



D2.2 Bird Species Requirements List

Deliverable for the Horizon Europe Project BirdWatch



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Introduction

BirdWatch's aim is to provide an EU-wide service supporting the monitoring and improvement of farmland habitat suitability for bird species which breed or forage on agricultural land.

The BirdWatch service will consist of an Earth Observation (EO) data-based monitoring service which evaluates the habitat suitability of farmland as well as of an optimisation workflow, serving as a decision-support for the identification of appropriate eco-schemes to improve habitat suitability.

An important input for deriving the habitat suitability are the habitat preferences of a bird species. To quantify the presence or absence of a habitat requirement, measurable proxies of a habitat requirement need to be found, which include, e.g., the land cover types with their respective percentage coverage, the occurrence of specific landscape elements, or the distance to these elements (e.g. forests, hedges, etc.). These proxies can then be fed into species distribution models (SDM)¹ which translate them into habitat suitability for specific species. The principles behind SDMs and the set up of the BirdWatch's SDM framework are part of WP4 and will be elaborated on in the respective deliverables.

In BirdWatch, habitat descriptors will mainly be derived from satellite data available from the Copernicus program of the EU that is jointly implemented with the European Space Agency (ESA), Entrusted Entities and Member States. Radar and multispectral images of the Sentinel-1 and Sentinel-2 satellites can be used to retrieve, e.g., textural parameters or land cover types. This is part of WP3 and will be described in detail in the deliverables D3.2-*Dynamic tools to integrate harmonised Sentinel-2 and Landsat timeseries in the modelling workflow* and D3.3-*Dynamic tools to integrate harmonised Sentinel-1 timeseries in the modelling workflow*. Further potential sources include digital terrain models, readily available land cover data or farmers' parcel information.

Apart from monitoring farmland habitats, parcel-based habitat suitability will also support the identification of appropriate pathways for the improvement of the habitat suitability of a specific agricultural parcel or holding. This will be accomplished by BirdWatch's internal optimisation framework which will match habitat requirements with the appropriate eco schemes, under consideration of the respective operational and financial constraints. The optimisation algorithm is part of WP5 and will be elaborated on in D5.1 - *Description of a Land Use Allocation Algorithm*.

¹ Edith J. & Leathwick J.R., 2009, *Species Distribution Models: Ecological Explanation and Prediction Across Space and Time*, Annual Review of Ecology, Evolution and Systematics, Vol 40:677-697, <https://doi.org/10.1146/annurev.ecolsys.110308.120159>



Selection of Target Species' Habitat Requirements

In deliverable D2-1-*Target bird species list*, we presented our ten initial target bird species, selected from a list of 39 bird species which are part of the Farmland Bird Index (FBI). Based on the selected species, we collected the respective habitat requirements under the following considerations:

- 1) They need to be sufficient to derive the habitat suitability for a specific bird species.
- 2) There should be enough habitat descriptors which are measurable via satellite remote sensing. This is especially important for cases in which additional data is not available and satellite data is the only source of data.
- 3) they need to allow the comparison of their respective importance for different bird species. This is especially relevant where certain habitat features have a positive impact on one bird species but a negative one on another. Conflicting habitat requirements and any regional climate-related factors will be addressed systematically in the SDM framework of WP4 as well as in the optimisation workflow of WP5.

Please note that the selection of ten initial bird species was necessary to advance the technical development. We will gradually include more species along with the respective habitat requirements.

Table 1 lists the types of habitat requirements collected for each bird species, along with the EO data and EO data-based measures to derive the presence or absence of a habitat requirement.

Requirement type	Requirement expressions	EO and EO-based data	Examples for EO-based measures
Structural habitat characteristics	● Open (e.g., wide, open fields) ● Semi-open (e.g., open fields with some vertical structures or landscape elements) ● Dense (dense growth of e.g., shrubs, trees or bushes) ● Mosaicked (mix of open and dense structures)	Sentinel 1 and -2 Readily available land cover classifications (e.g., Dynamic World ²)	Percentage land cover type per habitat Proportional extent of land cover type per habitat Texture measures (e.g., gray-level occurrence) Radar backscatter
Landscape elements	Trees, high shrubberies Low shrubberies, bushes, hedges	Sentinel 1 and -2	Percentage cover per land cover type

