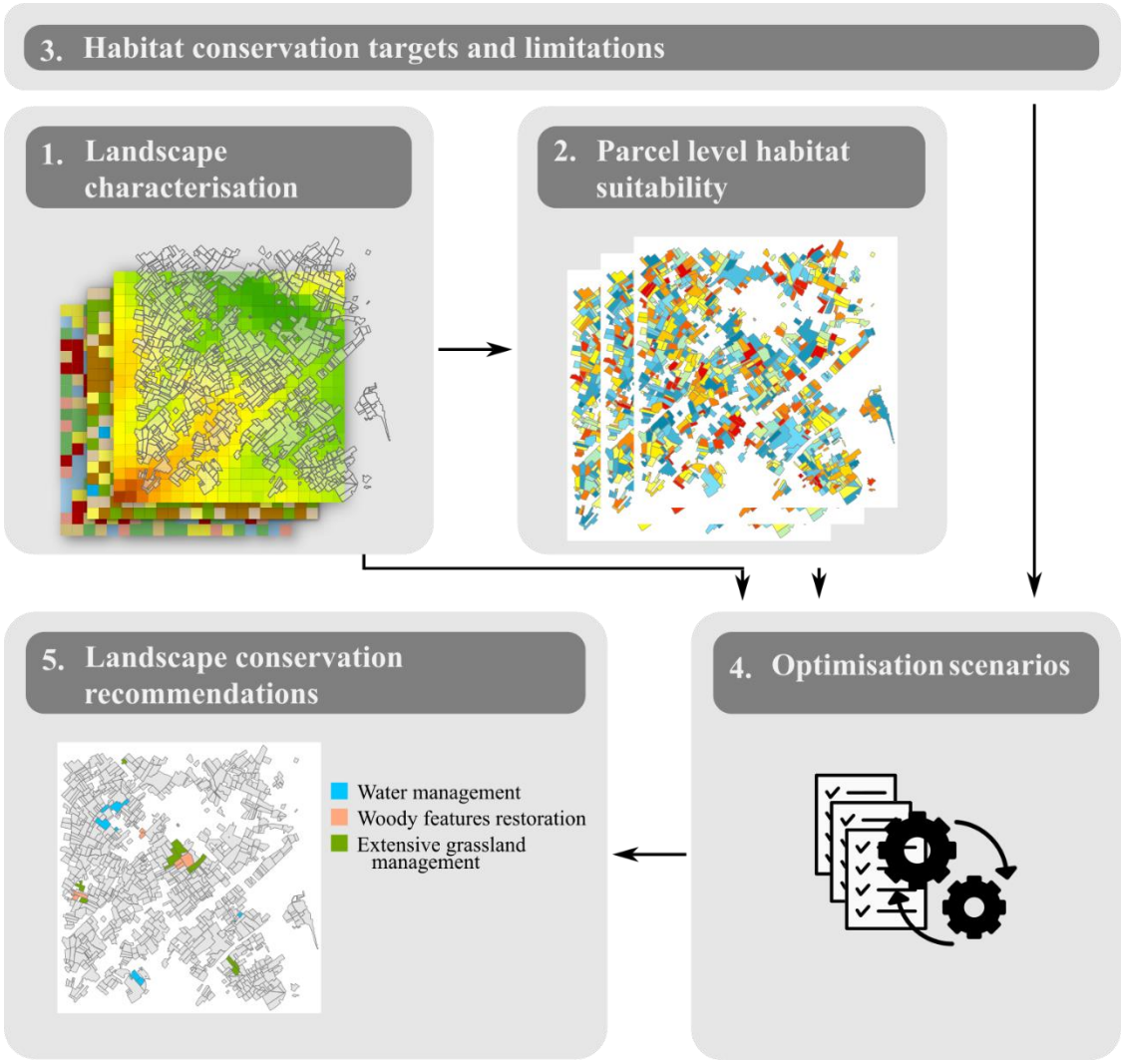

Figure 1 – Position of the BirdWatch habitat optimisation model within the BirdWatch project.

Funded by the European Union

3. Designing BirdWatch habitat optimisation scenarios

3.1. Flanders (Belgium)

Flanders is one of the three regions in Belgium (Figure 2). With a size of 13522 km² and over 6.5 million inhabitants, there is a high pressure on land in Flanders. The surface area of agricultural land in the region of Flanders is however relatively stable (Vlaanderen, 2023). In 2022, the total area of agricultural land was around 6200 km², or 45% of the total surface area. This agricultural land is the habitat of a range of bird species that use the land as nesting and/or feeding grounds.

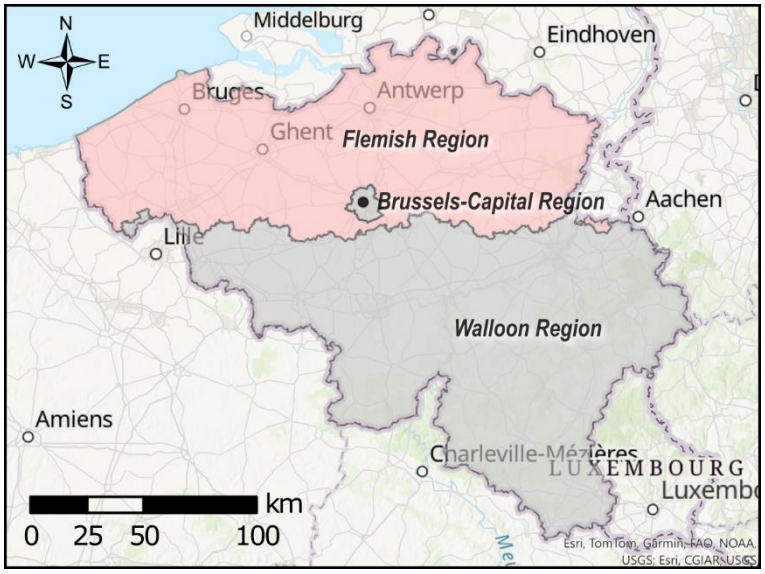

Figure 2 – Location of the three regions in Belgium: Flemish Region (red), Walloon Region and Brussels-Capital Region.

3.1.1. Farmland bird status for the species selected in BirdWatch in Flanders

The status of common farmland bird species is still significantly declining in Flanders (INBO, 2024). This is also the case for the majority of the bird species selected in BirdWatch, whose current population status and breeding population trends in Flanders were summarised by Vermeersch et al. (2020) (Table 1). Eight of the ten selected bird species were classified to be vulnerable or (critically) endangered in Flanders. Moreover, the population of six of these species has been decreasing further between 2007 and 2018, demonstrating the dire situation these species find

Funded by the European Union

themselves in. Special species protection programmes (*"Soortenbeschermingsprogramma's")* have been set up in Flanders with the aim of achieving a population recovery. Each species protection programme includes a number of protection measures for the endangered species that apply for a minimum of five years. Four of these species protection programmes have been set up to protect bird species selected in the BirdWatch project, i.e. the species protection programme for grassland specialists that focuses on the Black-tailed godwit (Vlaamse Regering, 2020a), the species protection programme for the European turtle dove (Vlaamse Regering, 2020b), the species protection programme for the Red-backed shrike (Vlaamse Regering, 2017), and the species protection programme for arable birds focussing on the Yellowhammer and Eurasian skylark (Vlaamse Regering, 2021). A number of instruments exist to realise the targets in these programmes, incl. agricultural management agreements[1], land- and nature design projects[2,3], subsidies for non-productive investments (NPI, part of VLIF)[4], subsidies for the protection of nests of grassland birds[5], project subsidies focussed on nature in general[6] and project subsidies focussed on specific species[7]. While some instruments can be implemented in any agricultural parcel (e.g. VLIF-NPI subsidies for planting a hedgerow), for others, the agricultural parcel needs to be located within a specific area in Flanders (e.g. management agreements focussed on the protection of species protection can only be made in *'management areas'*, where they contribute most to the Flemish objectives for biodiversity in agricultural areas).

[1] https://www.vlm.be/nl/themas/beheerovereenkomsten/Paginas/default.aspx
[2] https://www.vlm.be/nl/SiteCollectionDocuments/Landinrichting/Brochure%20landinrichting%20web.pdf
[3] https://www.vlm.be/nl/SiteCollectionDocuments/Natuurinrichting/Brochure_natuurinrichting.pdf
[4] https://lv.vlaanderen.be/subsidies/vlif-steun/niet-productieve-investeringssteun
[5] https://natuurenbos.vlaanderen.be/subsidies-en-projectoproepen/overige-subsidies/bescherming-nesten-en-jongen-broedvogels#toc-bedrag
[6] https://natuurenbos.vlaanderen.be/subsidies-en-projectoproepen/subsidiesprojectoproepen-inrichting-van-natuur/projectoproep-natuur
[7] https://natuurenbos.vlaanderen.be/sites/default/files/documenten/projectoproep-projectsubsidie-soorten-2023.pdf

Funded by
the European Union

Table 1 – Recent population estimates and trends of the BirdWatch species in Flanders.

Species	RL Flanders	POP-FL	ST-FL	LT-FL
Eurasian skylark *Alauda arvensis*	Vulnerable	6500-10.000	-35%	Decreasing
Meadow pipit *Anthus pratensis*	Endangered	2300-3400	-52%	Decreasing
Yellowhammer *Emberiza citrinella*	Least Concern	2800-4000	NS	Fluctuating
Red-backed shrike *Lanius collurio*	Endangered	38-65	+200%	Fluctuating
Black-tailed godwit *Limosa limosa*	Vulnerable	700-750	Decreasing	Decreasing
Eurasian tree sparrow *Passer montanus*	Endangered	10.000-20.000	-18%	Decreasing
Whinchat *Saxicola rubetra*	Critically Endangered	0-2	Fluctuating	Decreasing
European turtle dove *Streptopelia turtur*	Critically Endangered	<500	Decreasing	Decreasing
Common starling *Sturnus Vulgaris*	Least Concern	100.000-200.000	-36%	Decreasing
Northern lapwing *Vanellus vanellus*	Endangered	5000-15.000	-59%	Decreasing

RL Flanders: the Red List status of the species in Flanders based on Devos et al. (2016).
POP-FL: the minimum and maximum amount of breeding pairs in Flanders in the period 2013-2018 (Source: Vermeersch et al. (2020)).
ST-FL: the short-term trend (2007-2018) of the breeding population in Flanders. NS = Not significant (Source: Vermeersch et al. (2020)).
LT-FL: the long-term trend (1980-2018) of the breeding population in Flanders (Source: Vermeersch et al. (2020)).

3.1.2. Farmland bird conservation in Flanders

Black-tailed godwit (Limosa limosa)

The conservation of habitats for the Black-tailed godwit (*Limosa limosa*) is one of the targets of the species protection programme of the grassland specialist birds in Flanders (Vlaamse Regering, 2020a). The preservation of the existing habitat of the Black-tailed godwit, in terms of area and quality, is of great importance for the maintenance or development of a sustainable local population. Meadow birds have a high site fidelity and expansion of the population should therefore be initiated at the location of the remaining breeding sites. The current core areas where the Black-tailed godwit is present, and a surrounding network of satellite-areas that have the potential to make the population more robust, are delineated as focus areas for the Black-tailed godwit in the

species protection programme for meadow birds in Flanders. There are in total nine focus areas (Figure 3). The protection of the habitat for the Black-tailed godwit in Flanders must be ensured mainly by the conservation and restoration of a sufficiently large area and quality of the habitat of the Black-tailed godwit within the focus areas. For each of these focus areas, targets have been described related to increases in breeding pairs of the Black-tailed godwit (Table 2). The measures necessary to reach these targets differ per focus area and include grassland management, management of hydrology, landscape management and predation management. Assessing which measures are required per focus area is not yet clear and should be further examined. We assumed the proportion increase of breeding pairs is proportionate to the proportion increase of area with a high habitat suitability for the Black-tailed godwit.

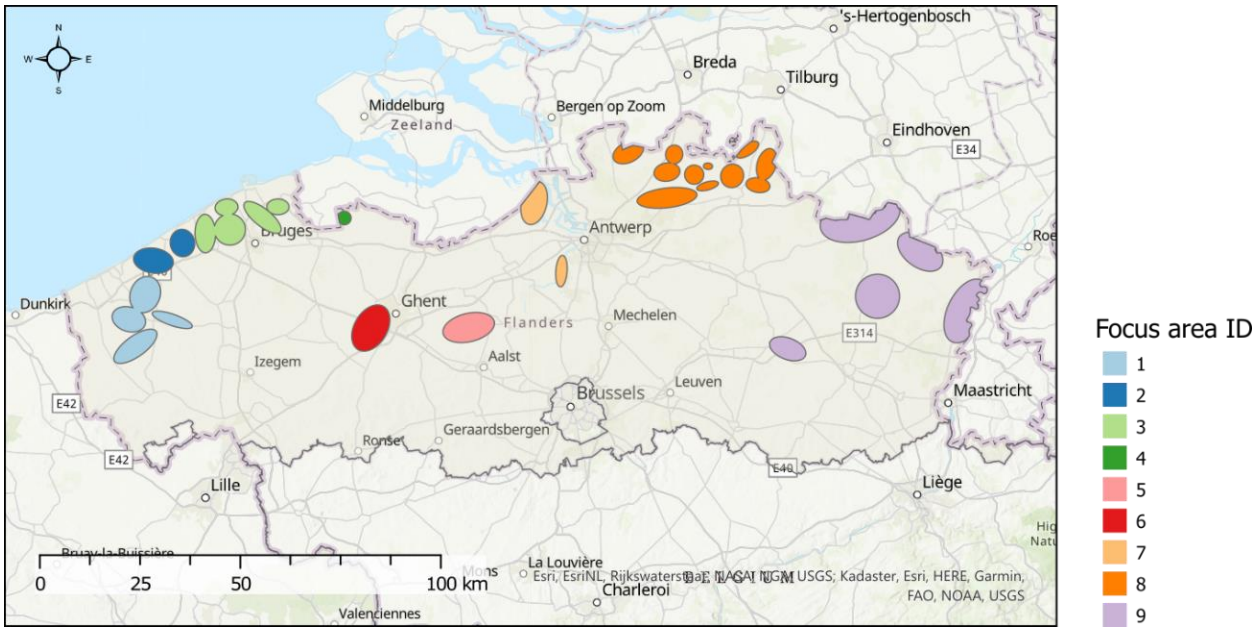

Figure 3 – Focus areas delineated in the species protection programme for grassland specialist bird species in Flanders.

Funded by the European Union

Table 2 – Targets for the Black-tailed godwit described in the species protection programme for grassland specialist bird species per focus area.

Focus area ID	Name	Starting number of breeding pairs	Target number of breeding pairs	Target proportion increase
1	IJzervallei	160	210	1.3
2	Middenkust	25	40	1.6
3	Oostkust	250	350	1.4
4	Krekengebied	10	40	4
5	Scheldevallei (Sigma)	40	50	1.3
6	Leievallei	8	20	2.5
7	Beneden-Zeeschelde	47	80	1.7
8	Antwerpse kempen	120	230	1.9
9	Limburg	15	70	4.7

Funded by
the European Union

Red-backed shrike (Lanius collurio)

In ten out of twelve focus areas delineated in the species protection programme for the Red-backed shrike (*Lanius collurio*), the target area of high habitat suitability for the Red-backed shrike must be at least 1250 km². This corresponds to an expansion of the area of high habitat suitability of 319-346 ha (Table 3). In the focus areas with ID 12 and 21, no expansion of highly suitable habitat is targeted.

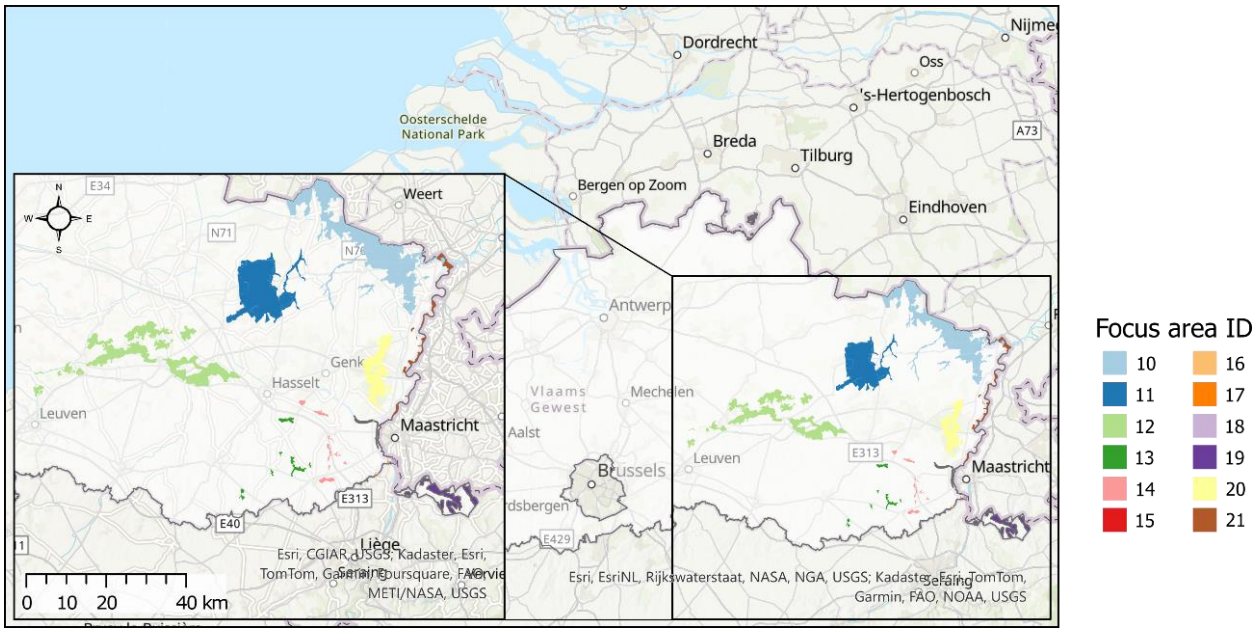

Figure 4 – Focus areas delineated in the species protection programme for the Red-backed shrike in Flanders.

The targeted surface area expansion of high habitat suitability area for the Red-backed shrike is described in Table 3.

Funded by the European Union

Table 3 – Targets for the Red-backed shrike described in the species protection programme for the Red-backed shrike per focus area.

Focus area ID	Name	Targeted surface area expansion (in hectares)
10	Hageven met Dommelvallei, Beverbeekse heide, Warmbeek en Wateringen (BE2200032); Abeek met aangrenzende moerasgebieden (BE220033); Itterbeek met Brand, Jagersborg en Schootsheide en Bererven (BE2200034); Hamonterheide, Hageven, Buitenheide, Stamprooierbroek en Mariahof (BE2221314)	121-131
11	Vallei- en brongebieden van de Zwarte Beek, Bolisserbeek en Dommel met heide en vengebieden (BE2200029); Militair domein en de vallei van de Zwarte Beek (BE2218311)	22
12	Demervallei (BE2400014 & BE2223316)	0
13	Bossen en kalkgraslanden van Haspengouw (BE2200038)	49-61
14	Jekervallei en bovenloop van de Demervallei (BE2200041)	20
15	Overgang Kempen-Haspengouw (BE2200042)	5-10
16	Plateau van Caestert met hellingbossen en mergelgrotten (BE1100036): Roosburg	13
17	Plateau van Caestert met hellingbossen en mergelgrotten (BE1100036): Tiendeberg	15
18	Plateau van Caestert met hellingbossen en mergelgrotten (BE1100036): Sint-Pietersberg	30
19	Voerstreek (BE2200039)	42
20	Mechelse heide en vallei van de Ziepbeek (BE2200035); Mechelse Heide en vallei van de Ziepbeek (BE2200727)	2
21	Uiterwaarden langs de Limburgse Maas met Vijverbroek (BE2200037)	0

Yellowhammer (Emberiza citrinella) & Eurasian skylark (Alauda arvensis)

In the species protection programme of arable birds (including *Emberiza citrinella* and *Alauda arvensis*), 85041 hectares of priority zones for the protection and recovery of arable birds were delineated (Figure 5). The described target within these priority zones is to maintain and create at least 7% highly suitable habitat for arable birds which corresponds to 5953 ha. It should still be assessed what the current surface area of highly suitable habitat for *Emberiza citrinella* and *Alauda arvensis* within these focus areas is to determine the target surface area for additional high-performance arable bird infrastructure.

