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BioBio indicator factsheet

Wild Bees and Bumblebees (Bees)

Refers to Chapter 6 ‘Species diversity indicators’ of the Guidebook ‘Biodiversity Indicators for European Farming Systems’

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Wild Bees and Bumblebees (Bees)

Description

Wild bees and bumblebees are pollinators of selected crops and wild flowering plants and as such are sensitive to the diversity and continuity of pollen and nectar supply in the flowering succession throughout spring and summer. Additionally, wild bees require appropriate nesting sites to propagate successfully. There is concern about recent, significant declines recorded for this group and that the economically important associated ecosystem service of crop and orchard pollination may be compromised. This is a **state indicator** and over time it can be used as a **change indicator**. There are initiatives to monitor bees using comparable methods across Europe due to this concern and comparison with this broader dataset adds value to the adoption of this indicator. Many common bee species are easily identifiable in the field with the aid of popular field guides, although the smaller, rarer species will require taxonomic expertise to confirm species identification. The indicator can allow comparison across spatial scales, namely the contribution of habitats within a farm, comparisons between farms of a region and pan-European assessment.

Surveyor skills

Surveyors must know how to use handheld GPS and how to retrieve stored co-ordinates to find each location. Manual dexterity and keen vision are required to feed out the measuring tape and to observe, identify or capture bees encountered along a walked transect. Use of a handheld net and experience of the procedure to transfer bees to labelled containers is essential to avoid the loss of specimens. Prior experience or training in the colours and physical characteristics of the queens, drones (males) and workers of common bee species for the geographic location is desirable.

Data collection method

Equipment: handheld net, 50 m tape measure, marker canes, killing jar, labelled sample pots, light meter, digital thermometer, anemometer, field guides to bee and wildflower identification.

Sampling procedure: Sampling is undertaken in each of the habitat types identified on the farm during the habitat mapping, i.e. one habitat/field plot per habitat type. A walked transect of 100 m total length must be accommodated into areal and linear features. The transect will require careful sub-division and positioning to represent the feature or to achieve the required length when features are close to the minimum mapping sizes of 400 m^2 (ca. 20 m available width) for areal and 30 m length for linear features. Due to the sensitivity of bee foraging activity to weather, the sampling should take place only when conditions are dry and bright (cloud cover less than 50%) between 10.00h and 19.00h, wind no stronger than Beaufort scale 4 (7 m s^{-1}) and temperature at or above 15^{o}C. A cane is placed at the start of the transect, angled 45^{o} away from the direction of the transect so that the tape measure end can be slid over the cane without pulling off under tension during the walk. The 100 m or shorter segments are walked steadily, spooling out the tape at a rate equivalent to 15 minutes for the 100 m or 0.4 km h^{-1}. The clock should be stopped each time the recorder stops, or a bee is netted, transferred to a sample tube or identified and recorded. Observations of bees are recorded in a 2 x 2 m width and height window along the length of the transect. It is desirable to note the species of flowering plant that each foraging bee is visiting. All monitoring sites of a region should be sampled in a 10 day period for each of three sampling events: spring, mid- and late summer.

The distinctive buff-tailed bumblebee Bombus monticola (top) of a grazed upland heath transect in Wales, UK (bottom). Photos: Peter Dennis, Aberystwith University

Calculation method

The basic comparator is the total number of species per habitat observed over the three sampling dates. This can be used to represent the number of species per farm or geographic region for general comparisons at each of these spatial scales and over time by aggregation of the number of species found in habitats. Estimates of the species richness of farms can be calculated from the species lists obtained for habitats (gamma, alpha, area weighted, rarefied and Chao estimated richness).

Synergies with other indicators

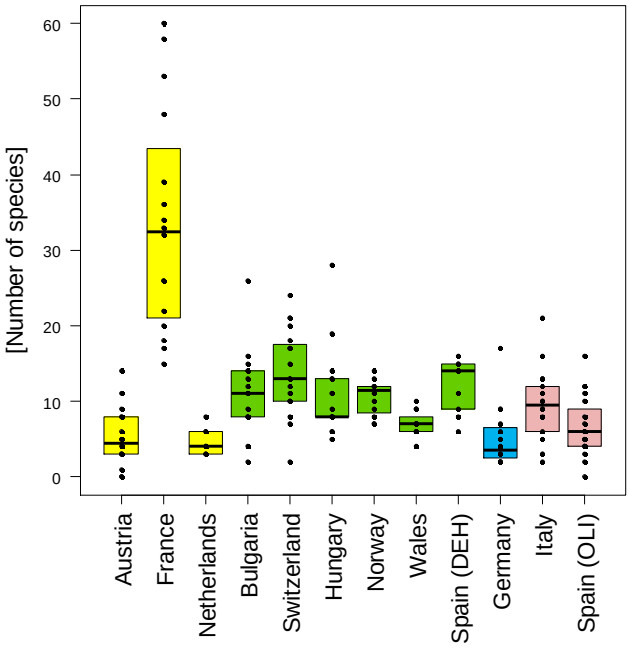
There is a relationship with the indicator farm gamma species richness of 'Vascular Plants' (8 of 12 case studies), of 'Spiders' (in 6 of 12 case studies) and of 'Earthworms' (in 3 of 12 case studies). In most of the farms, bee species richness was