² <https://dynamicworld.app/>



	Water bodies and water edge vegetation Man-made structures	Readily available land cover classifications Digital terrain models & digital elevation models	Spectral & radar vegetation indices Radar backscatter Difference calculations
Vegetation types	Crop types Grassland types	Sentinel 1 and -2 Readily available land cover and crop type classifications (e.g., EuroCrops ³)	Percentage land cover type per habitat Spectral & radar vegetation indices Texture measures (e.g., grey-level occurrence) Time series metrics
Species diversity	Homogeneous vegetation species Heterogeneous vegetation species Mix of natural and cultivated species	Sentinel 1 and -2 Readily available land cover and crop type classifications	Percentage crop / vegetation type per habitat Proportional extent of crop / vegetation type per habitat Spectral & radar vegetation indices Radar backscatter Texture measures (e.g., grey-level occurrence) Statistical diversity measures of crop / vegetation types (e.g., shannon-wiener index)
Ground characteristics	Soil moisture (wet / dry) Terrain (e.g. flat, undulated)	Sentinel 1 Digital elevation & terrain models ESA SMOS (Soil	Radar-derived soil moisture Radar backscatter Degree of slope & slope

³ <https://zenodo.org/record/7476474#.ZG4g1KXP23D>



		Moisture and Ocean Salinity) Satellite	direction
Farmland cultivation practices	Mowing, cutting, grazing intensity Start of mowing, cutting, grazing period	Sentinel 1 and -2	Time series metrics Radar backscatter Interferometric coherence

Table 1: Types of habitat requirements to be collected for each bird species, including the EO data sources to be collected and the measures to be used for habitat requirement identification

Table 2 gives an overview of the readily available land cover classifications for which the respective usefulness will be explored.

For example, the year for which bird observation data is available to build the habitat models determines the year for which land cover information is necessary.

Product	Spatial Resolution	Coverage of Test regions	Remarks
Corine Land Cover ⁴	500 m	All	the spatial resolution is too coarse for BirdWatch's purpose most recent dataset stems from 2018, new land cover is available every ~ 6 years
CLC+ ⁵	10 m	All	most recent dataset stems from 2018
High Resolution Layers ⁶	10 m	All	most recent datasets stem from 2018 contain useful additional information & attributes (grassland, water & wetness, small woody features)
Dynamic World	10 m	All	continuously (every 2-5 days) updated based on Sentinel-2 data
Groenkaart Vlaanderen ⁷	1 m	Flanders	most recent dataset stems from 2021
Bodembe-dekkingskaart ⁸	1 m	Flanders	most recent dataset stems from 2018

⁴ <https://land.copernicus.eu/pan-european/corine-land-cover>

⁵ <https://land.copernicus.eu/pan-european/clc-plus>

⁶ <https://land.copernicus.eu/pan-european/high-resolution-layers>

⁷ <https://download.vlaanderen.be/product/8025-groenkaartvlaanderen2021>

⁸ <https://download.vlaanderen.be/product/7682-bodembedekkingskaartbbk1mresolutieopname2018>



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Mundialis - Land cover based on Sentinel-2 data ⁹	10 m	Germany	most recent dataset stems from 2020
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Table 2: Readily available land cover classifications

In addition, we collected information on behavioural and biological characteristics with relevance to farmland cultivation practices and which can serve as further information on preferences:

- Preferred diet (e.g., insects, arthropods)
- Breeding and age until independence (i.e., the period of highest vulnerability to farmland cultivation activities, including mowing times)
- Habitat generalist or specialist (i.e., the ability to adapt to different habitats)

The habitat requirements for each target bird species, listed below, describe the general requirements. The setup of the habitat models of WP4 might need to take into account any regional differences in habitat requirements. In these cases, local expert knowledge will be consulted and which is not yet listed in the habitat requirements for the individual bird species.

The final habitat models will be estimated using breeding occurrences to predict which landscapes support successful establishment of breeding pairs. These models will thus operate at the home range scale (rather than the individual foraging scale) or even coarser as the landscape context surrounding the home ranges can also have a decisive role for the breeding occurrence.