Funded by the European Union

Figure 5 – Focus areas delineated in the species protection programme for arable birds in Flanders.

European turtle dove (Streptopelia turtur)

In Flanders, no regional conservation objectives (i.e. objectives to restore the population to a favourable population size) have been established for the European turtle dove *yet*. Therefore, a quantification of the targets for the species based on these objectives is not possible for the region of Flanders. The European plan of action for the European turtle dove (European Commission, Directorate-General for Environment, 2018) sets the stop of a further decline of the European population for the period 2018-2028, and the recovery of the European breeding bird population to a favourable population size for the period 2028-2038 as the objective. The current species action plan for the European turtle dove focuses on the stop of a further decline of the population. Once the population size is stable, Flanders aims to focus on the restoration of the breeding population to a favourable population size. The quantification of such a favourable population size is not obvious and has not yet been made concrete. Certain target requirements have however been described for 37 focus areas of the European turtle dove within Flanders (Figure 6):

- The expansion of breeding grounds should be located mainly in the 37 focus areas. This can be done by expansion and maintenance of the small landscape element network.
- The continuation of intensification of semi-natural feeding grounds should be avoided (e.g. the conversion of extensively managed grassland into arable land).

Funded by
the European Union

- Breeding grounds in the 37 focus areas should be protected. The following Natura 2000 habitat types have been described as important for the European turtle dove:
    - 6430: Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels;
    - 91E0: Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae), mainly type 91E0_sf and 91E0_va;
    - 9190: Old acidophilous oak woods with Quercus robur on sandy plains;
    - 2160: Dunes with Hippophae rhamnoides;
    - 2180: Wooded dunes of the Atlantic, Continental and Boreal regions.
- There should be at least one waterbody per square kilometre within the 37 focus areas. This water body should be within 300 m of nesting grounds.

Feeding grounds should be developed within 300 m of nesting grounds in the 37 focus areas with a minimum area of 2-3 ha per 100 ha agricultural land from mid-April to July.

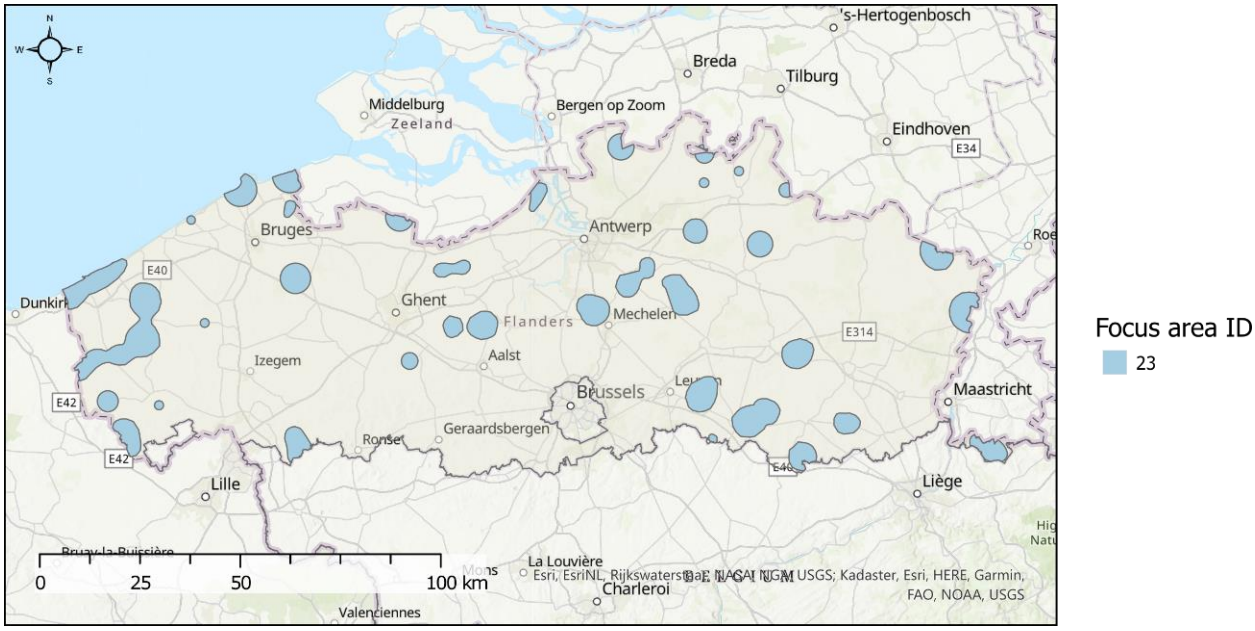

Figure 6 – Focus areas delineated in the species protection programme for the European turtle dove in Flanders.

Funded by the European Union

3.1.3. Potential measures to improve farmland biodiversity

To increase the likelihood of reaching the conservation targets, the habitat optimisation within the BirdWatch project will focus on measures farmers can take to increase biodiversity and for which they can request compensation. These compensations are often in the context of eco-schemes part of the 1st pillar of the CAP (incl. eco-schemes), measures subsidised through the European Agricultural Fund for Rural Development (EAFRD) (2nd pillar of the CAP), or measures for which the compensation is funded through local financing. These measures are still voluntary and the actual implementation is therefore strongly dependent on the willingness of the landowners. To assess the impact on the habitat suitability, it is necessary that the measures can be translated into a change in the explanatory variables used in the BirdWatch habitat suitability models.

Nest protection

Owners, tenants, or users of agricultural plots who have not yet mowed or harvested at least part of the plot at the place and time of the observation of a nest of specific bird species can ask for compensation when they agree to comply with measures taken to protect the nest and hatchlings (Agentschap Natuur & Bos, 2024). The Black-tailed godwit is the only bird species also included in the BirdWatch farmland bird species. The compensation that can be received is equal to €600 per hectare for the first mowing, and €500 per hectare for the next mowing(s). In order to receive the compensation, a number of conditions need to be met:

- Mowing of the parcel needs to be delayed until 1 June, or later if the nest is not yet hatched by 1 June;
- For parcels smaller than 1 ha, mowing is delayed on the entire parcel. For parcels larger than 1 ha, mowing is delayed on minimal 1 ha of the parcel;
- For fields that are not mowed but are grazed, either the entire field (for parcels smaller than 1 ha) or a zone of 1 ha around the nest (for parcels larger than 1 ha) are fenced off with an electrical fence.

The first mowing activity variable will be used as a proxy to distinguish between parcels on which mowing is (partly) delayed until after 1 June and parcels on which mowing is not delayed. This will enable us to assess the impact nest protection has on the habitat suitability of the ten considered species. It should however be noted that the habitat suitability models are developed at 200 m by 200 m spatial resolution, meaning that the area of one pixel is larger than the area on which delayed mowing should be implemented. Therefore, there is a possibility that the exact impact of the intervention is not correctly assessed.

Funded by
the European Union

Management agreements

Farmers can conclude a management agreement for (parts of) their parcel with the Flemish land agency (VLM). These management agreements are part of the Common Agricultural Policy (CAP) (VLM, 2021). On these parcels, the farmer implements management measures for 5 years that improve the agricultural biodiversity. Farmers who conclude a management agreement receive compensation. These measures are compensated for through both European and Flemish resources. The compensation is dependent on the type of measure and the area on the parcel to which the management agreement applies (Table 4).

Table 4 – Compensation rates for management agreements in Flanders that could impact farmland birds.

Target	Agreement type	Compensation	Source
Species protection	Fauna arable land	2248 - 2349 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/fauna_akker.pdf
	Fauna arable land - alfalfa	2072 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/fauna_akker_luzerne.pdf
	Fauna arable land - crop rotation	2248 - 2349 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/fauna_akker_wisselteelt.pdf
	Fauna edge	2444 - 2644 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/faunarand.pdf
	Fauna grassland	754 - 1220 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/faunagrasland.pdf
	Fauna food crop	2053 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/faunavoedselgewas.pdf
	Fauna food crop - crop rotation	2053 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/faunavoedselgewas_wisselteelt.pdf

Funded by the European Union

Target	Agreement type	Compensation	Source
Species protection	Alfalfa meadow	2094 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/luzernehooiland.pdf
	Development botanical grassland	432 - 1225 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/botanisch_grasland_ontwikkelen.pdf
	Maintenance botanical grassland	1406 - 1593 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/botanisch_grasland_instandhouden.pdf
Buffering and connecting	Field edge	1231 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/akkerrand.pdf
	Flower field	1998 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/bloemenakker.pdf
	Flower field functional agrobiodiversity	1998 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/bloemenakker%20FAB.pdf
	Flower field European turtle dove	1998 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/bloemenakker%20zomertortel.pdf
	Herbaceous field edge	1536 - 2058 €/ha/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/kruidenrijkeakkerstrook.pdf
Small landscape elements	Annual pruning	1.95 €/m/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/KLE_jaarlijks_snoeien.pdf
	Pollarding	8.51 €/tree/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/KLE_knotten.pdf
	Cutting back	1827 - 2882 €/ha/year or 0.84 - 1.33 €/m/year	https://www.vlm.be/nl/SiteCollectionDocuments/Beheerovereenkomsten/Infofiches%20BO%20vanaf%202023/Opgemaakte%20fiches/KLE_afzetten_terugsnoeien.pdf

Funded by the European Union

Non-productive investments (VLIF-NPI)

Subsidies for non-productive investments are available to agricultural companies in Flanders (Agentschap Landbouw & Zeevisserij, 2024a). These investments need to contribute to one or multiple of the following targets:

- Improvement of biodiversity;
- Habitat protection;
- Erosion reduction;
- Improvement of soil quality;
- Improvement of water management;
- Improvement of water quality;
- Development of landscape;
- Integration of farming constructions in the landscape.

Farmers can request subsidies for a specific project. The selection of projects that will be subsidised is made based on a sustainability score per individual investment request. The investments are subsidised 50%, 75%, or 100%, depending on the extent to which the investment is also productive. In contrast to the support farmers receive when a management agreement is made for a specific parcel, the investment support is a one-time type of support.

The subsidy rate for non-productive investments that could impact farmland birds and for which there is a flat-rate cost is given in Table 5. Most investments that could impact farmland birds target the development of the landscape through the implementation of small landscape elements (vegetative elements and farm ponds). A distinction is made between different types of linear vegetation that are grown typically along a field edge. A hedge is composed out of shrubs that are being pruned regularly ("*haag"*). They typically have a height below 3 m (PCFruit, 2009). Other hedges (that are not being pruned intensively) (*"heg"*) are also composed out of shrubs. These are however typically wider and higher (below 4 m) and get a chance to flower. Woody edges *("houtkant"*) are composed out of shrubs and trees and are even wider and higher with a maximal height of 30 m.

Funded by
the European Union

Table 5 – Support Farmers can apply for in Flanders for non-productive agricultural investments (Source: Agentschap Landbouw & Zeevisserij (2024b)).

Target	Investment type	Support	Support coverage
Development of the landscape	Tree row (indigenous trees)	95 €/tree	100%
	Tree row (trees typical for region)	86 €/tree	100%
	Hedge (indigenous plants)	4.68 €/m	100%
	Hedge (plants typical for region)	3.97 €/m	100%
	Hedge, pruned regularly (indigenous plants)	12.75 €/m	100%
	Hedge, pruned regularly (plants typical for region)	11.34 €/m	100%
	Woody edge (indigenous plants)	1.98 €/m²	100%
	Woody edge (plants typical for region)	1.79 €/m²	100%
	Farm pond with protection against cattle (≥ 50 m²)	28.34 €/m²	100%
	Farm pond (≥ 50 m²)	26.92 €/m²	100%
	Shrubs within parcel (indigenous plants)	1.98 €/m²	100%
	Shrubs within parcel (plants typical for region)	1.79 €/m²	100%
	Solitary tree (indigenous plants)	95 €/tree	100%
	Solitary tree (tree typical for region)	86 €/tree	100%
	Wetland creation	2.6 €/m²	100%
Water management	Buffer and storage basin (ecologically designed)	10785.8 €/m³	75%

[a] Conditions and requirements for the non-productive investment support for small landscape elements and farm ponds are described in Departement Landbouw & Visserij (2024a).
[b] Conditions and requirements for the non-productive investment support for water storage are described in Departement Landbouw & Visserij (2024b).

3.1.4. Description of the optimisation scenarios

Current situation (AS IS)

The current state of the habitat of the ten BirdWatch species will be assessed using the habitat suitability developed in the context of the BirdWatch project. To build these models, land management and land use-related variables will be derived from publicly available datasets such as the agricultural parcel map (ALV, 2019), while others will be derived from remote sensing data such as Sentinel-2, a product of the Copernicus Programme by the European Space Agency (ESA) and the European Union (EU). These variables will be derived for the year 2018, as they serve as input for the habitat suitability model that uses bird observation data from 2018 for the region of Flanders.

Funded by the European Union

Based on the land use and land management of 2018, the current status of the habitat suitability of the BirdWatch species will be assessed at parcel level in Flanders. Here, we will also consider management agreements concluded between farmers and the VLM that were active in 2018. As habitat suitability is a continuous index, a threshold should be set to define which parcels are suitable for each of the ten BirdWatch bird species, and which ones are not in order to assess the area of suitable habitat. This threshold is here set at 0.66 after Lauver et al. (2002), above which the parcel is considered to be suitable.

Species protection programme scenario

This scenario addresses the targets set for the Black-tailed godwit, the Red-backed shrike, the Yellowhammer and Eurasian skylark, and the European turtle dove in the species protection programme of the grassland specialist bird species (Vlaamse Regering, 2020a), of the Red-backed shrike (Vlaamse Regering, 2017), of the arable birds (Vlaamse Regering, 2021) and of the European turtle dove (Vlaamse Regering, 2020b) respectively. In each programme, focus areas have been delineated in which Flanders is concentrating their efforts on the protection and conservation of these species (Figure 3, Figure 4, Figure 5 and Figure 6). As the focus areas partly overlap (Figure 7), the land use will be optimised simultaneously to achieve the targets described in the four species protection programmes using different constraints per species. A suggestion will be made on how to adjust the land cover type and land management in the 23 focus areas to maximise the habitat suitability associated with the Black-tailed godwit, Red-backed shrike, Yellowhammer, Eurasian skylark and European turtle dove. The adjustments that will be suggested correspond to conservation measures for which farmers are compensated in Flanders (Table 4 and Table 5). To assess the impact on the habitat suitability, it is necessary that the measures can be translated into a change in the explanatory variables used in the BirdWatch habitat suitability models. Therefore, only these measures for which this translation is possible will be considered.

The optimal way to assign the conservation measures to the agricultural parcels can be defined by several optimisation objectives (e.g. maximise the area of a specific land use type, minimise the profit loss the farmer will be faced with or minimise the subsidy cost related to the implementation of the conservation measures). In the *species protection programme scenario*, the total compensation cost associated with the conservation measures will be minimised.

The targets set for the Black-tailed godwit are set in the species protection programme of the grassland specialist bird species in Flanders (Vlaamse Regering, 2020a). It focuses on the nine focus areas delineated for the protection of the Black-tailed godwit (Figure 3). These nine areas have a combined surface area of 1273 km². For each focus area, the habitat optimisation model will aim to

Funded by
the European Union

increase the surface area of the habitat suitable for the Black-tailed godwit by a target set for the corresponding focus area (Table 2). The current surface area of habitat suitable for the Black-tailed godwit (i.e. the surface area characterised by a habitat suitability above 0.66) is a result of the AS-IS scenario. This surface area within the nine focus areas will be multiplied with the target proportion increase (Table 2) to calculate the target surface area of suitable habitat additionally required. The sum of the surface area of the existing (AS-IS) and additionally required highly suitable habitat will be used as an optimisation constraint as described by Eq. 6 in Deliverable 5.1. The habitat optimisation model will assess the optimal way to achieve this increase in habitat suitability. A suggestion will be made on how to adjust the land use type in the nine focus areas in order to increase the habitat suitability associated with the Black-tailed godwit in an optimal way, i.e., with a minimal compensation cost.

The conservation targets set for the Red-backed shrike are described in the species protection programme focusing on this species (Vlaamse Regering, 2017). The programme focuses on the protection and restoration of habitats for the Red-backed shrike in 12 focus areas (Figure 4) with a combined surface area of 408 km². The 12 focus areas are mainly situated in the Campine region of Flanders, but also in the loam, sandy loam, sandy and meadow region (VLM, 2014). For 10 of the 12 focus areas, the habitat optimisation model will aim to increase the surface area of the habitat suitable for the Red-backed shrike by a target set for the corresponding focus area (Table 3). For focus areas with ID 12 and 21, no expansion of highly suitable habitat is targeted. As a constraint for the habitat optimisation model, a 'no decrease' of the surface area of highly suitable habitat will be targeted within these two focus areas. Contrary to the targets set for the Black-tailed godwit, the habitat targets for the Red-backed shrike are expressed in the absolute surface area of additional required habitat. The threshold for habitat suitability is again set at 0.66 above which a parcel is considered highly suitable for the Red-backed shrike. The sum of the surface area of the existing (AS-IS) and additionally required highly suitable habitat for the Red-backed shrike will be used as an optimisation constraint as described by Eq. 6 in Deliverable 5.1. The habitat optimisation model will assess the optimal way to achieve this increase in habitat suitability. A suggestion will be made on how to adjust the land use type in the 12 focus areas to increase the habitat suitability associated with the Red-backed shrike optimally, i.e., with a minimal compensation cost.

The species protection programme of arable birds in Flanders describes the conservation targets of several birds, including the Yellowhammer and Eurasian skylark. The programme focuses on 850 km² of priority zones (Figure 5), mainly located in the loam and sandy loam region of Flanders (VLM, 2014). The set target within these priority zones is to maintain and create suitable habitat for arable birds on at least 7% (i.e. 59.53 km²) of their surface area, with no specific goals set per individual zone. Therefore, in the habitat optimisation, no restrictions will be put on the desired distribution of the 59.53 km² highly suitable habitat within the focus areas of arable birds. For each parcel and conservation measure, the associated habitat suitability of the Yellowhammer and

Funded by
the European Union

Eurasian skylark will be calculated. If the average habitat suitability is above 0.66 (i.e. the selected threshold above which a parcel is considered to be highly suitable), the parcel is assumed to be suitable for both the Yellowhammer and Eurasian skylark. The sum of existing (AS-IS) and additionally required highly suitable habitat for the Yellowhammer and Eurasian skylark will be used as an optimisation constraint as described by Eq. 6 in Deliverable 5.1.

Finally, the requirements of the European turtle dove will also be taken into account in the *species protection programme scenario*. The species protection programme of the European turtle dove delineates focus areas in which conservation efforts should be concentrated (Figure 6). These focus areas have a surface area of 1250 km². The programme did not set specific targets for the extent of the suitable habitat within these zones. However, in accordance with the European plan of action for the European turtle dove, the Flemish species protection programme aims to stop the further decline of the population and to restore the breeding population to a favourable population size. Further, the programme describes some characteristics of habitats in Flanders that are suitable for the European turtle dove (Vlaamse Regering, 2020b). Thirty percent of the focus areas delineated for the European turtle dove overlap with focus zones for the Black-tailed godwit, the Red-backed shrike and arable birds considered in this scenario (Figure 7). Therefore, there is a risk that conservation efforts for other species may deteriorate the habitat of the European turtle dove in case of contradicting habitat requirements. To avoid this, a number of constraints will be used to ensure quality of the habitat of the European turtle dove in its focus zones. First, there will be a restriction added in the habitat optimisation model to ensure the overall habitat suitability does not deteriorate by setting the maximal deterioration for the European turtle dove at zero in Eq. 7 in Deliverable 5.1. Further, to avoid the removal of elements and land use types favoured by the European turtle dove, the following restrictions will be set within the focus areas of the European turtle dove, regardless of their potential favourable impact on other species:

- Hedgerows cannot be removed;
- Extensive grassland cannot be converted into arable land;
- Waterbodies cannot be removed.