Bee transect sampling in progress on Swiss grassland, illustrating use of tape to measure 100 m distance and with handheld net deployed (top) to collect and transfer a bee specimen to the killing jar (center and bottom) prior to transferring specimen to labelled dry pot or pinned into specimen box. Photos: Gisela Lüscher, Agroscope.

not significantly correlated to indirect management indicators recorded at farm level except in the German case study. Bee species richness was significantly correlated to 'Habitat Diversity' and sub-indicators, mostly in grassland dominated case studies. In Austria, bee species richness was positively related to the 'Tree Cover'. Bee species richness may add valuable additional information and deviate from a strong relationship with other habitat and management indicators, for instance when flowering is of brief duration during the year or there is an absence of suitable nest sites on the farmland (e.g., small mammal burrows in uncultivated or less grazed ground or crevices in walls and hollows in trees).

Estimated effort and costs (labour effort required, analysis)

The field sampling for a typical farm of 15 sample plots is estimated at 1.85 person days per farm for the 3 visits and sampling from 15 transects. The 45 samples yielded per farm each year will contain an average of 4 specimens per sample which requires an estimated 3.6 person days on identification per farm. Before identification specimen have to be pinned or



Distribution of indicator 'Wild Bees and Bumblebees'. *Each point displays the indicator value of a farm. Farms are grouped in the respective case studies. Yellow: field crops & horticulture in Austria, France and the Netherlands,green: specialist grazing livestock in Bulgaria, Switzerland, Hungary, Norway, Wales and Dehesa in Spain, blue: mixed crops & livestock in Germany, pink: permanent crops in Italy and olives in Spain. The colored box contains the values of 50 % of the farms of a case study. The line marks the median.*

frozen. For some genera it is necessary to genitalise the males.

Wild Bees and Bumblebees as an indicator

Significant declines in populations of domesticated honey bees and wild bumblebees and the potential catastrophic effect on effective yields of crops and orchard fruits have drawn strong attention to the vital ecosystem service of pollination. Weather conditions were noted to compromise the effective sampling of farms for the target three occasions, especially in countries occupying the western seaboard or north of Europe. This can accumulate additional costs from the need to revisit farms under suitable weather conditions. This can also disrupt the programme of sampling other indicators. In general, the field survey method can be undertaken by non-specialists given one or more amenable centres which can provide taxonomic support.

Interpretation

A change in indicator value (change in state) can reflect reduced densities of flowers from intensive arable farming, high stocking densities of livestock or increased inputs of nitrogen fertiliser. Favourable changes in this state indicator may also be a response to the application of agri-environmental policies, e.g., increased linear elements composed of dicotyledonous flowering plants that provide nectar and pollen sources and rank grassland where small mammals may be active and leave abandoned holes as potential bumblebee nest sites.

This factsheet is part of the Guidelines **Biodiversity Indicators for European Farming Systems**.
More detailed information on the set of indicators developed in the EU FP7 research project BioBio (Biodiversity indicators for organic and low input farming systems, KBBE-227161) is given in a printed report, published as ART Publication Series Nr. 17. The report can be downloaded from the BioBio website.
Printed versions can be ordered at www.agroscope.admin.ch or at Agroscope, Reckenholzstrasse 191, 8046 Zurich, Switzerland

BioBio Indicator Factsheets

Genetic diversity	
Breeds:	Number and amount of different breeds
CultDiv:	Number and amount of different varieties
CropOrig:	Origin of crops

Species diversity	
Plants:	Vascular plants
Bees:	Wild bees and bumblebees
Spiders:	Spiders
Earthworms:	Earthworms

Habitat diversity	
HabRich:	Habitat richness
HabDiv:	Habitat diversity
PatchS:	Average size of habitat patches
LinHab:	Length of linear habitats
CropR:	Crop richness
ShrubHab:	Percentage of farmland with shrubs
TreeHab:	Tree habitats
SemiNat:	Percentage of semi-natural habitats

Indirect management indicators / parameters	
EnerIn:	Total direct and indirect energy input
IntExt:	Intensification/Extensification - Expenditure on inputs
MinFert:	Area with use of mineral nitrogen fertiliser
NitroIn:	Total nitrogen input
FieldOp:	Field operations
PestUse:	Pesticide use
AvStock:	Average stocking rate
Graze:	Grazing intensity