Considering that different farmland bird species can have different home range sizes we assumed 200 by 200 metres (4 hectares) to be a reasonable value that approximates most of our chosen species home ranges. Based on the habitat preferences listed here, we will then consider the proportional cover of different land use types and the structural characteristics of landscape elements (e.g. patch size, edge length) within the home range and within certain spatial distances around the focal cell to represent the landscape context. The optimal distance will have to be tested using the habitat models and may vary between study regions.

In the following, we present the habitat preferences for each bird species, with the focus on the habitat requirement types listed in Table 1.

⁹ <https://www.mundialis.de/en/deutschland-2020-landbedeckung-auf-basis-von-sentinel-2-daten/>



Alauda arvensis

(Eurasian Skylark)



Fig. 1: Adult eurasian skylark;

Image Source: Peter Kennerley <https://macaulaylibrary.org/asset/237452191>

Cultivation-relevant behavioural and biological factors

Breeding Season	March / April to late August
Nest location	Ground
Number of Broods per Season	Up to 3
Incubation Period	11 days
Age of Independence	30 days
Diet	Insects, seeds, nuts, grains Seasonally changing diet
Foraging location	Ground
Territoriality	Solitary

Habitat Requirements

Habitat Generalist	No
Structural habitat characteristics	Open, mosaicked farmland
Landscape elements	
<i>Trees, high shrubberies</i>	Avoids high trees, shrubberies, forest edges
<i>Low shrubberies, hedges</i>	Avoids these structures
<i>Water bodies</i>	Likes marshes and ditches



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Vegetation type

Crop type

Spring-grown cereals

(Winter-grown cereals often too dense for foraging)

Grassland type

Cereal grasses

Vegetation species diversity

Benefits from crop diversity

Soil Moisture

Dry

Terrain

No specific preferences

Farmland Cultivation

Intensity

Medium intensity

(prefers to breed in short vegetation)

Time period of mowing, cutting, grazing

Late season

Species Specific References

BirdLife International. 2021. *Alauda arvensis* (Europe assessment). The IUCN Red List of Threatened Species 2021: e.T102998555A200204640.

<https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T102998555A200204640.en>.

Accessed on 22 May 2023.

Brambilla M., 2019, *Six (or nearly so) big challenges for farmland bird conservation in Italy*, *Avocetta* 43, 101-113



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Anthus pratensis

(Meadow Pipit)



Fig. 2: Meadow pipit;

Image Source: Adrien Mauss, <https://macaulaylibrary.org/asset/36424311>

Cultivation-relevant behavioural and biological factors

Breeding Season	March to August
Nest location	Close to Ground / hidden in vegetation
Number of Broods per Season	Up to 2
Incubation Period	13 days
Age of Independence	31 days
Diet	Mainly invertebrates, sometimes plant seeds
Foraging location	On ground in short grass / sparse vegetation
Territoriality	Yes

Habitat Requirements

Habitat Generalist	No
Structural habitat characteristics	Open, semi-open Mosaicked (prefer short grass but



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	hide nests in tall grass)
Landscape elements	
<i>Trees, high shrubberies</i>	Avoids high trees, shrubberies, forest edges
<i>Low shrubberies, hedges</i>	Benefits from small shrubs, bushes
<i>Water bodies</i>	Dykes
	Avoids reedbanks
Vegetation type	
<i>Grassland type</i>	Hummock meadows, wet marshy meadows
Vegetation species diversity	Benefits from species richness
Soil Moisture	Dry or Wet
Terrain	No specific preferences
Farmland Cultivation	
<i>Intensity</i>	Selects foraging sites according to vegetation height, density and diversity (under both high intensity sheep grazing and low intensity mixed grazing)
	Avoids high intensity grazing
<i>Time period of mowing, cutting, grazing</i>	Late season

Species Specific References

BirdLife International. 2021. *Anthus pratensis (Europe assessment). The IUCN Red List of Threatened Species 2021*: e.T22718556A166405843.
<https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22718556A166405843.en>. Accessed on 22 May 2023.