The *species protection programme scenario* will result in a configuration of conservation measures that minimises the compensation cost that can be requested for these measures in the context of nest protection, a management agreement or through VLIF-NPI while achieving the targets set in the species protection programmes.

Funded by
the European Union

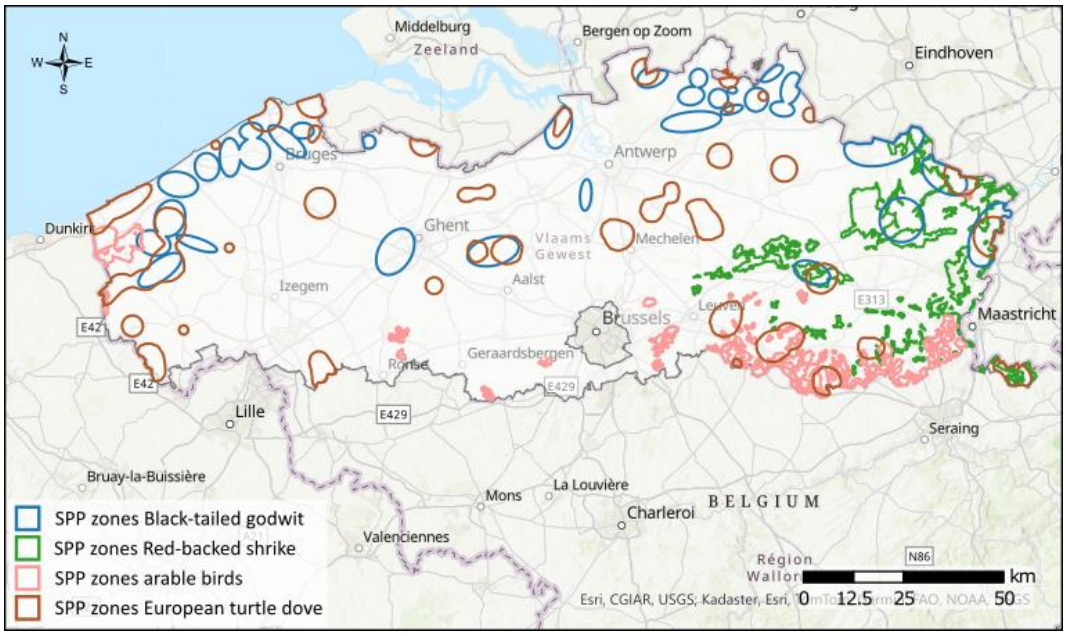

Figure 7 – Illustration of the location and overlap of the focus areas of the four species protection programmes in Flanders.

Budget-constraint scenario

Besides the *species protection programme scenario*, a *budget-constraint scenario* will be developed. In this scenario, the same conservation measures will be considered, i.e. the measures for which compensation can be requested in the context of nest protection, a management agreement (Table 4) or through VLIF-NPI (Table 5). Only these measures for which a translation into a change in the explanatory variables used in the BirdWatch habitat suitability models is possible will be considered. The implementation of these measures will not be limited to focus areas delineated in the species protection programmes but can be assigned to agricultural parcels in the whole of Flanders. The type and location of the conservation measures will be selected in such a way that the sum of the habitat suitability of the species considered in the *species protection programme scenario* (i.e. Black-tailed godwit, Red-backed shrike, Yellowhammer, Eurasian skylark and European turtle dove) is maximised (Eq. 1 in Deliverable 5.1). The surface area of parcels on which conservation measures are suggested by the habitat optimisation model will be limited by the budget available to compensate for the measures (Eq. 5 in Deliverable 5.1). The available budget will be set at the minimal budget needed to meet the constraints set in the *species protection programme scenario*. To ensure one or more of the selected species are not favoured at the expense of another considered species, the maximal allowed deterioration for all 10 BirdWatch target species will be

Funded by
the European Union

set at zero (Eq. 7 in Deliverable 5.1).

The *budget-constraint scenario* will result in a configuration of conservation measures that maximises the habitat suitability in agricultural parcels for the species for which a species protection programme was set up in Flanders. By considering the same budget as required to meet the conservation targets in the *species protection programme scenario*, an evaluation of the effectiveness of predefining the zones in which conservation efforts should be concentrated will be possible.

Funded by
the European Union

3.2. Germany

3.2.1. Farmland bird status for the species selected in BirdWatch in Germany

Over the period 1990-2018, farmland birds exhibited a strong decline in Germany (Kamp *et al.*, 2021). This has been proven to be especially true for ground-nesting birds. A potential explanation for this decrease could be the recultivation of abandoned land, accompanied by an increase in management intensity, that could be seen from the mid-1990s onwards (Kamp *et al.*, 2021). The decline in farmland birds in Germany can also be observed for the species selected in the BirdWatch project (Table 6). Recent estimates of the sizes of the population of the BirdWatch bird species in Germany and its trends were summarised in the Bird Protection Report of 2019 (BfN, 2019). Their Red List status was derived from NABU (2024). Seven of the ten selected bird species were classified to be vulnerable or (critically) endangered in Germany, i.e. Eurasian skylark, Meadow pipit, Black-tailed godwit, Whinchat, European turtle dove, Common starling and Northern lapwing. The population of all seven of these species has further been declining between 2004 and 2016. Further, also the population size of the Yellowhammer has been declining between 2004 and 2016. Conservation measures have been implemented before but are thus not effective enough to halt the continued deterioration. This demonstrates that additional conservation efforts are essential to improve the status of farmland birds in Germany.

Funded by
the European Union

Table 6 – Recent population estimates and trends of the BirdWatch species in Germany.

Species	RL Germany	POP-DE	ST-DE	LT-DE
Eurasian skylark *Alauda arvensis*	Vulnerable	1.200.000-1.850.000	-14%/-7%	-55%
Meadow pipit *Anthus pratensis*	Endangered	36.000-57.000	-31%/+6%	-79%
Yellowhammer *Emberiza citrinella*	Least Concern	1.100.000-1.650.000	-18%/-10%	-17%
Red-backed shrike *Lanius collurio*	Least Concern	84.000-150.000	-8%	+2%
Black-tailed godwit *Limosa limosa*	Critically Endangered	3600-3800	-43%	-78%
Eurasian tree sparrow *Passer montanus*	Near Threatened	840.000-1.250.000	+5%	-41%
Whinchat *Saxicola rubetra*	Endangered	19.500-35.000	-52%/-28%	-57%
European turtle dove *Streptopelia turtur*	Endangered	12.500-22.000	-70%/-51%	-89%
Common starling *Sturnus vulgaris*	Vulnerable	2.600.000-3.600.000	-22%/-7%	-55%
Northern lapwing *Vanellus vanellus*	Endangered	42.000-67.000	-50%/-31%	-93%

RL Germany: the Red List status of the species in Germany. Source: https://www.nabu.de/tiere-und-pflanzen/voegel/portraets/

POP-DE: the minimum and maximum amount of breeding pairs in Germany in 2016 (except *Limosa Limosa* for which population size was assessed between 2012-2016).

ST-DE: the short-term trend (2004-2016) of the breeding population in Germany.

LT-DE: the long-term trend (1980-2016) of the breeding population in Germany.

Funded by the European Union

3.2.2. Farmland bird conservation in Germany

In Germany, species management plans are determined on federal state level. No national-level management plans are in place for the BirdWatch species and, to our knowledge, no bundled collection of information on species programs in the individual federal states exists. Here, we rely on conservation measures, which have been summarised in the Bird Protection Report of 2019 (BfN, 2019).

Eurasian skylark

A number of measures have been taken in Germany tailored to the needs of the Eurasian skylark in Germany. These measures include:

- Fencing off the breeding grounds of the Eurasian skylark during the breeding season;
- Delayed mowing until after the breeding season;
- The reduction of pesticide use;
- The creation of a bare strip (*"Lerchenfenster"*) (Figure 8);
- Flower strips and fallow land as part of greening and agricultural support programmes (European Agricultural Fund for Rural Development (EAFRD), agri-environmental measures, contractual nature conservation of arable habitats);
- Regional cooperation project 'Wiesenzeiten';
- Upgrading of agricultural or fallow land for the skylark as part of compensation measures for loss of habitat due to development;
- Regional small game project of the hunting association.

Funded by
the European Union

Figure 8 – A bare strip ("Lerchenfenster") that can be used as a landing place for the Eurasian skylark.
Picture obtained from https://www.landwirtschaftskammer.de/landwirtschaft/naturschutz/biodiversitaet/lerchenfenster

Red-backed shrike

The conservation measures that have been taken to protect the Red-backed shrike in Germany aim to tackle the main risks the Red-backed shrike is faced with (BfN, 2019). The importance of addressing these risks was ranked as 'high importance' or 'medium importance' (Table 7).

Table 7 – Main hazards the Red-backed shrike is faced with in Germany.

Hazard	**Importance of addressing**
Removal of small landscape elements (hedges, stone walls, creeks, open ditches, springs, individual trees…)	High
Conversion to another type of agricultural land use (excl. drainage and burning)	Medium
Conversion from mixed farming system (arable farming and livestock) and agroforestry to specialised production (e.g. monoculture)	Medium
Change in species composition through natural succession	Medium
Accumulation of organic material	Medium
Natural eutrophication and acidification	Medium

Funded by the European Union

A number of conservation measures have been identified and taken to halt the deterioration of the status of the Red-backed shrike in Germany:

- Prevention of the conversion of natural and semi-natural habitats in agricultural areas;
- Restoration of small landscape elements in the agricultural landscape;
- Maintaining existing extensive agricultural practices and preserving agricultural landscape elements;
- Reintroduction of appropriate agricultural practices to counteract abandonment, incl. mowing, grazing, burning or similar measures;
- Adaptation of mowing, grazing or other comparable measures (to the respective habitat);
- Regulation of the use of natural fertilisers and chemicals in agricultural production;
- Adaptation/ maintenance of military activities;
- Habitat management to slow down, stop or reverse natural processes;
- Strengthening populations of species listed in the conservation guidelines;
- Habitat improvement for species listed in the nature conservation guidelines;

Two examples of conservation measures that have been taken are given in the Bird Protection Report of 2019 (BfN, 2019). In Saxony, the habitat of the Red-backed shrike has been improved through (1) the creation and management of hedges, (2) the creation and restoration of orchards and rows of fruit trees, (3) planting of individual trees, (4) restoration of field margins, forest edges and stone walls, and (5) the maintenance of open heathland, former mining landscapes and former military training areas. In North Rhine-Westphalia, efforts that have been taken to improve the habitat of the Red-backed shrike include (1) the conservation and maintenance of hedges, and (2) the establishment of grazing on grassland.

Black-tailed godwit

Despite the existence of an international species action plan for the Black-tailed godwit and the species being critically endangered in Germany, there is no national species action plan for this species. A continued deterioration of the Black-tailed godwit can be observed in terms of the planned targets described in the international species action plan. A number of conservation measures have been taken to protect the Black-tailed godwit in Germany, aiming to tackle the main risks the Black-tailed godwit is being faced with (BfN, 2019). The importance of addressing these risks was ranked as ‘high importance’ or ‘medium importance’ (Table 8).

Funded by
the European Union

Table 8 – Main hazards the Black-tailed godwit is faced with in Germany.

Hazard	Importance of addressing
Conversion to another type of agricultural land use (excl. drainage and burning)	High
Conversion from mixed farming system (arable farming and livestock) and agroforestry to specialised production (e.g. monoculture)	High
Drainage of agricultural land	High
Problematic native plant and animal species	High
Grassland management (cessation of grazing or mowing)	Medium
Mowing grassland	Medium
Intensive grazing or overgrazing (by livestock)	Medium

A number of conservation measures have been identified and taken to increase the population size and/or improve the population dynamics of the Black-tailed godwit in Germany:

- Restoration of small landscape elements in the agricultural landscape;
- Maintaining existing extensive agricultural practices and preserving agricultural landscape elements;
- Reintroduction of appropriate agricultural practices to counteract abandonment (incl. mowing, grazing, burning or similar measures);
- Adaptation of mowing, grazing or other comparable measures (to the respective habitat);
- Regulation of drainage, irrigation and infrastructure in agriculture;
- Adaptation/regulation of the construction and operation of renewable energy systems;
- Reduction of the impact of (re-)stocking for fishing and hunting, supplementary feeding and regulation of predators;
- Regulation of problematic native species;
- Other measures with regard to problematic species;
- Restoration of habitats affected by hydrological changes for various purposes.

The extent of the effectiveness of these conservation measures is however unclear and will require more research. While the restoration and preservation of small landscape elements in agricultural areas are for example listed as a possible conservation measure for the Black-tailed godwit, these elements potentially negatively impact this species. The presence of shrub and tree species in open landscapes is believed to have an adverse impact on ground-nesting meadow birds like the black-

tailed godwit who use these open landscapes as breeding areas (Verhulst *et al.*, 2004; Sanderson *et al.*, 2013; Leito *et al.*, 2014; Kamp *et al.*, 2018).

Some examples of conservation measures that have been taken are given in the Bird Protection Report of 2019 (BfN, 2019). In Brandenburg and North Rhine-Westphalia, efforts have been taken to protect nests and young birds. In Lower Saxony, the LIFE+ project 'Wiesenvogel'[8] was carried out between 2011 and 2022, which targeted the conservation of the Black-tailed godwit. In Schleswig-Holstein, the EU-LIFE project 'LIMOSA' was carried out between 2012-2022 by the Michael Otto Institute in NABU and the Schleswig-Holstein Nature Conservation Foundation[9]. In Mecklenburg-Western Pomerania, an improvement of the habitat was attempted through compensation measures as part of the construction of the Nordstream 2 natural gas pipeline. In Hesse, a species assistance concept for the Black-tailed godwit was developed. However, the species is extinct there now. The species is also currently extinct as a breeding bird in Saxony-Anhalt, and measures to restore suitable habitats have not yet been sufficient.

Other measures include the EU LIFE project ‘Meadow birds’, the promotion of breeding habitats through a regional wet meadow protection programme, Contract nature conservation, and protection of nests as part of the ‘Community meadow bird protection’

Despite the species action plan (SAP) that exists for the Black-tailed godwit, there is a continued deterioration in terms of the planned targets.

Whinchat

The conservation measures that have been taken to protect the Whinchat in Germany aim to tackle the main risks the species is faced with. The importance of addressing these risks was ranked as ‘high importance’ or ‘medium importance’ (Table 9).

[8] http://www.wiesenvoegel-life.de/das-life-projekt.html

[9] https://bergenhusen.nabu.de/forschung/life-limosa/index.html; https://www.wo-ist- greta.de/was/gretas-helfer/life-limosa/

Funded by
the European Union

Table 9 – Main hazards the Whinchat is faced with in Germany.

Hazard	Importance of addressing
Conversion to another type of agricultural land use (excl. drainage and burning)	High
Conversion from mixed farming system (arable farming and livestock) and agroforestry to specialised production (e.g. monoculture)	High
Mowing grassland	High
Removal of small landscape elements to clear up parcels (hedges, stone walls, creeks, open ditches, springs, individual trees…)	Medium
Grassland management (cessation of grazing or mowing)	Medium
Intensive grazing or overgrazing by livestock	Medium
Application of synthetic (mineral) fertilisers to agricultural land	Medium
Application of chemical pesticides in agriculture	Medium
Agricultural activities that cause air pollution	Medium
Change in species composition through natural succession (except direct change through changes in agricultural or forestry practices)	Medium
Removal of small landscape elements to clear up parcels (hedges, stone walls, creeks, open ditches, springs, individual trees…)	Medium

A number of conservation measures have been identified and taken in Germany. Their main purpose is to maintain the current range, population and/or habitat of the whinchat. These measures include:

- Prevention of the conversion of natural and semi-natural habitats in agricultural areas;
- Restoration of small landscape elements in the agricultural landscape;
- Maintaining existing extensive agricultural practices and preserving agricultural landscape elements;
- Reintroduction of appropriate agricultural practices to counteract abandonment, incl. mowing, grazing, burning or similar measures;
- Adaptation of mowing, grazing or other comparable measures (to the respective habitat);
- Avoiding to mow, graze and other comparable measures;
- Regulation of the use of natural fertilisers and chemicals in agricultural production;
- Other agricultural measures;
- Habitat management to slow down, stop or reverse natural processes;
- Habitat improvement for species listed in the nature conservation guidelines.

Funded by
the European Union

Specific examples of conservation measures taken were listed in the Bird Protection Report of 2019 (BfN, 2019). In Berlin, the natural succession on fallow land was reduced. In Saxony, the habitat of the Whinchat was improved by opening up heathland in the post-mining landscape and former military training areas. This was done by removal of bushes and trees and restoring the biotope through mowing. A new biotope network was established by (1) the creation and restoration of hedges, (2) the restoration of rows of fruit trees, field margins, timber strips and forest edges, (3) the restoration of stone ridges, and (4) the implementation of conservation measures as part of grazing projects and agricultural projects without the use of pesticides. In Hesse, a species support programme *'Braunkehlchen'* for whinchats was developed. In Schleswig-Holstein, research is currently being done as part of the project *'Braunkehlchen in Schleswig-Holstein'* carried out by the Michael Otto Institute at NABU. The intention of this project is the development of a nationwide protection programme for the Whinchat[10]. In Saxony-Anhalt, the measures that are currently being taken are not sufficient to stop and reverse the sharp decline of the Whinchat. To ensure a favourable conservation status of the species, the timely implementation of a set of agri-environmental measures and intensive area control in coordination with farmers are necessary.

European turtle dove

There is no national management plan in place for the European turtle dove in Germany. However, a number of conservation measures have been implemented in Germany, which have been summarised in the Bird Protection Report of 2019 (BfN, 2019). These include (1) a programme for cultural landscape elements, (2) the conservation of landscape elements, (3) the promotion of extensive agriculture, and (4) avoiding the use of fertilisers and pesticides. Despite these actions, a continued deterioration of the species has been observed.

Northern lapwing

The Northern lapwing has shown the steepest decline in the period 1980-2016 of all ten bird species (Table 6). This decline can also be seen if looking at the short-term population dynamics. The main reasons for this decline are insufficient breeding success due to habitat deterioration and loss of wet grassland, the conversion from summer to winter cereals, the reduction in fallow land and the increase in maize cultivation (Böhner et al., 2023). However, there are no national management plans

[10] https://bergenhusen.nabu.de/forschung/braunkehlchen/index.html

Funded by the European Union

for the Northern lapwing in Germany. However, since 2014, NABU's nationwide working group on lapwing protection has been in the process of creating a lapwing protection network that will expand the necessary measures and structures and advise the specialist authorities at the federal, state and local levels. Between 2014 – 2020 NABU carried out the project "Der Sympathieträger Kiebitz als Botschafter: Umsetzung eines Artenschutz-Projektes zur Förderung des Kiebitzes in der Agrarlandschaft" ("The popular lapwing as an ambassador: implementation of a species conservation project to promote the lapwing in the agricultural landscape") as part of the Federal Programme for Biological Diversity (NABU, 2024). The project has resulted in the formulation of the requirements for Northern lapwing protection in Germany (Cimiotti et al., 2022):

- In general, it is preferred that Lapwing plots are created on fields where the Northern lapwing already occurs;
- In grasslands and protected areas, a mosaic of wet and dry as well as low- and higher-growing areas within an open, treeless landscape should be created;
- Water management should be implemented in Lapwing breeding areas;
- Hot-spots of breeding success (i.e. small optimal habitats that meet all requirements for successfully breeding Lapwings (incl. fencing off areas to prevent ground predators such as Red Foxes)) should be implemented to maintain a sufficiently high breeding success. These lapwing islands are an unused area within a field with a size of 0.5-1 ha

In order to stabilise the Northern lapwing population in Germany, 40% of the population should be protected by a measure such as 'lapwing islands' by 2023 (Böhner et al., 2023). To achieve a population increase of 30% as proposed by the EU Commission (EU COM/2022/304), as much as 65% must be protected. Depending on the objective and intensity of the area management, the annual area requirement for lapwing islands should be between 900 ha and 5600 ha with assumed conservation costs between €1.2 million and €2.6 million per year (Böhner et al., 2023).

The measures needed to fulfill these requirements can be funded through different funding schemes (Cimiotti et al., 2022). The implementation of "eco-schemes" of the new CAP from 2023 onwards would meet the requirements of the farmers as well as those of the Lapwings (e. g. by annual flexibility). Other instruments include 2nd pillar funding, regional projects together with farmers, contractual nature conservation programmes, land purchase or the management of protected areas.

Some conservation measures have already been taken to protect the Northern lapwing in Germany (BfN, 2019). These measures aim to tackle the main risks the species is faced with. The importance of addressing these risks was ranked as 'high importance' or 'medium importance' (Table 10).

Funded by
the European Union

Table 10 – Main hazards the Northern lapwing is faced with in Germany.

Hazard	Importance of addressing
Conversion to another type of agricultural land use (excl. drainage and burning)	High
Agricultural tillage (e.g. ploughing)	High
Drainage of agricultural land	High
Problematic native plant and animal species	High
Grassland management (cessation of grazing or mowing)	Medium
Mowing grassland	Medium
Intensive grazing or overgrazing (by livestock)	Medium
Application of chemical pesticides in agriculture	Medium
Modification of hydrological flow conditions or physical changes to watercourses for agricultural purposes (excl. development and operation of dams)	Medium
Hunting of Northern lapwing	Medium

A number of conservation measures are in place for the Northern lapwing in Germany. Their main purpose is to increase the population size and/or improve the population dynamics. These measures include:

- Restoration of small landscape elements in the agricultural landscape;
- Maintaining existing extensive agricultural practices and preserving agricultural landscape elements;
- Adaptation of mowing, grazing or other comparable measures (to the respective habitat);
- Adaptation of agricultural land;
- Regulation of drainage, irrigation and infrastructure on agricultural land;
- Reduction of the impact of (re-)stocking for fishing and hunting, supplementary feeding and regulation of predators;
- Restoration of habitats affected by hydrological changes for various purposes;
- Habitat management to slow down, stop or reverse natural processes;
- Habitat improvement for species listed in the nature conservation guidelines.

Funded by the European Union

Other conservation measures that have been taken include:

- EU-Life project “Wiesenvögel”;
- Major nature conservation project “Untere Havel” (creation of habitats);
- The recording of breeding sites and protection of nests (management of agricultural work, temporary management restrictions) through regional protection programmes and contractual agreements and coordination with farmers (contractual nature conservation, “Gemeinschaftlicher Wiesenvogelschutz”, the Northern lapwing species support programme, environmental emergency programme 2017, reporting of breeding sites under the direction of the lower level nature conservation authorities (i.e. the administrations of the districts and independent cities));
- The implementation of agri-environmental measures to regulate mowing and harvesting dates and the introduction of fallow land;
- Local protection measures against predation;
- Measures for habitat optimization and rewetting, conservation measures in calcareous fens;
- Extensive grazing projects.

Specific examples of conservation projects that have been or still are being carried out were listed in the Bird Protection Report of 2019 (BfN, 2019). In North Rhine-Westphalia, Schleswig-Holstein and Saxony, nests and young birds are being protected. This is done by fencing off protected areas and restricting the management. In Schleswig-Holstein, the “Gemeinschaftlicher Wiesenschutz” (“Community Meadow Protection”) project[11] is successfully carried out by the Michael Otto Institute at NABU in six areas since 2013. Within the project, farmers who adapt their land management in favour of the Northern lapwing receive compensation payments during the breeding season. In Schleswig-Holstein and Saxony, conservation measures as part of the promotion of agri-environmental measures are being implemented[12]. An example of this is the Saxon funding programme AUNaP, for which measures for nature conservation-friendly arable management were taken and fallow land and areas with flowering plants were installed. In Saxony, measures have also been taken in the context of habitat improvement as part of moorland revitalization. In Rhineland-Palatinate, the species aid programme “Gefährdete Bodenbrüter” (“Endangered Ground Breeders”) was launched. In Saxony-Anhalt, the measures that have been taken so far have been proven to be too local and not efficient enough to actually improve the status of the Northern lapwing. Lastly, in

[11] https://bergenhusen.nabu.de/forschung/wiesenvoegel/index.html
[12] https://www.schleswigholstein.de/DE/Themen/V/vertragsnaturschutz.html

Funded by
the European Union

Hessen, an action progamme for the Northern lapwing has been developed (HLNUG, 2015). This programme lists a number of recommended measures including:

- Rewetting of former wet meadows;
- The optimization and creation of new shallow water areas and shallow flooded ponds is therefore of great importance;
- Water level management with the aim of maintaining moist to wet areas over a large area or at least in places until July;
- Inclusion of dry areas in grazing or mowing to prevent succession processes;
- Removal of drainage systems, raising the groundwater level;
- Adjustable damming of ditches;
- Ensuring a sufficient water level even in dry years;
- Mosaic of use consisting of extensive mowing and grazing of the wet meadows with cattle;
- Reduction of eutrophication;
- Effective predator protection through fencing.

3.2.3. Potential agri-environmental measures to improve farmland biodiversity

In Germany, CAP resources are allocated to farmers that implement measures selected from a predefined list. The EU funds are supplemented with national co-financing. The financial resources provided by the EU come from different funds, the so-called two pillars of the CAP, i.e. the 1st pillar (European Agricultural Guarantee Fund (EAGF)), and the 2nd pillar (European Agricultural Fund for Rural Development (EAFRD)). The 1st pillar funds are further divided into Direct Payments including eco-schemes and funding through Sector Programmes. The measures subsidised through the 1st and 2nd pillar have a variety of goals with one being conservation measures that focus on biodiversity targets. The subsidised measures that focus on biodiversity are listed in Table 11. The measures taken in the context of eco-schemes are subject to an annual commitment, while EAFRD measures are subject to a multi-annual commitment. The allocated budget differs per state, per year and per intervention that is being subsidised (Table 12).

Funded by
the European Union

Table 11 – Conservation measures focussing on biodiversity that receive subsidies from CAP in Germany.

Intervention ID	Intervention
DZ0401	Provision of areas to improve biodiversity and preserve habitats
DZ0402	Cultivation of diverse crops with at least five main crop species in arable farming, including the cultivation of legumes with a minimum share of 10 percent
DZ0403	Maintaining agroforestry management on arable land and permanent grassland
DZ0404	Extensification of the entire permanent grassland of the farm
DZ0405	Outcome-oriented extensive management of permanent grassland areas with proof of at least four regional indicator species
DZ0406	Cultivation of arable or permanent crop areas of the farm without the use of chemical-synthetic plant protection products
DZ0407	Application of land management methods determined by the conservation objectives on agricultural areas in Natura 2000 areas
EL0101	Management obligations to improve climate protection
EL0102	Management obligations to improve water quality
EL0103	Management obligations to improve soil protection
EL0105	Management obligations to improve biodiversity
EL0107	Management obligations for sustainable forest management
EL0108	Organic farming
EL0110	Management obligations to conserve genetic resources
EL0111	Income equalisation reforestation
EL0301	Management obligations to implement Natura 2000
SP0100	Sector programme fruit and vegetables

Funded by the European Union

Table 12 – Average and maximal (between brackets) allocated annual budget (in millions of euros) for the period 2023-2027 per German federal state per conservation measure type. The conservation measure corresponding to the Intervention ID is listed in Table 11 (Source: BMEL (2023)).

Source of funding	ID	State													
		BW	**BY**	**BB-BE**	**HE**	**MV**	**NI-HH-HB**	**NW**	**RP**	**SL**	**SN**	**ST**	**SH**	**TH**	**Total**
Direct Payments – eco-schemes	DZ0401	25.6 (26)	53.4 (54)	40.4 (41)	19 (19)	31.4 (32)	44.8 (46)	18.4 (19)	17.6 (18)	2 (2)	13.6 (14)	25.6 (26)	19 (19)	10 (10)	321.2 (326)
	DZ0402	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	DZ0403	0.6 (1)	1.2 (2)	0.6 (1)	0.6 (1)	0.6 (1)	0.6 (1)	0.6 (1)	0.6 (1)	0 (0)	0.2 (1)	0.6 (1)	0.6 (1)	0 (0)	6.6 (12)
	DZ0404	24.8 (28)	40.2 (45)	18.4 (20)	16.4 (18)	15.6 (18)	17.6 (20)	17.4 (19)	12.4 (14)	3 (3)	9.2 (10)	9.2 (10)	8.4 (10)	11.4 (13)	203.8 (227)
	DZ0405	14 (15)	30 (32)	12 (13)	10.6 (11)	7 (7)	14 (15)	14 (15)	7.6 (8)	2 (2)	7.6 (8)	8.4 (9)	3 (3)	14 (15)	144.4 (154)
	DZ0406	11.6 (13)	32.8 (36)	10.6 (12)	3 (3)	9.4 (10)	26.4 (29)	13.6 (15)	3 (3)	0 (0)	6.4 (7)	7.2 (8)	9.4 (10)	4.6 (5)	138.6 (153)
	DZ0407	5 (5)	5 (5)	14 (14)	4 (4)	4 (4)	8 (8)	3 (3)	2 (2)	0 (0)	3 (3)	2 (2)	2 (2)	2 (2)	52 (52)
Source total		82 (85)	162.8 (168)	95.2 (98)	53 (55)	67.8 (70)	111.8 (115)	67.2 (70)	42.8 (45)	7.4 (8)	40 (41)	52.6 (54)	42.6 (43)	42.2 (44)	867.2 (897)

Funded by the European Union

Source of funding	ID	State													
		BW	BY	BB-BE	HE	MV	NI-HH-HB	NW	RP	SL	SN	ST	SH	TH	Total
European Agricultural Fund for Rural Development (EAFRD)	EL0101	1	8.8	2.2	0	2.8	0.2	0	1	0	0	0	2.4	0	18.4
		(1)	(13)	(3)	(0)	(4)	(1)	(0)	(1)	(0)	(0)	(0)	(3)	(0)	(22)
	EL0102	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	EL0103	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	EL0105	27.8	74.2	8	0	17	42.4	37.6	8	3	22.6	24	16.2	20	301.2
		(37)	(90)	(9)	(0)	(17)	(56)	(55)	(9)	(3)	(24)	(29)	(19)	(21)	(367)
	EL0107	0	0	0	0	0	0	0	0	0	0	1.2	0	1.8	2.8
		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(2)	(0)	(2)	(3)
	EL0108	57	112.4	37.6	27.4	28.2	44.8	23.4	20.2	2.8	25	15.2	13.8	15.8	423.4
		(59)	(153)	(68)	(37)	(33)	(69)	(42)	(27)	(3)	(28)	(26)	(28)	(19)	(553)
	EL0110	0	0	0	0	0	0	0	0	0	0	0	0	0	0.6
		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)
	EL0111	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0.4
		(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)
	EL0301	2	0	3	0	5	0	3	0	1	0	4.2	3	0	21.4
		(2)	(0)	(5)	(0)	(5)	(0)	(3)	(0)	(1)	(0)	(7)	(3)	(0)	(26)
Source total		89.8	194.8	50.8	27.4	53.8	87.4	64.8	29	6.4	48	44.8	35.2	37.8	769.8
		(101)	(248)	(80)	(37)	(59)	(125)	(101)	(37)	(7)	(52)	(63)	(52)	(42)	(965)

Funded by the European Union

Source of funding	ID	State													
		BW	**BY**	**BB-BE**	**HE**	**MV**	**NI-HH-HB**	**NW**	**RP**	**SL**	**SN**	**ST**	**SH**	**TH**	**Total**
Sector Programmes	SP0100	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	59.6 (102)
Source total		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	59.6 (102)
Total		171.4 (181)	357.6 (406)	146 (173)	80.4 (88)	121.6 (125)	199 (234)	131.8 (166)	71.8 (79)	13.8 (14)	88.2 (91)	97.4 (115)	77.6 (94)	80.2 (83)	1696.6 (1887)

BW: Baden-Württemberg; **BY**: Bayern; **BB-BE**: Brandenburg & Berlin; **HE**: Hessen; **MV**: Mecklenburg-Vorpommern; **NI-HH-HB**: Niedersachsen, Hamburg & Bremen; **NW**: Nordrhein-Westfalen; **RP**: Rheinland-Pfalz; **SL**: Saarland; **SN**: Sachsen; **ST**: Sachsen-Anhalt; **SH**: Schleswig-Holstein; **TH**: Thuringia

Funded by the European Union

The exact compensations given to farmers through EU funds and supplemented with national co-financing depends on the type of measure that is being implemented. The compensations to implement biodiversity-promoting measures can be divided into Direct Payments (Table 13) and funding through the European Agricultural Fund for Rural Development (EAFRD) (indirect payments) (Table 14).

Table 13 – Direct Payments of the Common Agricultural Policy (CAP) given to farmers as compensation for the implementation of eco-schemes. The intervention ID corresponds with the ID in Table 11 (Source: MLUK (2024a)).

Measure		Threshold values	Compensation (between 2024 and 2026) in Euros/ha	Intervention ID
1a	Non-productive area (fallow land on arable land)	Between 4% and 5% Between 5% and 6% Between 6% and 10%	1300 500 300	DZ0401
1b	Flower strips, -zones on fields, in addition to 1a)	/	200	
1c	Flower strips, -zones on permanent cropland	/	200	
1d	Unmown Grassland Stripes (Altgrasstreifen) in permanent grassland	1% Between 1% and 3% Between 3% and 6%	900 400 200	
2	Diverse crops in agriculture	Above 10 ha	60	DZ0402
3	Agroforestry on arable land and grassland	Between 2% and 35%	200	DZ0403
4	Company-wide grassland extensification	Between 0.3 ha and 1.4 ha	100	DZ0404
5	Grassland extensification with characteristic species		225	DZ0405
6	Avoidance of chemical-synthetic pesticides: Summer crops and permanent crops Avoidance of chemical-synthetic pesticides: Grass, green fodder, legumes		150 50	DZ0406
7	Management in NATURA		40	DZ0407

Funded by the European Union

Table 14 – Funding through the European Agricultural Fund for Rural Development (EAFRD) (indirect payments) of the Common Agricultural Policy (CAP) supplemented with national co-financing given to farmers as compensation for the implementation of a selection of agri-environmental and climate measures. The intervention ID corresponds with the ID in Table 11 (Source: MLUK (2024a)).

Measure	Code	Compensation	Intervention ID
Climate protection			**EL0101**
Extensive grassland management (FP 810)	810	165 €/ha/year	
Peat soil-friendly damming (FP 830)	831	387 €/ha/year	
Conversion of arable land into permanent grassland (FP 3140)			
Permanent conversion of arable land into permanent grassland (water edges, drainage channels) areas / strips	2141, 2142	1600 €/ha/year	
Peat soil protection measures (FP 3130)			
Peat soil-friendly management (40 cm below ground level) (in combination with extensive grassland (GLex))	2131A	65 €/ha/year	
Peat soil-friendly management (30 cm below ground level) (in combination with GLex)	2131B	140 €/ha/year	
Peat soil-friendly damming (20 cm below ground level) (in combination with GLex)	2131C	174 €/ha/year	
Peat soil-friendly damming (10 cm below ground level) (in combination with GLex)	2131D	199 €/ha/year	
Winter water retention from 1 November to 30 April (at least 0 cm above ground level)	2131E	48 €/ha/year	
Grazing allowance for moor sheep	2131F	115 €/ha/year	
Paludiculture on arable land	2132	350 €/ha/year	
Water retention in the landscape (FP 3200)			
Water retention in the landscape (no use of plant protection products and fertilization) on grassland	2201	344 €/ha/year	
Water retention in the landscape GL within NSG and NLPUO	2202	179 €/ha/year	
Water retention in the landscape (no use of plant protection products and fertilization) on arable land	2203	261 €/ha/year	
Cooperative climate protection measures (FP 3200)			
Implementation of cooperative climate protection measures	3222	300 €/ha/year	
Water quality			**EL0102**
Water quality (FP 3190)			
Water protection/river bank strips	2191	366 €/ha/year	
Extensive arable farming on water bodies, in floodplains and in water-sensitive areas	2192	241 €/ha/year	

Funded by the European Union

Measure	Code	Compensation	Intervention ID
Biodiversity			**EL0105**
Nature conservation-oriented grassland farming (FP 3110)			
No use of any fertilization, grazing is permitted (in combination with GLex)	2111A	49 €/ha/year	
Exclusive grazing with sheep and/or goats (in combination with GLex)	2111B	130 €/ha/year	
No use of any fertilization and exclusive grazing with sheep and/or goats (in combination with GLex)	2111C	146 €/ha/year	
Use of cutter bar for mowing (in combination with Glex)	2115	40 €/ha/year	
Mowing with partial mowing (in combination with GLex)	2116	59 €/ha/year	
First use after 1 July	2112	97 €/ha/year	
First use after 15 July	2113	104 €/ha/year	
First use before 15 June 15th and further use after 31 August	2114	111 €/ha/year	
Grazing of heaths with sheep/goats/equidae (FP 3120)			
Grazing of heaths with sheep/goats/equidae	2121	346 €/ha/year	
Grazing of heaths with cattle	2122	161 €/ha/year	
Grazing of dry grassland with sheep/goats/equids, GL according to established local practices and other sensitive grassland locations	2123	258 €/ha/year	
Grazing of dry grassland with cattle, GL according to established local practices and other sensitive grassland locations	2124	111 €/ha/year	
Nature conservation-oriented grazing (FP 3210)			
Field bird “islands”	2211	305 €/ha/year	
Light (i.e. less dense planted) field zones/strips	2213A/2213B	180 €/ha/year	
Use of arable land as extensive grassland	2214	320 €/ha/year	
Permanent conversion of arable land into extensive permanent grassland	2216	1600 €/ha/year	
Extensive production processes on arable land within Natura 2000 areas	2215	170 €/ha/year	
Additionally, no fertilization of any kind	2215A	156 €/ha/year	
Supplement for the use of old varieties (gene reserve)	2215B	150 €/ha/year	
Preservation and care of orchard trees (FP 3150)			
Preservation and care of orchard trees	3150	9 €/tree/year	
Cooperative biodiversity measures (FP 3220)			
Implementation of cooperative Biodiversity measures	3221	300 €/ha/year	
Promotion of natural structural elements in arable farming (FP 890)			
Perennial flower strips	892	700 €/ha/year	
Field margins	893	390 €/ha/year	
Soil protection			**EL0103**
Soil protection (FP 3230)			
Cultivation of large-grain legumes	2231	85 €/ha/year	

Funded by the European Union

Measure	Code	Compensation	Intervention ID
Organic farming			**EL0108**
Organic farming (FP 880)			
Introduction of arable land	781, 781EP	335 €/ha/year	
Introduction of grassland	782	210 €/ha/year	
Introduction of vegetables	783, 783EP	630 €/ha/year	
Introduction of pome and stone fruit	784, 784EP	1553 €/ha/year	
Introduction of berries, bush and wild fruit	785, 785EP	1350 €/ha/year	
Retention of arable land	781	220 €/ha/year	
Retention of grassland	782	210 €/ha/year	
Retention of vegetables	783	490 €/ha/year	
Retention of pome and stone fruit	784	994 €/ha/year	
Retention of berries, bush and wild fruit	785	830 €/ha/year	
Transaction costs for introduction or retention		40 per company	
Transaction costs for retention		40 per company	
Conservation of genetic resources			**EL0110**
Conservation of plant genetic resources (FP 860)			
Cultivation of one- to two-year-old crops	861	196 €/ha/year	
Surcharge for small batches	861A	296 €/ha/year	
Permanent crops	862	500 €/ha/year	
Conservation of animal genetic resources (FP 870)			
Cattle (German Black Pied Lowland Cattle)	871	230 €/ha/year	
Sheep / Goats (Skudde, Merino meat sheep, East Frisian dairy sheep, German White Noble Goat, Thuringian Forest Goat, Pomeranian Land Sheep)	872	166 €/ha/year	
Pigs (German noble pig, German landrace, German saddleback pig, red-and-white Husum pig, Leicoma)	873	260 €/ha/year	
Horses (Rhineland German coldblood)	874	140 €/ha/year	
Additionally: provision of embryos and/or sperm from animals for the breeding programme	875	100 €/ha/year	

Funded by the European Union

Measure	Code	Compensation	Intervention ID
Natura 2000			**EL0301**
Natura 2000 compensation (FP 50)			
Extensive use of grassland	11Z	165 €/ha/year	
without mineral fertilizers	12Z	48 €/ha/year	
without liquid manure	13Z	47 €/ha/year	
without fertilizers	14Z	56 €/ha/year	
Use not before 16 June	21Z	57 €/ha/year	
Use not before 1 July	22Z	97 €/ha/year	
First use of grassland before 15 June and further use only after 31 August	24Z	111 €/ha/year	
Use not before 16 August	25Z	200 €/ha/year	
High water retention until 30 April	30Z	65 €/ha/year	
High water retention until 30 June	32Z	227 €/ha/year	
Restriction on the use of arable land (no chemical-synthetic N fertilizers)	51Z	100 €/ha/year	
Restriction on the use of arable land (no use of liquid manure)	52Z	47 €/ha/year	
Restriction on the use of arable land (no use of herbicides, insecticides and fungicides)	53Z	70 €/ha/year	
Compensation for plant protection (FP 40)			
Arable land	41	267 €/ha/year	
Permanent crops	42	1069 €/ha/year	
Extensive management of individual areas of grassland in Natura 2000 areas (outside of nature reserves (*Naturschutzgebieten*)) (FP 800)			
No mineral nitrogen fertilization	801	140 €/ha/year	

No measures in the context of management obligations for sustainable forest management (EL0107) are being funded in the State of Brandenburg (Table 14). Therefore, also no budget is allocated to fund these measures (Table 12). The same applies for the Sector Programme fruit and vegetables (SP0100). Further, although a budget for income equalisation for reforestation (EL0111) was allocated in the State of Brandenburg from 2024 onwards (Table 12), no specific measures have been formulated yet (Table 14).