Kumstátová T.; et al. , 2004, Habitat preferences of tree pipit (*Anthus trivialis*) and meadow pipit (*A. pratensis*) at sympatric and allopatric localities, *J Ornithol* (2004) 145: 334–342, DOI 10.1007/s10336-004-0048-3

Vandenberghe C. et al. , 2009, Influence of livestock grazing on meadow pipit foraging behaviour in upland grassland, *Basic and Applied Ecology* 10 662–670



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Emberiza citrinella

(Yellowhammer)



Fig. 3: Yellowhammer;

Image Source: Nigel Voaden, <https://macaulaylibrary.org/asset/78557031>

Cultivation-relevant behavioural and biological factors

Breeding Season	April to August
Nest location	Close to Ground / hidden in vegetation
Number of Broods per Season	Up to 2
Incubation Period	13 days
Age of Independence	23 days
Diet	Mainly seeds, grains and other plant materials tree, herb and grass species; During the breeding season it shifts to invertebrates
Foraging location	
Territoriality	Yes

Habitat Requirements

Habitat Generalist	No
Structural habitat characteristics	Semi-open



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Mosaics of crop-free plots and microhabitats (with patches of permanent vegetation), stubble fields and manure heaps

Landscape elements

Trees, high shrubberies

Low shrubberies, hedges

Water bodies

Vegetation type

Crop type

Shrubs, forest edges

Shrubs, hedges

No specific preferences

Cereals

Winter stubble fields important sources of non-cereal plant food

Benefits from semi-natural habitats

Dry and Wet

No specific preferences

Vegetation species diversity

Soil Moisture

Terrain

Farmland Cultivation

Intensity

Tilled fields are favoured over grassland for territory settlement and by adults foraging for their chicks

Uncultivated fields are important as source for weeds

Time period of mowing, cutting, grazing

Late season

Species Specific References

BirdLife International. 2021. *Emberiza citrinella* (Europe assessment). *The IUCN Red List of Threatened Species* 2021: e.T22720878A166420307.

<https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22720878A166420307.en>.

Accessed on 22 May 2023.

Copete, J.L. 2016. Yellowhammer (*Emberiza citrinella*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. and de Juana, E. (eds), *Handbook of the Birds of the World Alive*, Lynx Edicions, Barcelona.

Orlowski, G., Czarnecka, J. and Golawski, A. 2014. Winter diet of Yellowhammers *Emberiza citrinella* on contemporary farmland: the different contribution of forbs, wild grasses and cereals in semi-natural and agricultural habitats. *Bird Study* 61: 484-495.

Whittingham, M.J., Swetnam, R.D., Wilson, J.D., Chamberlain, D.E. and Freckleton, R.P. 2005. Habitat selection by yellowhammer *Emberiza citrinella* on lowland farmland at two spatial scales: implications for conservation management. *Journal of Applied Ecology* 42: 270-280.



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Saxicola rubetra

(Whinchat)



Fig. 4: Saxicola rubetra;

Image Source: Ian Davis, <https://macaulaylibrary.org/asset/42408031>

Cultivation-relevant behavioural and biological factors

Breeding Season	April to August
Nest location	Close to Ground / hidden in vegetation
Number of Broods per Season	1
Incubation Period	13 days
Age of Independence	29 days
Diet	Mainly invertebrates and arthropods, sometimes fruits and seeds Feed grains to their young
Foraging location	Ground
Territoriality	Yes

Habitat Requirements

Habitat Generalist	No
Structural habitat characteristics	Open to semi-open



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Landscape elements

Trees, high shrubberies

Low shrubberies, hedges

Water bodies

Vegetation type

Grassland type

Vegetation species diversity

Soil Moisture

Terrain

Farmland Cultivation

Intensity

Time period of mowing, cutting, grazing

Single trees

Scattered shrubs, bushes, herb layers

Breeds in the fringes of reedbeds

Wildflower pastures, herbaceous plants

No clear benefits

Dry and Wet

No specific preferences

Low intensity

Benefits from low intensity grassland farming

Late season

Species Specific References

BirdLife International. 2021. *Saxicola rubetra* (Europe assessment). *The IUCN Red List of Threatened Species* 2021: e.T22710156A166355215.

<https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22710156A166355215.en>. Accessed on 22 May 2023.

Britschgi, A., Spaar, R. and Arlettaz, R. 2006. Impact of grassland farming intensification on the breeding ecology of an indicator insectivorous passerine, the Whinchat *Saxicola rubetra*: Lessons for overall Alpine meadowland management. *Biological Conservation* 130(2): 193-205.