In addition to measures (partly) funded through subsidies in the context of the EU CAP, specific measures are subsidised through contract-based measures ("*Verwaltungsvorschrift*") (Table 15). These measures are available, especially for the cases in which the measures (partly) subsidised through the CAP are not available or not sufficient to finance a specific goal. For example, farmland bird islands are not explicitly funded through the EAFRD but funding is available through a contract-based measure. The contract-based measures are funded by federal or state budget. Some of the measures for which compensation is available through contract-based measure compensations can also be compensated through the EAFRD. Compensations for contract-based measures are however

Funded by the European Union

available for anyone who wants to implement a conservation measure whereas EAFDR is only available to farmers.

Table 15 – Measures for which compensation is available through federal- or state-funded contract-based measures. In case a corresponding EAFRD measure (Table 14) exists in the State of Brandenburg, this is indicated in the 'Present in EAFD-funded measures' column, and the code of the EAFRD measure is indicated in the 'EAFRD funding code' column (Source: MLUK (2024b)).

Measure	Annual Compensation	Unit	Present in EAFD-funded measures	EAFRD funding code
Nature conservation-oriented grassland management				
Extensive management of selected areas on grassland				
a) No application of mineral nitrogen fertilisers	165	€/ha/year	✓	810, 11Z
b) In addition to a. No fertilization of any kind, grazing is permitted	49	€/ha/year	✓	2111A
c) In addition to a. Exclusive grazing with sheep and/or goats	130	€/ha/year	✓	2111B
d) In addition to a. No fertilization of any kind and exclusive grazing with sheep and/or goats	146	€/ha/year	✓	2111C
e) In addition to a. No mineral fertilizers	48	€/ha/year	✓	12Z
f) In addition to a. No use of liquid manure in companies that generate liquid manure	47	€/ha/year	✓	13Z
g) In addition to a. No fertilisation of any kind and use for pure mowing including clearing	136	€/ha/year	×	
Late use of grassland dates				
a) First use after 15 June	57	€/ha/year	×	
b) First use after 1 July	97	€/ha/year	✓	2112
c) First use after 15 July	104	€/ha/year	✓	2113
d) First use after 15 July and second use after 31 August	111	€/ha/year	✓	2114
e) First use after 16 August	200	€/ha/year	×	
Protected areas in grassland				
a) One-year protected areas	108	€/ha/year	×	
b) Multi-year protected areas	150	€/ha/year	×	
Mowing activities				
Partial mowing	59	€/ha/year	✓	2116
Mosaic mowing	79	€/ha/year	×	
No rolling or towing	43	€/ha/year	×	

Funded by the European Union

Measure	Annual Compensation	Unit	Present in EAFD-funded measures	EAFRD funding code
Preservation of the Spreewald meadows				
a) Mowing once a year if the area can be reached by land	104	€/ha/year	×	
b) Mowing once a year if the area can be reached by water	241	€/ha/year	×	
High water retention				
a) until 30 April	65	€/ha/year	✓	30Z
b) until 30 May	140	€/ha/year	×	
c) until 30 June	227	€/ha/year	✓	32Z
d) from 1 August to 31 December	313	€/ha/year	×	
Nature conservation-oriented arable land use				
General				
Use of arable land as extensive grassland	320	€/ha/year	✓	2214
Permanent conversion of arable land into extensive grassland	1600	€/ha/year	✓	2216
Creation of field bird islands	305	€/ha/year	✓	2211
Lichtacker - more distance between crop rows	180	€/ha/year	✓	2213A/2213B
Perennial flowering areas with regional seeds	710	€/ha/year	×	
Protected areas in the fields	340	€/ha/year	×	
Bird protection by leaving overwintering stubble	72	€/ha/year	×	
Rest period in arable fodder production including high cut	492	€/ha/year	×	
Extensive production methods in arable farming				
a) The use of extensive production methods on arable land is promoted by refraining from applying mineral nitrogen fertilizers	170	€/ha/year	✓	2215
b) And in addition to a., refraining from using liquid manure	47	€/ha/year	×	
c) And in addition to a., refraining from using any type of fertilizer	156	€/ha/year	✓	2215A
d) And in addition to a., the use of old crop varieties that are listed in the central directory of eligible crops of the Federal Office for Agriculture and Food.	150	€/ha/year	✓	2215B

Funded by the European Union

Measure	Annual Compensation	Unit	Present in EAFD-funded measures	EAFRD funding code
Conservation of special biotopes				
General				
Mechanical mowing of heaths, semi-dry grasslands and dry grasslands	275	€/ha/year	×	
Mechanical mowing of wet meadows	371	€/ha/year	×	
Promoting wildflowers	30	€/ Bee colony/ year	×	
Grazing of heaths (heathlands)				
a) Heathlands grazing with sheep and/or goats and/or equines	346	€/ha/year	✓	2121
b) Heathlands grazing with cattle	161	€/ha/year	✓	2122
Conservation of dry grassland and sensitive permanent grassland through grazing				
a) Grassland grazing with sheep and/or goats and/or equines	258	€/ha/year	✓	2123
b) Grassland grazing with cattle	111	€/ha/year	✓	2124
Keeping areas open by removing woody elements				
a) Basic funding for keeping areas open, light	159		×	
b) Basic funding for keeping areas open, medium	397		×	
Disposal of landscaping materials				
a) Mowings/cuttings up to 20 cm in diameter	18	€/m³/year	×	
b) Mowings/cuttings up to 20 cm in diameter	25	€/m³/year	×	
Conservation of orchards				
a) Growth pruning	20	€/tree/year	×	
b) Maintenance pruning	75	€/tree/year	×	
c) Old tree pruning	161	€/tree/year	×	
Pollard willow pruning				
a) Pollard willow pruning light	140	€/tree/year	×	
b) Pollard willow pruning medium	274	€/tree/year	×	
b) Pollard willow pruning difficult	359	€/tree/year	×	
Species conservation measures				
Grant amounts are determined on a case-by-case basis				

Funded by the European Union

3.2.4. Development of the optimisation scenarios

Current situation (AS IS)

The current state of the habitat of the ten BirdWatch species will be assessed using the habitat suitability developed in the context of the BirdWatch project. To build these models, land management and land use-related variables will be derived from publicly available datasets such as the Thünen crop type dataset, while others will be derived from remote sensing data such as Sentinel-2, a product of the Copernicus Programme by the European Space Agency (ESA) and the European Union (EU). These variables will be derived for the year 2022, as they serve as input for the habitat suitability model that uses bird observation data from 2022 for Germany.

Based on the land use and land management of 2022, the current status of the habitat suitability of the BirdWatch species will be assessed at parcel level in the State of Brandenburg. The surface area suitable for each of the ten species will be assessed by applying a habitat suitability threshold of 0.66 after Lauver et al. (2002), above which the parcel is considered to be suitable.

Natura 2000 management scenario

No national-level management plans are in place for the BirdWatch species in Germany. This implies that also no national targets for these species have been set for the conservation of these species in Germany. The BirdWatch habitat optimisation model could aid in selecting areas and measures that would have the greatest impact on the habitat suitability of the BirdWatch species and contribute to regional management plans for these species. The Ministry of Agriculture, Climate and Environment of Brandenburg has shown interest in applying the BirdWatch service to establish species management plans for the Natura 2000 areas in the State of Brandenburg. In total, there are 712 Natura 2000 sites in the federal state of Brandenburg with a total area of around 9800 km² (Figure 9). The BirdWatch species are however not present in all 712 sites. A total of 103 sites with a combined surface area of 6750 km² protect one or multiple of the BirdWatch species (Table 16).

Funded by
the European Union

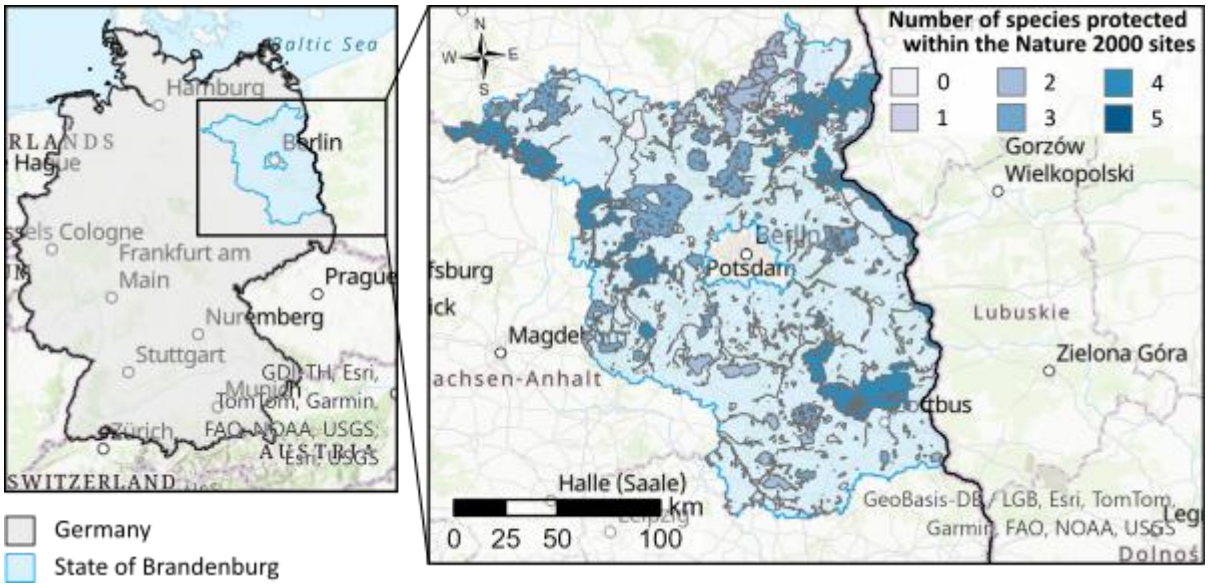

Figure 9 – Natura 2000 zones in the State of Brandenburg, Germany, and the number of BirdWatch species these zones protect.

The BirdWatch habitat optimisation model will be implemented to produce land cover and land management suggestions within the Natura 2000 zones in the State of Brandenburg that benefit the ten BirdWatch focus species. The management options that will be considered are partly taken from conservation measures already taken to protect the ten species in Germany, as described in section 3.2.2. In Natura 2000 zones that protect more than one of the ten focus species (Figure 9), care will be taken that the actions suggested do not include actions that could harm one of the species. Such actions are described as the main hazards the species are faced with in section 3.2.2 (Table 7, Table 8, Table 9 and Table 10). The cost for the suggested actions will be determined based on the compensation farmers currently receive to offset costs and income losses in Natura 2000 zones (Ministerium für Landwirtschaft, Umwelt und Klimaschutz (2023), Table 13, Table 14 and Table 15). Only these measures for which a translation into a change in the explanatory variables used in the BirdWatch habitat suitability models is possible will be considered. Additional constraints concerning the total cost and biodiversity targets set in the region will be set in collaboration with the relevant stakeholders in the State of Brandenburg.

Funded by the European Union

Table 16 – Number of Natura 2000 zones in the State of Brandenburg that the ten BirdWatch species are protected by and their combined surface area.

Species	Number of Natura 2000 zones species are protected by	Surface area (in km²) of Natura 2000 zones species are protected by
Eurasian skylark *Alauda arvensis*	3	8.2
Meadow pipit *Anthus pratensis*	7	25.2
Yellowhammer *Emberiza citrinella*	1	5.3
Red-backed shrike *Lanius collurio*	91	6712.1
Black-tailed godwit *Limosa limosa*	18	3443.2
Eurasian tree sparrow *Passer montanus*	1	0.8
Whinchat *Saxicola rubetra*	49	5725.3
European turtle dove *Streptopelia turtur*	13	92.6
Common starling *Sturnus vulgaris*	2	0.8
Northern lapwing *Vanellus vanellus*	55	6207.8

Special protection areas (SPAs) for birds management scenario

Besides applying the BirdWatch habitat optimisation model to identify the optimal land cover and land management within the Natura 2000 zones in the State of Brandenburg, the Landesamt für Umwelt Brandenburg (LfU) has shown interest in the BirdWatch service. BirdWatch could aid in the development of management plans for the EU bird protection areas. There are 742 of such special protection areas (SPAs) for birds in Germany with a combined surface area of over 60000 km² (BISE, 2024; UNEP-WCMC, 2024) (Figure 10). The State of Brandenburg contains 58 of the SPAs (6488 km²) being located in (UNEP-WCMC, 2024) (Figure 10). Together with the Sites of Community Importance (SCI) that aim to protect specific habitat types, the SPAs make up the Natura 2000 network. Whereas in the *Natura 2000 management scenario,* we will only look at optimising the habitat of the species that are already being protected by the Natura 2000 zones, the *SPAs scenario* will investigate the impact of also aiming to improve the habitat suitability of species that do not yet occur in these SPAs. The considered measures will include the ones for which compensation for farmers is available (Table 13, Table 14 and Table 15). Only these measures for which a translation into a change in the

Funded by the European Union

explanatory variables used in the BirdWatch habitat suitability models is possible will be considered. Further, actions listed as potentially harmful for bird species that do already occur in these areas (Table 7, Table 8, Table 9 and Table 10) will not be considered. Additional constraints concerning the total cost and biodiversity targets set in the region will be set in collaboration with the relevant stakeholders in the state of Brandenburg.

The overall habitat suitability and the habitat suitability of the individual species will be compared between the Natura 2000 management scenario and the SPAs management scenario. This will allow us to assess the potential benefits and costs of improving the habitat of birds that do not yet occur in an area. During the analysis, a special focus will be placed on birds that are endangered in Germany, i.e. Meadow pipit, Black-tailed godwit, Whinchat, European turtle dove and Northern lapwing (Figure 8) as it is important that the habitat of these species does not further deteriorate.

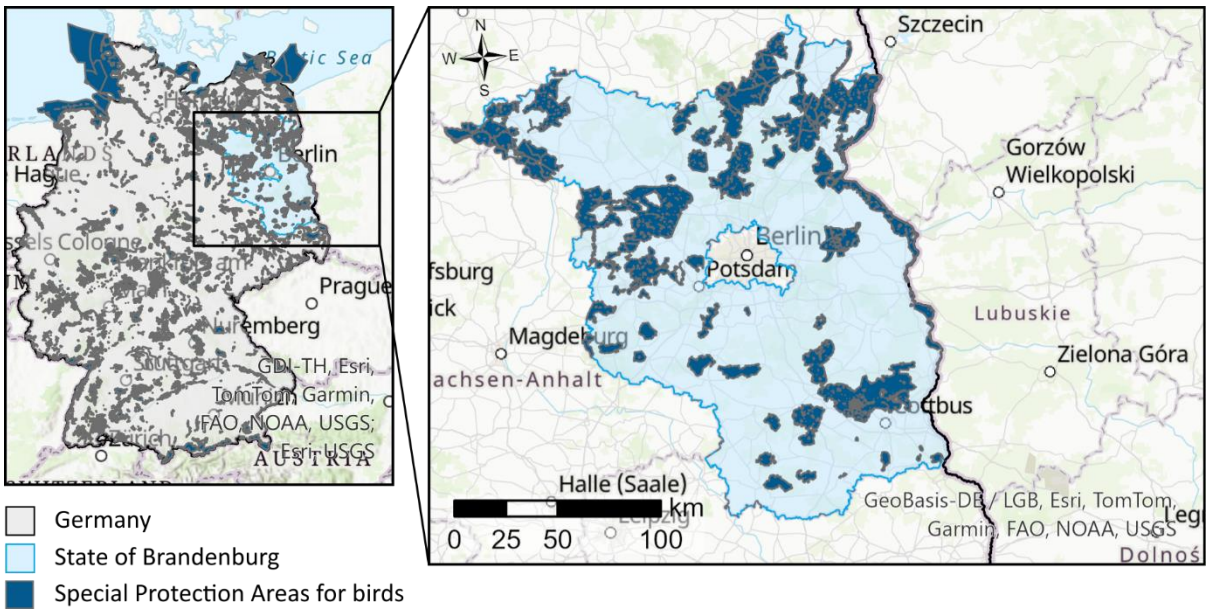

Figure 10 – Special Protection Areas (SPAs) for birds in the State of Brandenburg, Germany (Source: UNEP-WCMC (2024)).

Funded by the European Union

Budget-constraint scenario

A *budget-constraint scenario* will be developed for the State of Brandenburg. In this scenario, both the conservation measures subsidised in the context of the 1st pillar of the CAP (i.e. eco-schemes) (Table 13) and the measures subsidised in the context of the 2nd pillar (i.e. measures subsidised through the EAFRD) (Table 14) will be considered. Further, measures for which funding is available through federal- or state-funded contract-based measures agreements will also be considered (Table 15). To assess the impact on the habitat suitability, it is necessary that the measures can be translated into a change in the explanatory variables used in the BirdWatch habitat suitability models. Therefore, only these measures for which this translation is possible will be considered.

The type and location of the conservation measures will be selected in such a way that the sum of the habitat suitability of the ten BirdWatch species is maximised (Eq. 1 in Deliverable 5.1). The surface area of parcels on which conservation measures are suggested by the habitat optimisation model will be limited by the budget available to compensate for the measures (Eq. 5 in Deliverable 5.1). The average available annual budget for eco-schemes that could promote farmland biodiversity financed through the 1st pillar of the CAP is provided in Table 12 per state in Germany. The average available budget for measures financed in the context of the 2nd pillar of the CAP (supplemented with national co-financing) is also provided in Table 12 per state in Germany. The total annual amount of funding available in Brandenburg for contract-based measures will be obtained from the Ministry of Agriculture, Environment and Climate Protection (Ministeriums für Landwirtschaft, Umwelt und Klimaschutz).

Within the Natura 2000 zones (Figure 10), the maximal allowed deterioration for the species that are protected by the zones will be set at zero (Eq. 7 in Deliverable 5.1). This will ensure that one or more species are not favoured at the expense of another species that requires special protection in that area. Further, potential constraints identified during the stakeholder engagement part of work package 7 of the BirdWatch project will be accounted for.

The *budget-constraint scenario* will result in a configuration of conservation measures that maximises the habitat suitability in agricultural parcels for the ten BirdWatch species in the State of Brandenburg. The scenario can also be developed for the other 15 federal states of Germany provided that the type of measures eligible for compensation, and the compensation rate are available. Further, local connections with relevant stakeholders are required to identify further potential constraints.

Funded by
the European Union

3.3. Lithuania

3.3.1. Farmland bird status for the species selected in BirdWatch in Lithuania

In Lithuania, the condition of the agricultural landscape is deteriorating fast. According to the annual nationwide observations conducted by the Lithuanian Ornithological Society, the abundance of common breeding birds in the rural landscape decreased by 54.76% between 2000 and 2022, or at a rate of 2.4% per year (Lietuvos Ornitologų Draugijos, 2024). Between 2014 and 2022, the decline in their abundance was even stronger (40% or a decrease of 4.35% per year). The reduction in the farmland bird populations in Lithuania can also be observed for the majority of the bird species selected in BirdWatch for which the population estimates and trends were reported under Article 12 of the Birds Directive (Eionet, 2020) (Table 17). The short-term population trend of seven of the ten selected bird species is declining while the long-term population trend is declining for five of the selected bird species.

Funded by
the European Union

Table 17 – Recent population estimates and trends of the BirdWatch species in Lithuania.

Species	RL Lithuania	POP-LT	ST-LT	LT-LT
Eurasian skylark *Alauda arvensis*	Unknown	400.000-900.000	0%	-10%/0%
Meadow pipit *Anthus pratensis*	Unknown	30.000-60.000	-45%/-30%	-40%/-20%
Yellowhammer *Emberiza citrinella*	Unknown	300.000-400.000	5%/10%	0%/0%
Red-backed shrike *Lanius collurio*	Unknown	30.000-45.000	-25%/-20%	10%/20%
Black-tailed godwit *Limosa limosa*	Endangered [a]	70-120	-30%/-10%	0%/0%
Eurasian tree sparrow *Passer montanus*	Unknown	100.000-200.000	-10%/-5%	-40%/-30%
Whinchat *Saxicola rubetra*	Unknown	180.000-300.000	-25%	N/A
European turtle dove *Streptopelia turtur*	Endangered [a]	2700-4000	-40%/-30%	-80%/-60%
Common starling *Sturnus Vulgaris*	Unknown	300.000-500.000	0%/0%	0%/0%
Northern lapwing *Vanellus vanellus*	Unknown	9600-12.000	-20%	-30%/-20%

RL Lithuania: the Red List status of the species in Lithuania.
[a] Source: Rašomavičius (2021)
POP-LT: (minimum/maximum) or best single value of the number of breeding pairs in Lithuania between 2013 and 2018
ST-LT: the short-term trend (2013-2018) of the breeding population in Lithuania.
LT-LT: the long-term trend (1980-2018) of the breeding population in Lithuania.

3.3.2. Farmland bird conservation in Lithuania

All bird species are protected in Lithuania (Lietuvos Ornitologų Draugijos, 2018). However, Bird species taken up in the Red List taxa of Lithuania (Rašomavičius, 2021) were given a special protection status. Although population trends show a decrease in the population size for seven of the bird species selected in the BirdWatch project, only the Black-tailed godwit and European turtle dove are included in the Red List taxa of Lithuania (Rašomavičius, 2021). As a result, conservation efforts in Lithuania also do not focus on the bird species not taken up in the Red List taxa of Lithuania. For example, a number of management restrictions in the context of the EU "Statutory Management Requirement" (SMR) number 3 concerning the Birds Directive (European Union, 2021) apply in specific areas in Lithuania (Figure 11). These management restrictions that aim to conserve

Funded by the European Union

the habitat of birds only focus on one of the ten BirdWatch species, i.e. the Black-tailed godwit. Consequently, whether Lithuanian farms receive Direct Income support through CAP is independent of the impact of their management choices on the other nine bird species. The management limitations that apply in the zones delineated for SMR3 in Lithuania include the prohibition of ploughing and reseeding meadows, the conversion of meadows into another land use type, and the drainage of meadows.

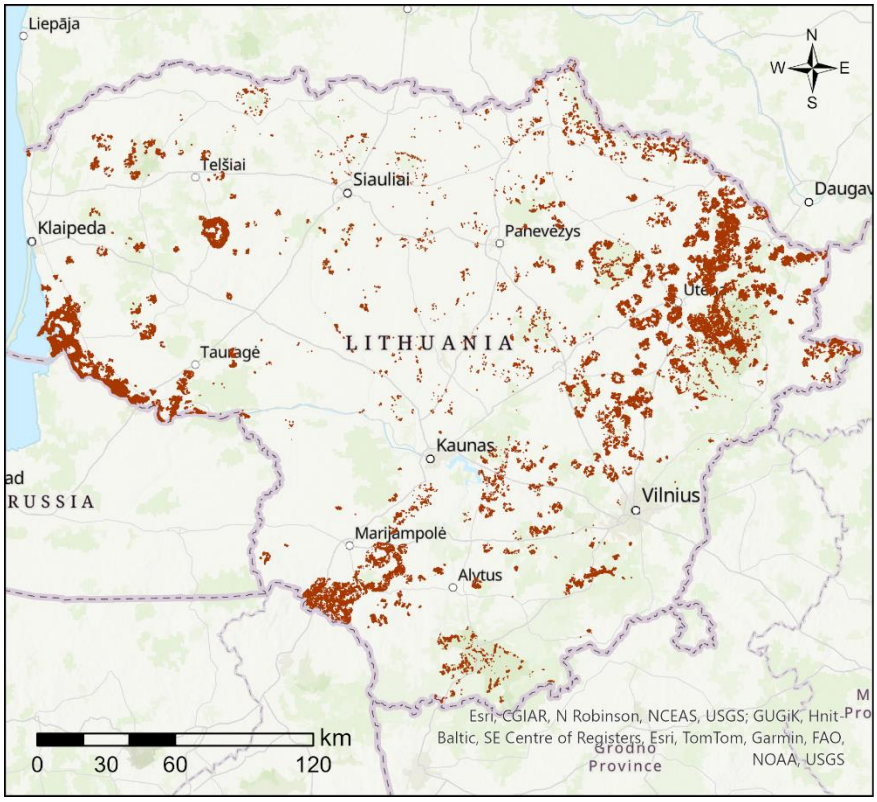

Figure 11 – Areas (in red) delineated in Lithuania in the context of the "Statutory management requirement" (SMR) 3 of the Common Agricultural Policy (CAP) for 2023-2027.

Besides areas delineated in the context of SMR3, there are also zones defined for the "Standard of Good Agricultural and Environmental Conditions of Land" (GAEC) number 8 (i.e. Minimum share of agricultural area [arable land] devoted to non-productive areas or features, retention landscape features and ban cutting hedges/trees during bird rearing season) (European Union, 2021) (Figure

Funded by
the European Union

12) and GAEC number 9 (i.e. Protection of permanent grasslands designated as environmentally-sensitive permanent grasslands in Natura 2000 sites) (European Union, 2021) (Figure 13).

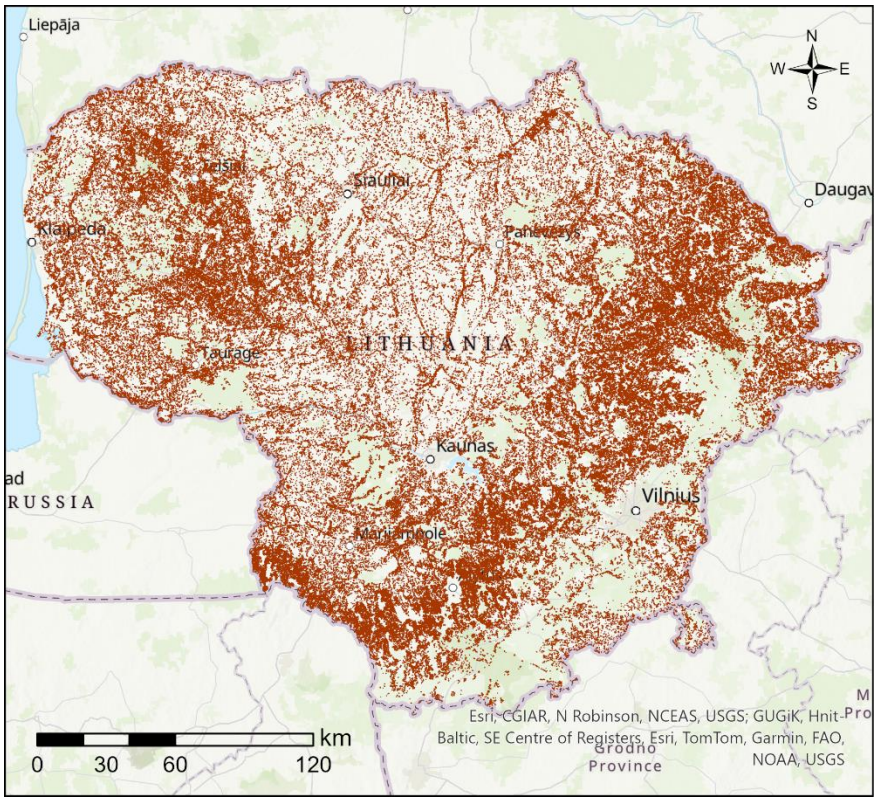

Figure 12 – Areas (in red) delineated in Lithuania in the context of the "Standard of Good Agricultural and Environmental Conditions of Land" (GAEC) number 8 of the Common Agricultural Policy (CAP) for 2023-2027.

Funded by
the European Union

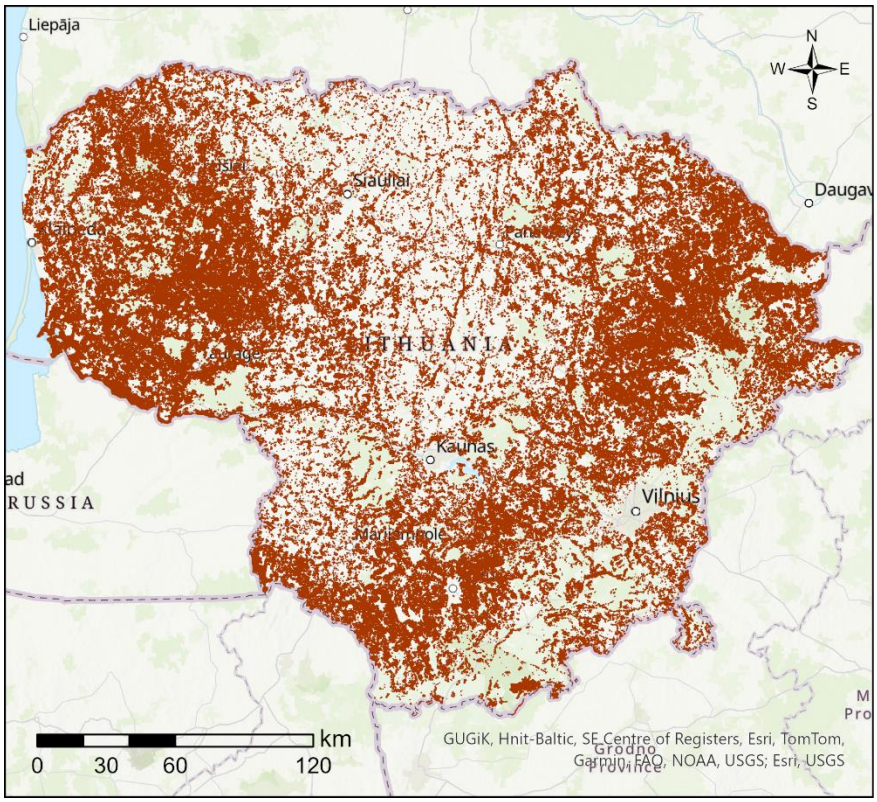

Figure 13 – Areas (in red) delineated in Lithuania in the context of the "Standard of Good Agricultural and Environmental Conditions of Land" (GAEC) number 9 of the Common Agricultural Policy (CAP) for 2023-2027.

3.3.3. Potential measures to improve farmland biodiversity

The National Paying Agency under the Ministry of Agriculture of the Republic of Lithuania identified the actions which are relevant for the conservation of farmland birds and for which farmers can receive compensation in the context of the CAP (Table 18). The compensation rate of 2023 was provided by the National Paying Agency under the Ministry of Agriculture of the Republic of Lithuania. It should however be noted that the compensation rate depends on the total number of hectares on which farmers apply biodiversity-improving measures and for which compensation is requested. In this project, it will however be assumed the compensation rate is fixed.

Funded by the European Union

Table 18 – Compensation rates of 2023 for biodiversity-improving measures that can be taken in the context of the CAP in Lithuania that could impact farmland birds (Source: NMA (2024)).

Strategic plan intervention Name	Compensation (in Euro per hectare)
Natural grasslands of EC importance	297.00
Management of wetlands of EC importance	297.00
Extensive management of perennial meadows with livestock grazing	192.00
Transition to organic farming for perennial grasses	206.00
Transition to organic farming for vegetables, potatoes, berries, gardens, herbs, aromatic and spice plants	652.00
Transition to organic farming for cereals, forage crops, seed crops and perennial grasses for seed	280.00
Coupled support for the cultivation of berries and nuts	330.90
Coupled support for fruit production	486.95
Coupled support for open field vegetable production	431.28
Organic farming (fruits, berries, vegetables, herbs and spices)	560.00
Perennial grass strips	170.00
Belts of short-lived woody plants	180.00
Coupled support for areas growing sugar beet	103.30
Replacement of arable peatlands with meadows	225.00
Extensive wetland management is new	242.00
Non-arable sustainable agriculture technologies	66.00
Management of gardens and orchards in a nature-friendly manner	102.00
Sustainable fruit, berry and vegetable programme (NKP)	337.00
Coupled support for areas under seed potatoes	597.40
Replacing eroded land with grassland	187.00
Crop rotation	41.97
Coupled support for legume production	50.73
Maintenance of landscape elements. Maintenance of existing landscape elements	150.00
Maintenance of landscape elements. Establishment of new grassy elements	157.00
Maintenance of landscape elements. Planting of new tree elements	1 329.00
Catch crops	102.36
Organic farming for perennial grasses	198*
Organic farming for crops, perennial grass seeds	239*
Protection of wild birds outside the Natura 2000 area	74*

*Fixed compensation rate

Funded by the European Union

3.3.4. Description of the optimisation scenarios

Current situation (AS IS)

The current state of the habitat of the ten BirdWatch species will be assessed using the habitat suitability developed in the context of the BirdWatch project. To build these models, land management and land use-related variables will be derived from publicly available datasets such as the Land Parcel Identification System (LPIS) dataset, while others will be derived from remote sensing data such as Sentinel-2, a product of the Copernicus Programme by the European Space Agency (ESA) and the European Union (EU). These variables will be derived for the year 2022, as they serve as input for the habitat suitability model that uses bird observation data from 2022 for Lithuania.

Based on the land use and land management of 2022, the current status of the habitat suitability of the BirdWatch species will be assessed at parcel level in Lithuania. The surface area suitable for each of the ten species will be assessed by applying a habitat suitability threshold of 0.66 after Lauver et al. (2002), above which the parcel is considered to be suitable.

Localised habitat optimisation scenario

Lithuania has a surface area of over 65000 km² and is divided into 60 municipalities. Within Lithuania, there is a large range of agricultural practices with regions characterised by a large density of elements that are in generally thought of as biodiversity-improving such as hedgerows, and regions with high agricultural intensity. The National Paying Agency under the Ministry of Agriculture of the Republic of Lithuania identified the municipalities which are characterised by a high agricultural intensity (Figure 14).

Funded by
the European Union

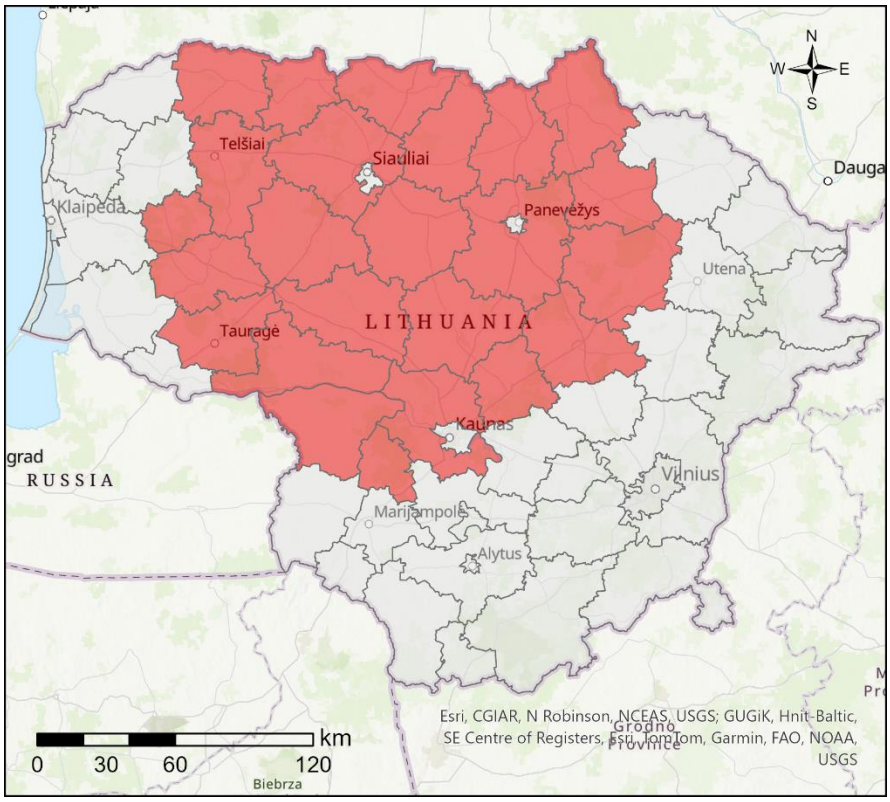

Figure 14 – Municipalities of Lithuania with the municipalities characterised by a high agricultural intensity displayed in red.

As described in Deliverable 5.1 of the BirdWatch project, when the habitat suitability model is applied to a large area –especially if this area has large ranges in habitat suitability– there is a risk that the model will mainly identify parcels characterised by a relatively high habitat suitability to implement conservation measures on. To avoid this, the region can be divided into subregions based on agricultural practices. Specific optimisation targets for each of these subregions can then be defined. This will ensure that also in intensive agricultural areas, conservation measures are suggested. In the BirdWatch projects, the 60 municipalities of Lithuania will be used as subregions, concentrating the efforts mainly on the municipalities characterised by intensive agriculture (Figure 14).

There are no local targets set for the BirdWatch bird species in Lithuania yet. Further, only two of the ten species are taken up in the Red List taxa of Lithuania (Rašomavičius, 2021). Therefore, areas

Funded by the European Union

that could benefit from extra protection measures for the other eight species are not considered in parcels on which the SMR 3 of the Common Agricultural Policy (CAP) for 2023-2027 applies.

The National Paying Agency under the Ministry of Agriculture of the Republic of Lithuania identified that the BirdWatch habitat optimisation algorithm can aid in suggesting new areas in which to focus biodiversity-improving measures. This will be done at municipality level (Figure 14), identifying per municipality for one or multiple bird species which parcels to focus conservation efforts on. The selection of these areas can be made by specifying specific targets for the bird species at municipality level while minimising the cost it would take to compensate for these measures (Table 18). Another way the parcels can be selected is by specifying a fixed budget for the compensation level at municipality level while maximising the habitat suitability of one or multiple bird species. This will eventually allow us to evaluate whether the zones currently delineated for additional bird protection measures suffice or if specific species could benefit from the expansion of these zones and what the additional cost related to compensations paid out to farmers would be. Additional constraints such as the obliged conservation of small woody elements will be considered when applying the habitat optimisation model. Further, potential constraints identified during the stakeholder engagement part of work package 7 of the BirdWatch project will be accounted for.

Funded by
the European Union

3.4. South Tyrol (Italy)

The Autonomous Province of South Tyrol in Northern Italy has a surface area of 7400 km². The terrain is characterised by a broad elevation range (194–3905 m a.s.l.) (Anderle *et al.*, 2022). The landcover consists mainly of forests (42.7%), natural and seminatural landscapes (e.g. alpine grasslands, rocks, freshwater habitats and glaciers) (39.6%) and intensive agricultural land (13.4%) (Anderle *et al.*, 2022). Agricultural land comprises meadows (64.3%), orchards (19.1%), pastures (6.3%), vineyards (5.6%), and annual crops (3.9%). Where croplands are mainly located in valley bottoms, meadows and pastures can be found on mountainsides and in the subalpine and alpine belt (Anderle *et al.*, 2022).