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Lanius collurio

(Red-backed Shrike)



Fig. 5: Red-backed Shrike;

Image Source: Ferit Bašbuğ, <https://macaulaylibrary.org/asset/28885141>

Cultivation-relevant behavioural and biological factors

Breeding Season	May to July
Nest location	Open arboreal, cup in bush, tree
Number of Broods per Season	1
Incubation Period	14 days
Age of Independence	37 days
Diet	Mostly insects and other invertebrates as well as small mammals, birds, amphibians and reptiles.
Foraging location	Often forages from a high branch above the bush, before diving to the ground from there. Sometimes also catches insects in flight.
Territoriality	Yes

Habitat Requirements

Habitat Generalist	Yes (as long as there is enough feed)
Structural habitat characteristics	Mosaicked



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High-quality habitats tend to feature mosaic-like grassy vegetation with alternating areas of tall and short growth and bare areas, with perches. Benefits from linking of suitable habitat fragments by a series of protected areas

Landscape elements

Trees, high shrubberies

Low shrubberies, hedges

Water bodies

Vegetation type

Vegetation species diversity

Soil Moisture

Terrain

Farmland Cultivation

Intensity

Low trees

Shrubs, bushes, hedges with medium to high density e.g., for nesting

(recommended: 15-20 % coverage by shrubs / hedges)

No clear preferences

Overgrown Orchards

Open Grasslands

Benefits from diversity / semi-natural cultivations

Dry and wet

Prefers gently sloping terrain

Medium intensity

Species Specific References

BirdLife International. 2021. *Lanius collurio (Europe assessment). The IUCN Red List of Threatened Species* 2021: e.T22705001A166332899.

<https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22705001A166332899.en>. Accessed on 22 May 2023.

Brambilla M., 2019, Six (or nearly so) big challenges for farmland bird conservation in Italy, *Avocetta* 43: 101-113

Brambilla M., Rubolini D., Giodali, F., Between land abandonment and agricultural intensification: habitat preferences of Red-backed Shrikes *Lanius collurio* in low-intensity farming conditions. *Bird Study* (2007) 54, 160–167

Ceresa et. al., 2012, The importance of key marginal habitat features for birds in farmland: an assessment of habitat preferences of Red-backed Shrikes *Lanius collurio* in the Italian Alps, *Bird Study* 59, 327–334



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Limosa limosa

(Black-tailed Godwit)

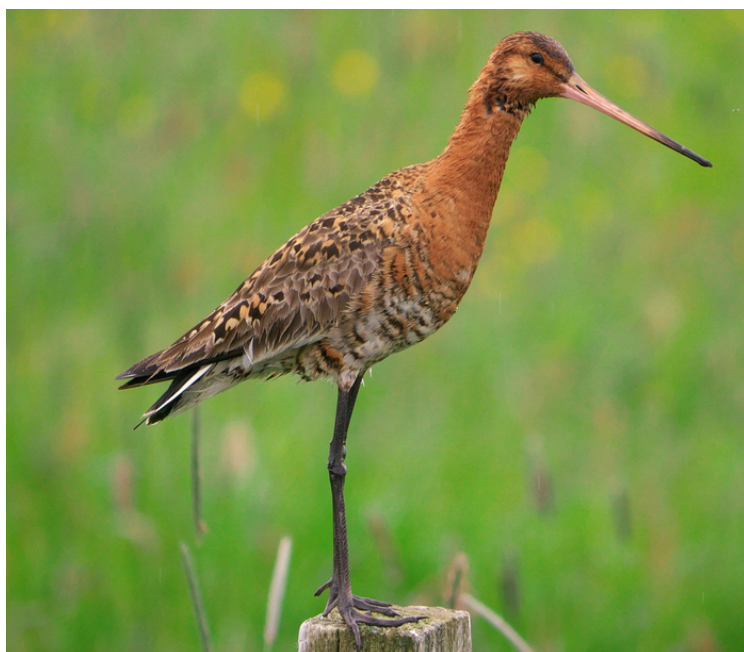


Fig. 6: Black-tailed Godwit;