3.4.1. Farmland bird status for the species selected in BirdWatch in South Tyrol

In 2022, the Farmland Bird Index (FBI) continued to show a negative trend in Italy, with a decline in the bird species that comprise the FBI amounting to -36.63% compared to the year 2000 (Rete Rurale Nazionale and Lipu, 2020). The main factors behind the FBI's decline include the loss of suitable habitats and food resources. In mountainous areas, which take up a large part of the surface area in the province of South Tyrol, this loss can be related back to the abandonment of cultivated fields and pasture and the disappearance of small, family-run farms. This has drastically altered the landscape, with a reduction in open habitats such as grasslands and meadows and a constant increase in forest cover. The changes in these mountainous landscapes have resulted in the loss of suitable habitats and nesting sites for the typical species of these environments, as evidenced by the FBI of montane grassland birds, which declined by 28.28% between 2000 and 2022 (Rete Rurale Nazionale and Lipu, 2020).

Funded by
the European Union

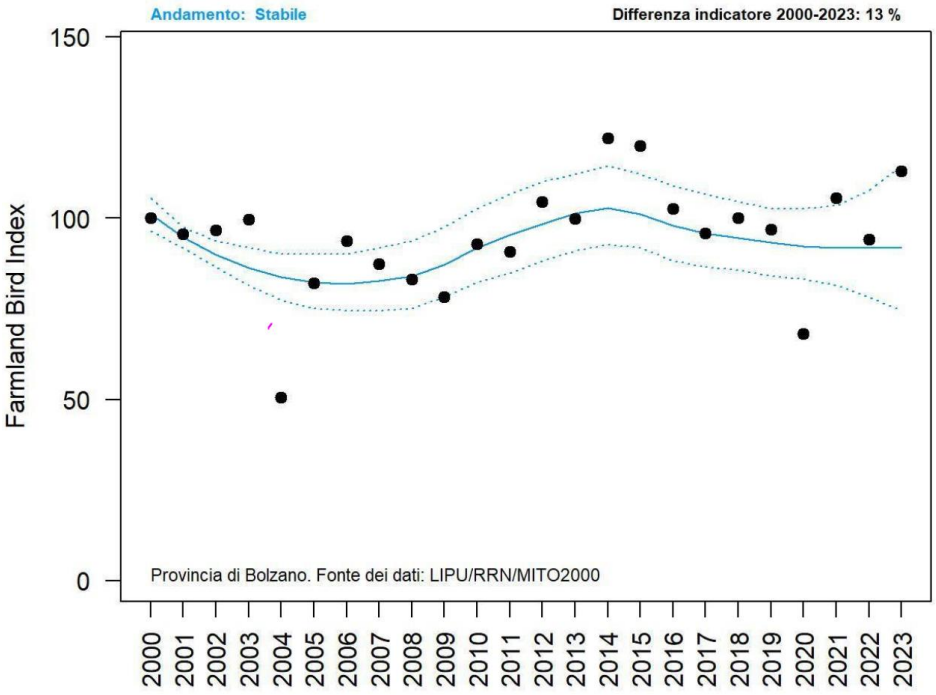

Figure 15 – Trend of the Farmland Bird Index (FBI, calculated as the geometric mean of the trends of 23 individual farmland bird species, including 6 out of 7 BirdWatch species that breed in South Tyrol, i.e. Eurasian skylark, Yellowhammer, Red-backed shrike, Eurasian tree sparrow, Whinchat and Common starling) in the province of South Tyrol over the period 2000-2023. The dots indicate the annual values of the FBI, the solid and dashed lines represent the trend of the FBI and its 95% confidence interval respectively (Source: Rete Rurale Nazionale and Lipu (2024)).

The FBI in the region of South Tyrol remained however relatively stable in this period (Figure 15). The population of 11 of the 23 bird species included in the FBI of South Tyrol was considered to be stable in 2023 (Rete Rurale Nazionale and Lipu, 2024). Only two species are considered to be in decline: the Whinchat (*Saxicola rubetra*) and Fieldfare (*Turdus pilaris*). However, the Eurasian skylark (*Alauda arvensis*) is also thought to be in decline in South Tyrol, but the population trend could not be calculated due to insufficient data available. Of the 23 bird species included in the FBI of South Tyrol, six are also part of the farmland bird species selected in the BirdWatch project (i.e. Eurasian skylark, Yellowhammer, Red-backed shrike, Eurasian tree sparrow, Whinchat and Common starling). Seven of the ten farmland bird species selected in the BirdWatch project breed in the province of South Tyrol. This information is based on expert opinion and backed up by occurrence data that was standardised by the Museum of Nature South Tyrol. The Black-tailed godwit (*Limosa*

Funded by
the European Union

limosa), Northern lapwing (*Vanellus vanellus*), and Meadow pipit (*Anthus pratensis*) do not breed in South Tyrol. For all BirdWatch species that do breed in the province but the European turtle dove, the population dynamics are summarised in Rete Rurale Nazionale and Lipu (2024) if sufficient data was available to calculate the population trend (Table 19).

The Whinchat showed the strongest decline of the 23 bird species included in the FBI of South Tyrol. The species has known a real collapse in South Tyrol between 2000 and 2023, with the FBI declining over 90% in this period (Rete Rurale Nazionale and Lipu, 2024).

Table 19 – Recent population estimates and trends of the BirdWatch species in South Tyrol.

Species	ST-ST	Average annual variation (in %) (SE)
Eurasian skylark *Alauda arvensis*	Insufficient data	
Yellowhammer *Emberiza citrinella*	Stable	-0.38 (1.28)
Red-backed shrike *Lanius collurio*	Stable	0.31 (1.35)
Eurasian tree sparrow *Passer montanus*	Uncertain	0.25 (3.86)
Whinchat *Saxicola rubetra*	Strong decline	-9.76 (1.60)**
European turtle dove *Streptopelia turtur*	Unknown	
Common starling *Sturnus Vulgaris*	Insufficient data	

ST-ST: the short term trend (2000-2023) of the breeding population in South Tyrol.
Average annual variation (SE): the mean annual variation (with the associated standard error (SE)) and the associated level of significance (* = p<0.05; ** = p<0.01) of the 2000-2023 trends.

Funded by the European Union

3.4.2. Farmland bird conservation in South Tyrol

Despite halting and reversing biodiversity loss is one of the objectives of the EAFRD of the Autonomous Province of Bolzano – South Tyrol (SZ6) (Autonome Provinz Bozen, 2023), current actions for the protection of farmland birds in South Tyrol are limited. The only funding available for measures directly aimed at the conservation of farmland birds is the *Wiesenbrüter* project in the Malser Haide, covering 1574 ha, or about 0.2% of the total area of South Tyrol (CIVIS, 2024). In this project, additional fundings are given to meadows who also participate in the SRA08 "Permanent grassland" or SRA29 "Organic production" of the 2nd pillar of the CAP and agree to some management actions. These actions include:

- Neither level nor drain the affected areas;
- Maintaining existing structures such as stone piles, dry stone walls and hedges;
- Delayed mowing; respect the cutting date depending on the sub-zone;

However, because of the limited size of the project, the impact is not sufficient to promote farmland bird biodiversity in South Tyrol.

While eco-schemes generally aim to support farmers in adopting practices that minimise the negative impact of agriculture on the environment and climate, they are currently not sufficiently targeting farmland bird protection. This was highlighted by the nature conservation organisations 'Nature Office of South Tyrol' and 'Working group for Ornithology and Bird Protection – South Tyrol', interviewed in the context of the BirdWatch project. It was mentioned that ecological aspects are overall not in the focus of the eco-schemes. Research has however demonstrated the importance of land use and land cover for shaping the local biodiversity and bird communities in South Tyrol (Anderle *et al.*, 2022). Therefore, land cover and land use changes driven by the implementation of the eco-schemes and other agri-environmental and climate measures could still benefit farmland bird species. The regional Red List of breeding birds reported that almost half of the bird species in South Tyrol suffer from habitat destruction due to changes in land cover and land use and the disappearance of uncultivated areas, riparian vegetation and hedges. Another large proportion of the species suffers from intensive management of farmed areas. Functional diversity of the avian community in the area was demonstrated to be positively impacted by alpine grasslands and summer pastures which demonstrated the importance of open spaces and their management (Anderle *et al.*, 2022). Further, wetlands, lakes and rivers have been shown to be important hotspots for biodiversity, including threatened bird species in alpine regions (Brusa *et al.*, 2019; Anderle *et al.*, 2022). Permanent crops and annual crops could also be associated with vulnerable and endangered bird species (Anderle *et al.*, 2022). This demonstrates that heterogenous landscapes

with more structural elements and different land use and land cover patches are key to conserving farmland bird species in alpine regions. Some measures implemented in the Rural Development Programmes of the 2nd pillar of the CAP focus on crop diversification and on the restoration of natural or seminatural habitats such as ponds, shrub patches and grasslands (Anderle *et al.*, 2022). This could provide an important contribution to the objective of landscape heterogenisation.

3.4.3. Potential measures to improve farmland biodiversity

Although not specifically targeting farmland birds, some measures eligible for funding throughout the territory of South Tyrol could benefit farmland birds. These include the programmes of the 2nd pillar of the CAP that focus on crop diversification and on the restoration of natural or seminatural habitats such as ponds, shrub patches and grasslands (Anderle *et al.*, 2022). These interventions and the available budget per intervention are listed in Table 20. The budget is a combination of EU support through CAP (40.70%) supplemented with a share paid by the Italian government (41.51%) and by the Province of Bolzano (17.79%) (Autonome Provinz Bozen, 2023). For some interventions, the Province of Bolzano provides additional state aid on top of its share.

Table 20 – Interventions eligible for compensation through the 2nd pillar of CAP, supplemented with national co-financing in South Tyrol, and the available budget for the period 2023-2027 (Source: Autonome Provinz Bozen (2023)).

Intervention	Available budget for the period 2023-2027 (in million Euros)
SRA08 – ACA08 – Management of permanent grassland and pastures	54
SRA09 – ACA9 – Management of Natura 2000 habitats	16
SRA29 – Payment for the introduction and retention of organic agricultural	22
SRB01 – Support for mountain areas with natural handicaps	97.5
SRD04 – Non-productive investments – Enhancement of the ecological diversity of species and habitats in agricultural landscapes	1.5

While the support for mountain areas with natural handicaps (SRB01) does not impact biodiversity directly, it could help to prevent land abandonment which could pose a threat to biodiversity (Anderle *et al.*, 2022). The measures subsidised through intervention SRD04 (Non-productive investments – Enhancement of the ecological diversity of species and habitats in agricultural

Funded by the European Union

landscapes) could directly impact biodiversity as this intervention promotes the installation of structural elements.

The measures subsidised through intervention SRD04 include:

- Enhancement measures for Natura 2000 habitats and species, such as:
  - Habitat enhancement for Natura 2000 species through structural improvements;
  - Targeted shrub removal from dry grasslands followed by goat pasture;
  - Upgrading measures of wetland habitats by removing competing plants;
  - Resumption of extensively managed meadows and pastures through bush clearing and bush removal;
  - Containment of invasive alien plant and animal species.
- Measures for the interconnection of Natura 2000 habitats and species, such as:
  - Creation of hedges and other field shrubs;
  - Creation and/or restoration of typical landscape features such as ponds, ponds, wetland habitats, dry stone walls, etc.
- Measures in favour of Natura 2000 species, such as:
  - Removal of barbed wire fences;
  - Underground laying of overhead lines, securing medium and high-voltage pylons and lines for avifauna.

Funded by
the European Union

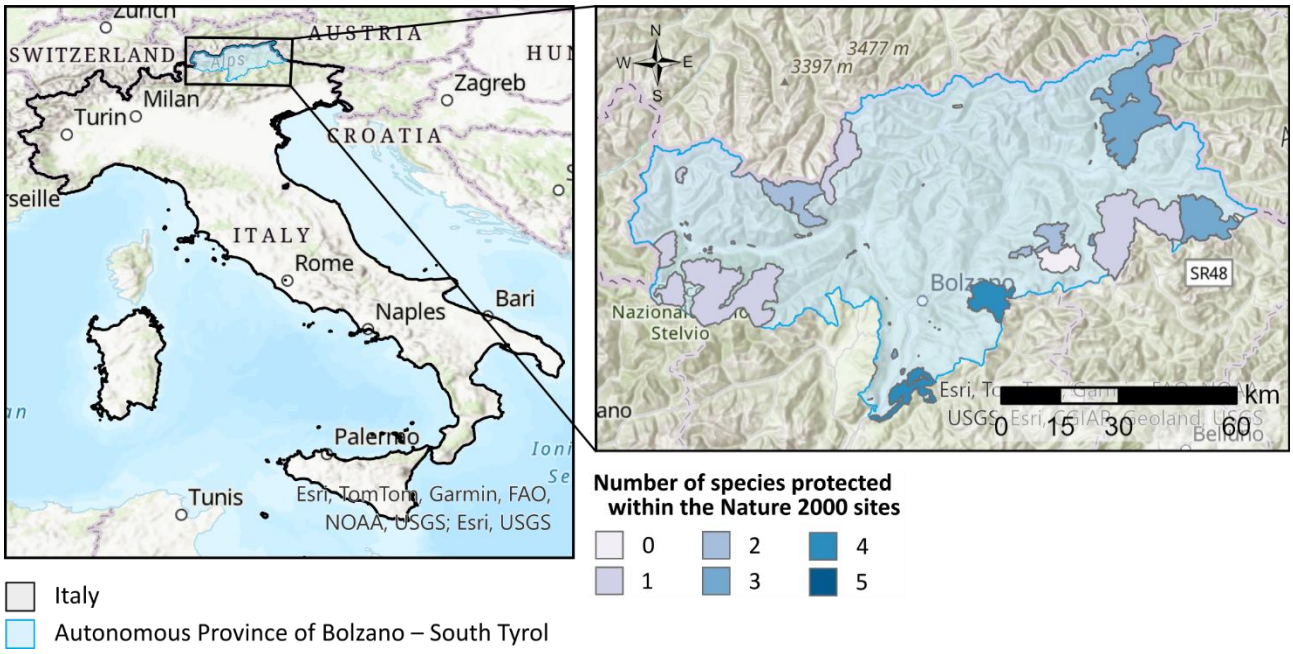

Figure 16 – Natura 2000 zones in the Autonomous Province of Bolzano – South Tyrol, Italy, and the number of BirdWatch species these zones protect.

Funding for SRA09 – ACA9 – Management of Natura 2000 habitats, the so-called *Landschaftspflegeprämien,* offers payment for the conservation of specific landscape types (Table 21), specifically in Natura 2000 habitats (Figure 16) (natur-raum, 2023). The conservation of the landscape types and the corresponding compensation are part of a five-year agreement. These payments come with specific conditionalities such as late mowing (after 15 July) and the limited use of fertilisation, maintenance of agroforestry, and mowing in late summer/autumn for wet meadows. The specific commitments per landscape type are listed in Autonome Provinz Bozen (2023). The total amount of funding actually distributed among farmers of South Tyrol is available through the Nature Conservation Department of South Tyrol while the available budget for the period 2023-2027 is presented in Table 20.

Funded by the European Union

Table 21 – Compensation farmers receive for the conservation of specific landscape types in Natura 2000 areas in South Tyrol (Source: natur-raum (2023)).

Landscape type	Compensation
Poor meadows and fen meadows	660 Euros/ha
Species-rich mountain meadows	530 Euros/ha
Reed beds	810 Euros/ha
Wooded, species-rich meadows	990 Euros/ha
Wooded meadows	540 Euros/ha
Wooded pastures	120 Euros/ha
Chestnut groves and orchards	550 Euros/ha
Moors and floodplain forests	240 Euros/ha
Hedges > 1000 m above sea level	0.3 Euros/m
Hedges < 1000 m above sea level	0.9 Euros/m

Besides the funding through the 2nd pillar of CAP, also specific eco-schemes could benefit biodiversity in South Tyrol (Autonome Provinz Bozen, 2023). These eco-schemes are subject to an annual commitment, which is compensated by an annual premium per hectare in addition to the basic premium. An annual ceiling for the total amount of compensation is set (Table 22). Farmers are compensated for management actions that fit within the context of these eco-schemes (Table 23).

Table 22 – Available budget for the eco-schemes that could promote farmland biodiversity in South Tyrol (Source: Autonome Provinz Bozen (2023)).

Eco-scheme	Annual ceiling available budget (in million euros)
2 – Permanent greening of woody crops	151.07
4 – Extensive systems for forage plants	168.85
5 – Specific measures for pollinators	44.43

Funded by
the European Union

Table 23 – Annual funding through the eco-schemes (Direct Payments) of the Common Agricultural Policy (CAP) given to farmers as compensation for the implementation of the schemes (Source: Autonome Provinz Bozen (2023)).

Eco-scheme	Obligation	Compensation
2 – Permanent greening of woody crops	Permanent greening of the areas with permanent crops (agricultural woody crops)	120 €/ha
4 – Extensive systems for forage plants	Crop rotation with legumes at least every two years, excluding or reducing the use of plant protection products, and synthetic herbicides	110 €/ha (increased by 20% in Natura 2000 areas)
5 – Specific measures for pollinators	Specific agronomic measures for crops of interest to beekeepers	Trees: 250 €/ha Arable land: 500 €/ha

3.4.4. Development of the optimisation scenarios in South Tyrol

Current situation (AS IS)

The current state of the habitat of the seven BirdWatch species that breed in South Tyrol will be assessed using the habitat suitability developed in the context of the BirdWatch project. These species are: Eurasian skylark, Yellowhammer, Red-backed shrike, Eurasian tree sparrow, Whinchat, European turtle dove and Common starling. To build these models, land management and land use-related variables will be derived from publicly available datasets, while others will be derived from remote sensing data such as Sentinel-2, a product of the Copernicus Programme by the European Space Agency (ESA) and the European Union (EU). These variables will be derived for the year 2022, as they serve as input for the habitat suitability model that uses bird observation data from 2022 for the Autonomous Province of South Tyrol. Based on the land use and land management of 2022, the current status of the habitat suitability of the seven BirdWatch species will be assessed at parcel level in South Tyrol.

Funded by
the European Union

Budget-constraint scenario

A *budget-constraint scenario* will be developed for South Tyrol. In this scenario, both the conservation measures subsidised in the context of the 1st pillar of the CAP (Table 23) and the measures subsidised in the context of the 2nd pillar (Table 20) will be considered. To assess the impact on the habitat suitability, it is necessary that the measures can be translated into a change in the explanatory variables used in the BirdWatch habitat suitability models. Therefore, only these measures for which this translation is possible will be considered. As compensation for the implementation of part of these measures is only possible within Natura 2000 zones (Figure 16), a special focus will be put on these zones. The BirdWatch habitat optimisation model will however be implemented on all agricultural parcels within South Tyrol to assess the optimal type and location of measures eligible for compensation regardless of their relation to Natura 2000 zones.

The type and location of the conservation measures will be selected in such a way that the sum of the habitat suitability of the species that breed in South Tyrol (i.e. Eurasian skylark, Yellowhammer, Red-backed shrike, European tree sparrow, Whinchat, European turtle dove and Common starling) is maximised (Eq. 1 in Deliverable 5.1). The surface area of parcels on which conservation measures are suggested by the habitat optimisation model will be limited by the budget available to compensate for the measures (Eq. 5 in Deliverable 5.1). The total available annual budget for eco-schemes that could promote farmland biodiversity financed through the 1st pillar of the CAP is provided in Table 22. The total available budget for measures financed in the context of the 2nd pillar of the CAP (supplemented with national co-financing) is available for the period 2023-2027 (Table 20). An equal distribution of the budget over the five-year period will be assumed to achieve an annual available budget. Within the Natura 2000 zones, the maximal allowed deterioration for the species that are protected by the zones will be set at zero (Eq. 7 in Deliverable 5.1). This will ensure that one or more species are not favoured at the expense of another species that requires special protection in that area. To halt the further decline of the Whinchat and Eurasian skylark, an additional constraint will be implemented that sets the maximal allowed deterioration of these species outside of Natura 2000 zones in which they occur also to zero (Eq. 7 in Deliverable 5.1). Further, potential constraints identified during the stakeholder engagement part of work package 7 of the BirdWatch project will be accounted for.