Image Source: Paul Tavares, <https://macaulaylibrary.org/asset/35830281>

Cultivation-relevant behavioural and biological factors

Breeding Season	April to mid June-July
Nest location	Ground
Number of Broods per Season	1
Incubation Period	23 days
Age of Independence	Leaving nest after 0 days, flying after 28 days
Diet	Adults: soil fauna e.g. worms, leatherjackets, fish eggs Chicks: insects, spiders (above soil) In Winter plant material, including rice grains, berries and seeds
Foraging location	Ground
Territoriality	Yes



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Habitat Requirements

Habitat Generalist

No

Structural habitat characteristics

Open

Sufficient amount of tall grass with an open vegetation structure during the pre-fledging period (May to mid-June) in which chicks can feed and find cover

Landscape elements

Trees, high shrubberies

Avoids these elements

Low shrubberies, hedges

Avoids these elements

Water bodies

Ditches are beneficial

Flooded areas are important for roosting

(pre- and post-breeding) and for feeding, especially in the pre-breeding period

Man-made structures

Avoids man-made structures

Vegetation type

Grassland type

mildly-fertilised, herb-rich grassland

Swards

Rich in soil fauna (adults)

Rich in flowers (chicks)

Vegetation species diversity

Benefits from species diversity

Soil Moisture

Wet

Terrain

Flat

Farmland Cultivation

Intensity

Late 1st mowing date (only 1 brood per season)

Grazed much better than mowed grassland

Benefits from mosaic management

Species Specific References

BirdLife International. 2021. *Limosa limosa* (Europe assessment). *The IUCN Red List of Threatened Species* 2021: e.T22693150A166244428.

<https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22693150A166244428.en>. Accessed on 22 May 2023.

Kleijn, D.; Schekkerman, H.; Dimmers, W. J.; Van Kats, R. J. M.; Melman, D.; Teunissen, W. A. 2010. Adverse effects of agricultural intensification and climate change on breeding habitat quality of Black-tailed Godwits *Limosa l. limosa* in the Netherlands. *Ibis* 152: 475-486.



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MANAGEMENT PLAN for BLACK-TAILED GODWIT (*Limosa limosa*) 2007 –2009

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Oosterveld, E.B., van Lierop, S. & Sikkema, M. 2009. Use of unfertilised margins on intensively managed grassland by Black-tailed Godwit *Limosa limosa* and Redshank *Tringa totanus* chicks. Wader Study Group Bull. 116(2): 69–74.

Van Gils, J., Wiersma, P., Christie, D.A. & Garcia, E.F.J. 2017. Black-tailed Godwit (*Limosa limosa*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E (ed.), *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona. (retrieved from <http://www.hbw.com/node/53888> on 17 February 2017).



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Passer montanus

(Eurasian Tree Sparrow)



Fig. 7: Adult Eurasian Tree Sparrow;

Image Source: Ivan Sjögren, <https://macaulaylibrary.org/asset/219798061>

Cultivation-relevant behavioural and biological factors

Breeding Season	April to August
Nest location	Hole: in tree, bank, ground, crevice
Number of Broods per Season	2 to 3
Incubation Period	13 days
Age of Independence	30 days
Diet	Mainly seeds and it prefers smaller seeds of low herbs and grasses Diet changes over the season
Foraging location	On the ground or in trees, also hopping on herbaceous plants to obtain seeds or arthropods
Territoriality	No

Habitat Requirements

Habitat Generalist	Yes
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Structural habitat characteristics	Dense, mosaicked
Landscape elements	
<i>Trees, high shrubberies</i>	Yes, e.g. for nesting
<i>Low shrubberies, hedges</i>	Yes; shrubs, hedges
<i>Man-made structures</i>	Also found in build-up areas
Vegetation type	
<i>Crop type</i>	Orchards Spring-sown cereals provide food source Root crops Weedy fodder Make use of seed-bearing crops
Vegetation species diversity	Benefits from crop diversity
Soil Moisture	Dry Often chooses nest places in vicinity of wetlands
Terrain	No specific preferences
Farmland Cultivation	
<i>Intensity</i>	Low intensity

Species Specific References

BirdLife International. 2021. *Passer montanus* (Europe assessment). *The IUCN Red List of Threatened Species* 2021: e.T22718270A166399056.

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Streptopelia turtur

(European Turtle Dove)



Fig. 8: Juvenile European Turtle Dove;

Image Source: Yann Kolbeinsson, <https://macaulaylibrary.org/asset/183922461>

Cultivation-relevant behavioural and biological factors

Breeding Season	April to September
Nest location	Open arboreal, cup in bush, tree
Number of Broods per Season	2 to 3
Incubation Period	14 days
Age of Independence	28 days
Diet	Seeds and fruits of weeds and cereals
Foraging location	On the ground; prefer open foraging sites
Territoriality	Solitary

Habitat Requirements

Habitat Generalist	Yes
Structural habitat characteristics	Mosaic of low intensity arable landscapes with fallow fields or low-input crops that provide accessible abundant seed and with a heterogeneous sward structure with at least one-third bare ground.



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Landscape elements

Trees, high shrubberies

Trees

Low shrubberies, hedges

Shrubs, hedges

Water bodies

Breeds in reedbeds and marshes; visits standing water

Vegetation type

Crop type

Fruit, cereals

Vegetation species diversity

Benefits from species diversity

Soil Moisture

Dry and Wet

Terrain

No specific preferences

Farmland Cultivation

Intensity

no/low-input rotational fallow/crop land

Time period of mowing, cutting, grazing

Late season

Species Specific References

Baptista, L.F., Trail, P.W., Horblit, H.M., Boesman, P. and Sharpe, C.J. 2015. European Turtle-dove (*Streptopelia turtur*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. and de Juana, E. (eds), *Handbook of the Birds of the World Alive*, Lynx Edicions, Barcelona.

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Sturnus vulgaris

(Common Starling)



Fig. 9: Adult Common Starling;

Image Source: Ryan Schain, <https://macaulaylibrary.org/asset/39278421>

Cultivation-relevant behavioural and biological factors

Breeding Season	March to July
Nest location	Hole: in tree, bank, ground, crevice, building
Number of Broods per Season	1 to 2
Incubation Period	12 days
Age of Independence	29 days
Diet	Insects, Invertebrae, opportunistic omnivore Fruits and grains when young
Foraging location	Ground
Territoriality	Gregarious

Habitat Requirements

Habitat Generalist	Yes
Structural habitat characteristics	Open / Semi-open or



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mosaicked, with small distances to foraging / nesting sites

Landscape elements

Trees, high shrubberies

Low shrubberies, hedges

Man-made structures

Trees, e.g. for nesting

Shrubs

Also found in build-up areas

Vegetation type

Crop type

Spring sown crops such as maize, fodder beet and spring sown cereals

Orchards

Grassland type

Dry or wet

Vegetation species diversity

Benefits from crop diversity

Soil Moisture

Dry or wet

Terrain

No specific preferences

Farmland Cultivation

Intensity

Medium intensity

Show preference for grazed areas (e.g., for finding prey)

Species Specific References

BirdLife International. 2021. *Sturnus vulgaris (Europe assessment). The IUCN Red List of Threatened Species* 2021: e.T22710886A166360937.

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Vanellus vanellus

(Northern Lapwing)



Fig. 10: Northern Lapwing;

Image Source: Yann Kolbeinsson, <https://macaulaylibrary.org/asset/23897261>

Cultivation-relevant behavioural and biological factors

Breeding Season	April to July
Nest location	Ground
Number of Broods per Season	1
Incubation Period	28 days
Age of Independence	40 days
Diet	Primarily insects and other small invertebrates, in and above soil
Foraging location	Ground
Territoriality	Gregarious

Habitat Requirements

Habitat Generalist	No
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Structural habitat characteristics

Landscape elements

Trees, high shrubberies

Low shrubberies, hedges

Water bodies

Man-made structures

Vegetation type

Crop type

Grassland type

Vegetation species diversity

Soil Moisture

Terrain

Farmland Cultivation

Intensity

Open, sparse vegetation

Avoids high trees, shrubberies, forest edges

Avoids these structures

especially the breeding success, the successful fledging of the offspring, depends on the presence of permanent water-logged areas

Ditches

Avoids man-made structures

In breeding season prefer spring sown cereals, root crops

Winter crops, e.g. wheat, barley, rye or oilseed-rape

Short grass with bare spots

Benefits from species diversity

Wet or dry

Flat

Low intensity

Suggested ploughing or mowing before breeding season (low vegetation preferred for breeding)

Benefit from Lapwing-specific plots / Mosaic management

Species Specific References

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