The *budget-constraint scenario* will result in a configuration of conservation measures that maximises the habitat suitability in agricultural parcels for the seven breeding species in South Tyrol.

Funded by
the European Union

3.5. Overview of the habitat optimisation scenarios

Table 24 provides an overview of the scenarios that will be developed per test region.

Table 24 – Summary of the optimisation scenarios described per test region in section 3.1.4 (Flanders, Belgium), 3.2.4 (Germany), 3.3.4 (Lithuania) and 3.4.4 (South Tyrol, Italy).

Test Region	Scenario	Objective	Coverage
Flanders (Belgium)	AS IS-scenario	Assessing the status of habitat suitability in agricultural areas	Region-wide coverage for the region of Flanders
Flanders (Belgium)	Species protection program scenario	Achieving conservation targets in species protection zones at minimal cost	Species protection areas
Flanders (Belgium)	Budget-constraint scenario	Maximising farmland bird habitat suitability at a fixed budget available for compensation	Region-wide coverage for the region of Flanders
Germany	AS IS-scenario	Assessing the status of habitat suitability in agricultural areas	Region-wide coverage for the State of Brandenburg
Germany	"Natura 2000" management scenario	Maximising farmland bird habitat suitability at a fixed budget available for compensation within Natura 2000 zones in the State of Brandenburg	Natura 2000 zones in the State of Brandenburg
Germany	"Special Protection Areas (SPAs) for birds" management scenario	Maximising farmland bird habitat suitability at a fixed budget available for compensation within "Special Protection Areas (SPAs) for birds" in the State of Brandenburg	SPAs for birds in the State of Brandenburg
Germany	Budget-constraint scenario	Maximising farmland bird habitat suitability at a fixed budget available for compensation in the State of Brandenburg	Region-wide coverage for the State of Brandenburg

Funded by the European Union

Test Region	Scenario	Objective	Coverage
Lithuania	AS IS-scenario	Assessing the status of habitat suitability in agricultural areas	Region-wide coverage for Lithuania
Lithuania	Localised habitat optimisation scenario	Maximising farmland bird habitat suitability at a fixed budget available for compensation per municipality	Region-wide coverage for Lithuania
South Tyrol (Italy)	AS IS-scenario	Assessing the status of habitat suitability in agricultural areas	Region-wide coverage for the Autonomous Province of South Tyrol
South Tyrol (Italy)	Budget-constraint scenario	Maximising farmland bird habitat suitability at a fixed budget available for compensation	Region-wide coverage for the Autonomous Province of South Tyrol

The development and description of habitat optimisation scenarios are inherently dependent on the definition of the optimisation objectives and constraints. These can vary significantly and even contradict among different stakeholder groups, reflecting their varying priorities and concerns. This variation underscores the importance of stakeholder engagement in the scenario development process. Consequently, it will be imperative to nuance our results adequately to reflect this diversity.

In instances with limited stakeholder engagement, there is a risk of obtaining a limited set of constraints. This does however not necessarily imply that the outputs of such scenarios lack usefulness. On the contrary, such scenarios can still serve as a valuable tool for raising awareness about the potential benefits of conservation measures. This awareness can be pivotal in increasing stakeholder engagement, catalysing more detailed scenario development and fostering a deeper understanding of conservation strategies in these and similar regions.

Funded by the European Union

4. Data availability

The description of the BirdWatch habitat optimisation model (Deliverable 5.1 – Description of the Land Use Allocation Algorithm) is available from the responsible author.

5. References

Aebischer NJ, Green RE, Evans AD. 2000. From science to recovery: four case studies of how research has been translated into conservation action in the UK. *Ecology and conservation of lowland farmland birds*: 43–54

Agentschap Landbouw & Zeevisserij. 2024a. VLIF Niet-productieve investeringen voor milieu- en klimaatdoelen (vanaf 2023) Available at: https://lv.vlaanderen.be/subsidies/vlif-steun/niet-productieve-investeringssteun [Accessed 18 April 2024]

Agentschap Landbouw & Zeevisserij. 2024b. Simulatie forfaitaire kost. Niet Productieve Investeringssteun (Bron: oproep 20/4/2024 - 30/6/2024). *E-loket Landbouw en Visserij* Available at: https://e-loket2.landbouwvlaanderen.be/p/vlif4/web/bui/vko-calculator-extern [Accessed 16 July 2024]

Agentschap Natuur & Bos. 2024. Compensatiesteun bescherming nesten en jonge broedvogels op landbouwpercelen.: 8

ALV. 2019. Dataserie Landbouwgebruikspercelen 2018. *geopunt* Available at: https://www.vlaanderen.be/datavindplaats/catalogus/landbouwgebruikspercelen-lv-2018 [Accessed 25 February 2021]

Anderle M, Paniccia C, Brambilla M, Hilpold A, Volani S, Tasser E, Seeber J, Tappeiner U. 2022. The contribution of landscape features, climate and topography in shaping taxonomical and functional diversity of avian communities in a heterogeneous Alpine region. *Oecologia* **199** (3): 499–512 DOI: 10.1007/s00442-022-05134-7

Autonome Provinz Bozen. 2023. Verordnung (EU) Nr. 2021/2115. GAP-Strategieplan 2023-2027. Übersichtsbroschüre. Maßnahmen der I. und II. Säule der gemeinsamen Agrarpolitik Available at: https://assets-eu-01.kc-usercontent.com/e90ea1ed-9101-0155-579f-5243d49e1f43/a7fa4715-9bd1-44f3-b095-def9dbf8b18a/ELR%20Broschuere%2023%20-%2027%2004.05.23.pdf

BfN. 2019. Ergebnisübersicht-Nationaler Vogelschutzbericht 2019. Bundesamt für Naturschutz. Available at: https://www.bfn.de/vogelschutzbericht-2019

BISE. 2024. Germany. *Biodiversity Information System for Europe* Available at: https://biodiversity.europa.eu/countries/germany [Accessed 26 June 2024]

BMEL. 2023. Der GAP-Strategieplan in Zahlen. *Bundesministeriums für Ernährung und Landwirtschaft (BMEL)* Available at: https://www.bmel.de/DE/themen/landwirtschaft/eu-agrarpolitik-und-foerderung/gap/gap-dashboard.html [Accessed 16 July 2024]

Funded by the European Union

Brusa G, Fratte MD, Bogliani G, Celada C, Gaibani G, Luoni F, Soldarini M. 2019. [Wetlands in the Continental biogeographical region of Northern Italy: from scenarios of change to conservation perspectives]. *Natural History Sciences* **6** (2) DOI: 10.4081/nhs.2019.427

CIVIS. 2024. Wiesenbrüter - Malser Haide - Gewährung einer Beihilfe Available at: https://civis.bz.it/de/dienste/dienst.html?id=1038144 [Accessed 9 July 2024]

Departement Landbouw & Visserij. 2024a. Fiche NPI - kleine landschapselementen (KLE) Available at: https://lv.vlaanderen.be/sites/lv/files/2024-04/Fiche%20NPI%20-%20kleine%20landschapselementen%20%28KLE%29.pdf

Departement Landbouw & Visserij. 2024b. Fiche NPI - wateropslagsystemen Available at: https://lv.vlaanderen.be/sites/lv/files/2024-01/Fiche%20NPI%20-%20wateropslagsystemen.pdf

Devos K, Anselin A, Driessens G, Herremans M, Onkelinx T, Spanoghe G, Stienen EWM, T'Jollyn F, Vermeersch G, Maes D. 2016. De IUCN Rode-Lijst van de broedvogels in Vlaanderen (Rapporten van het Instituut voor Natuur-en Bosonderzoek INBO. R. 2016.11485739)

Donald PF, Sanderson FJ, Burfield IJ, van Bommel FPJ. 2006. Further evidence of continent-wide impacts of agricultural intensification on European farmland birds, 1990–2000. *Agriculture, Ecosystems & Environment* **116** (3): 189–196 DOI: 10.1016/j.agee.2006.02.007

Duchardt CJ, Monroe AP, Heinrichs JA, O'Donnell MS, Edmunds DR, Aldridge CL. 2021. Prioritizing restoration areas to conserve multiple sagebrush-associated wildlife species. *Biological Conservation* **260**: 109212 DOI: 10.1016/j.biocon.2021.109212

Eionet. 2020. Article 12 web tool on population status and trends of birds under Article 12 of the Birds Directive (version 2020). Species trends at the Member State level: Lithuania Available at: https://nature-art12.eionet.europa.eu/article12/report?period=3&country=LT [Accessed 23 May 2024]

European Commission, Directorate-General for Environment. 2018. *International single species action plan for the conservation of the European turtle-dove Streptopelia turtur (2018 to 2028)*. Publications Office of the European Union: LU. Available at: https://data.europa.eu/doi/10.2779/743376 [Accessed 25 October 2023]

European Union. 2021. Regulation (EU) 2021/2115 of the European Parliament and of the Council of 2 December 2021 establishing rules on support for strategic plans to be drawn up by Member States under the common agricultural policy (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulations (EU) No 1305/2013 and (EU) No 1307/2013. *OJ L* **435** Available at: http://data.europa.eu/eli/reg/2021/2115/oj/eng [Accessed 18 June 2024]

Fraixedas S, Lindén A, Piha M, Cabeza M, Gregory R, Lehikoinen A. 2020. A state-of-the-art review on birds as indicators of biodiversity: Advances, challenges, and future directions. *Ecological Indicators* **118**: 106728 DOI: 10.1016/j.ecolind.2020.106728

Funded by the European Union

Heldbjerg H, Sunde P, Fox AD. 2018. Continuous population declines for specialist farmland birds 1987-2014 in Denmark indicates no halt in biodiversity loss in agricultural habitats. *Bird Conservation International* **28** (2): 278–292 DOI: 10.1017/S0959270916000654

HLNUG. 2015. Maßnahmenblatt Kiebitz (Vanellus vanellus). Hessisches Landesamt für Naturschutz, Umwelt und Geologie (HLNUG). Available at: https://www.hlnug.de/fileadmin/dokumente/naturschutz/artenschutz/steckbriefe/Voegel/Massnahmenblaetter/Mb_Kiebitz.pdf

INBO. 2024. Vogels van het landbouwgebied volgens de Algemene Broedvogelmonitoring Vlaanderen. *INBO* Available at: https://www.vlaanderen.be/inbo/indicatoren/vogels-van-het-landbouwgebied-volgens-de-algemene-broedvogelmonitoring-vlaanderen [Accessed 18 April 2024]

Inger R, Gregory R, Duffy JP, Stott I, Voříšek P, Gaston KJ. 2015. Common European birds are declining rapidly while less abundant species' numbers are rising. *Ecology Letters* **18** (1): 28–36 DOI: 10.1111/ele.12387

Kamp J, Frank C, Trautmann S, Busch M, Dröschmeister R, Flade M, Gerlach B, Karthäuser J, Kunz F, Mitschke A, et al. 2021. Population trends of common breeding birds in Germany 1990–2018. *Journal of Ornithology* **162** (1): 1–15 DOI: 10.1007/s10336-020-01830-4

Lauver CL, Busby WH, Whistler JL. 2002. Testing a GIS Model of Habitat Suitability for a Declining Grassland Bird. *Environmental Management* **30** (1): 88–97 DOI: 10.1007/s00267-001-2609-z

Lietuvos Ornitologų Draugijos. 2018. Pagal naują sistemą parengtame Lietuvos saugomų rūšių sąraše – pokyčiai Available at: https://www.birdlife.lt/pagal-nauja-sistema-parengtame-lietuvos-saugomu-ru [Accessed 4 June 2024]

Lietuvos Ornitologų Draugijos. 2024. Biologinės įvairovės išsaugojimas – mūsų visų rūpestis Available at: https://birdlife.lt/biologines-ivairoves-issaugojimas-musu-visu-rupest [Accessed 23 May 2024]

Mekonen S. 2017. Birds as Biodiversity and Environmental Indicator. *Advances in Life Science and Technology* **60** (0): 16

Ministerium für Landwirtschaft, Umwelt und Klimaschutz. 2023. Richtlinie des Ministeriums für Landwirtschaft, Umwelt und Klimaschutz des Landes Brandenburg zum Ausgleich von Kosten und Einkommensverlusten für Landwirte in Natura-2000-Gebieten Available at: https://mluk.brandenburg.de/sixcms/media.php/9/Richtlinie-Ausgleich-Einkommensverluste-Natura-2000.pdf

MLUK. 2024a. Direktzahlungen (2023 bis 2027). Betriebsprämienrechner Brandenburg 2024. *Ministerium für Landwirtschaft, Umwelt und Klimaschutz (MLUK)* Available at: https://mluk.brandenburg.de/mluk/de/landwirtschaft/agrarpolitik/neue-gap-foerderperiode-ab-2023/direktzahlungen/ [Accessed 16 July 2024]

MLUK. 2024b. Verwaltungsvorschrift des Ministeriums für Landwirtschaft, Umwelt und Klimaschutz zum Vertragsnaturschutz Offenland im Land Brandenburg (VV-VN Offenland). Ministerium

für Landwirtschaft, Umwelt und Klimaschutz (MLUK). Available at: https://mluk.brandenburg.de/mluk/de/service/foerderung/natur/vv-vertragsnaturschutz-offenland/

NABU. 2024. Vögel in Deutschland: 314 Arten kurz vorgestellt – NABU. *NABU - Naturschutzbund Deutschland e.V.* Available at: https://www.nabu.de/tiere-und-pflanzen/voegel/portraets/ [Accessed 18 April 2024]

natur-raum. 2023. Landschaftspflegeprämien. *Natur, Landschaft und Raumentwicklung: Landschaftspflegeprämien, Beiträge und Investitionen* Available at: https://natur-raum.provinz.bz.it/de/landschaftspflegepramien [Accessed 9 July 2024]

NMA. 2024. Parama. Patvirtinti išmokų dydžiai. *Nacionalinė mokėjimo agentūra prie Žemės ūkio ministerijos (NMA)* Available at: https://www.paramakaimui.lt/index.php/parama/tiesiogines-ismokos/patvirtinti-ismoku-dydziai/2023-m-patvirtinti-ismoku-dydziai/46179 [Accessed 16 July 2024]

PCFruit. 2009. Functionele biodiversiteit en ecologische maatregelen voor een duurzame landbouw. Hoofdstuk 2: Hagen. Available at: https://www.pcfruit.be/nl/functionele-biodiversiteit-en-ecologische-maatregelen-voor-een-duurzame-landbouw

Peach WJ, Lovett LJ, Wotton SR, Jeffs C. 2001. Countryside stewardship delivers cirl buntings (*Emberiza cirlus)* in Devon, UK. *Biological Conservation* **101** (3): 361–373 DOI: 10.1016/S0006-3207(01)00083-0

Rašomavičius V (ed.). 2021. *Lietuvos raudonoji knyga. Gyvūnai, augalai, grybai. (Red Data Book of Lithuania. Animals, plants, fungi).* Vilnius. Available at: https://gamtosknyga.lt/leidinys/lietuvos-raudonoji-knyga/

Reif J, Vermouzek Z. 2019. Collapse of farmland bird populations in an Eastern European country following its EU accession. *Conservation Letters* **12** (1): e12585 DOI: 10.1111/conl.12585

Rete Rurale Nazionale, Lipu. 2020. Common farmland birds in Italy. Update of population trends and Farmland Bird Indicator for the National Rural Network.

Rete Rurale Nazionale, Lipu. 2024. Provincia di Bolzano – Farmland Bird Index e andamenti di popolazione delle specie 2000-2023.

Rigal S, Dakos V, Alonso H, Auniņš A, Benkő Z, Brotons L, Chodkiewicz T, Chylarecki P, de Carli E, del Moral JC, et al. 2023. Farmland practices are driving bird population decline across Europe. *Proceedings of the National Academy of Sciences* **120** (21): e2216573120 DOI: 10.1073/pnas.2216573120

Stralberg D, Applegate DL, Phillips SJ, Herzog MP, Nur N, Warnock N. 2009. Optimizing wetland restoration and management for avian communities using a mixed integer programming approach. *Biological Conservation* **142** (1): 94–109 DOI: 10.1016/j.biocon.2008.10.013

Tarjuelo R, Margalida A, Mougeot F. 2020. Changing the fallow paradigm: A win–win strategy for the post-2020 Common Agricultural Policy to halt farmland bird declines. *Journal of Applied Ecology* **57** (3): 642–649 DOI: 10.1111/1365-2664.13570

Funded by the European Union

Traba J, Morales MB. 2019. The decline of farmland birds in Spain is strongly associated to the loss of fallowland. *Scientific Reports* **9** (1): 9473 DOI: 10.1038/s41598-019-45854-0

Tryjanowski P, Hartel T, Báldi A, Szymański P, Tobolka M, Herzon I, Goławski A, Konvička M, Hromada M, Jerzak L, et al. 2011. Conservation of farmland birds faces different challenges in Western and Central-Eastern Europe. *Acta Ornithologica* **46** (1): 1–12 DOI: 10.3161/000164511X589857

UNEP-WCMC. 2024. Protected Area Profile for Germany from the World Database on Protected Areas, June 2024. *Protected Planet* Available at: www.protectedplanet.net [Accessed 27 June 2024]

Vermeersch G, Devos K, Driessens G, Everaert J, Feys S, Herremans M, Onkelinx T, Stienen E, T'Jollyn F. 2020. Broedvogels in Vlaanderen 2013-2018. Instituut voor Natuur- en Bosonderzoek, Brussels, Belgium. DOI: doi.org/10.21436/inbor.18794135

Vlaamse Regering. 2017. *Soortenbeschermingsprogramma voor de grauwe klauwier*. Available at: https://codex.vlaanderen.be/Zoeken/Document.aspx?DID=1037892&param=informatie&ref=search&AVIDS=1463315,1463316

Vlaamse Regering. 2020a. *Soortenbeschermingsprogramma voor weidevogels met focus op de grutto (Limosa limosa) en de wulp (Numenius arquata)*. Available at: https://codex.vlaanderen.be/Zoeken/Document.aspx?DID=1035076&param=informatie&ref=search&AVIDS=

Vlaamse Regering. 2020b. *Soortenbeschermingsprogramma voor de zomertortel*. Available at: https://codex.vlaanderen.be/Zoeken/Document.aspx?DID=1035075&param=informatie&ref=search&AVIDS=

Vlaamse Regering. 2021. *Soortenbeschermingsprogramma voor akkervogels*. Available at: https://natuurenbos.vlaanderen.be/dieren-en-planten/soortenbescherming/lijst-van-alle-sbps#toc-akkervogels

Vlaanderen. 2023. Landbouwareaal. *www.vlaanderen.be* Available at: https://www.vlaanderen.be/statistiek-vlaanderen/landbouw-en-visserij/landbouwareaal [Accessed 20 June 2024]

VLM. 2014. Landbouwstreken. *www.vlaanderen.be* Available at: https://www.vlaanderen.be/datavindplaats/catalogus/landbouwstreken [Accessed 8 May 2024]

VLM. 2021. Beheerovereenkomsten in het nieuwe GLB (2023-2027) Available at: https://www.vlm.be/nl/nieuws/Pages/Beheerovereenkomsten-in-het-nieuwe-GLB.aspx [Accessed 22 April 2024]

Wesemeyer M, Kamp J, Schmitz T, Müller D, Lakes T. 2023. Multi-objective spatial optimization to balance trade-offs between farmland bird diversity and potential agricultural net returns. *Agriculture, Ecosystems & Environment* **345**: 108316 DOI: 10.1016/j.agee.2022.108316

Funded by the European Union

de Zwaan DR, Alavi N, Mitchell GW, Lapen DR, Duffe J, Wilson S. 2022. Balancing conservation priorities for grassland and forest specialist bird communities in agriculturally dominated landscapes. *Biological Conservation* **265**: 109402 DOI: 10.1016/j.biocon.2021.109402

Funded by
the European Union