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BIOBIO indicator factsheet

Spiders (Spiders)

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

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Origin of Crops (CropOrig)

Description

Spiders are exclusively predators found in crops, pastures and all kinds of semi-natural habitats on farmland. The actual species composition of spiders found in a particular habitat will vary and depends upon the availability of different kinds of insect prey and the architecture of plant species which provide anchorage for web producing species. There are also spider species that actively chase or ambush prey on a range of substrates from bare ground and short turf to tussock grassland and flowerheads. Populations of spiders can be adversely affected by insecticide applications to arable crops and can take several weeks to recover, usually from immigration by small, ballooning money spiders. Scientific research has demonstrated an important role of spiders as natural enemies of many crop pest species. Thus, there is a potential economic benefit of spiders through their prevention of certain plant feeding insect populations from reaching damaging levels in most years (ecosystem service). Species diversity of spiders can be used as a **state indicator** and over time it can be used as a **change indicator**. There are national initiatives to record the distribution of spiders in several European countries and they are also monitored in some national Long Term Environmental Change programmes. Identification depends upon sampling spiders when they are present in habitats as adults since only that life stage expresses the distinct characteristics used by experts to identify spiders at species level. The indicator can allow comparison across spatial scales, namely the contribution of habitats within 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. They do not require any specialist knowledge of spiders since the sampling method effectively collects spiders using a modified leaf blower which vacuum samples the vegetation. The sample is placed in a labelled bag and frozen until later laboratory sorting (alternative: immediate hand sorting). The same surveyors may be able to undertake primary sorting in the laboratory. This involves the separation of spiders from the vegetation, dust and other invertebrates in the frozen sample. It requires basic training in order to recognise the variety of sizes, body shapes and colours of spiders. During sorting, all spiders are transferred from the frozen field sample to a preservative solution in a small, labelled tube for later dispatch to a taxonomic expert. Species identification requires a high level of taxonomic specialism and experience available in just a few centres and the capacity to promptly identify all specimens in samples is critical for the widespread adoption of this indicator.

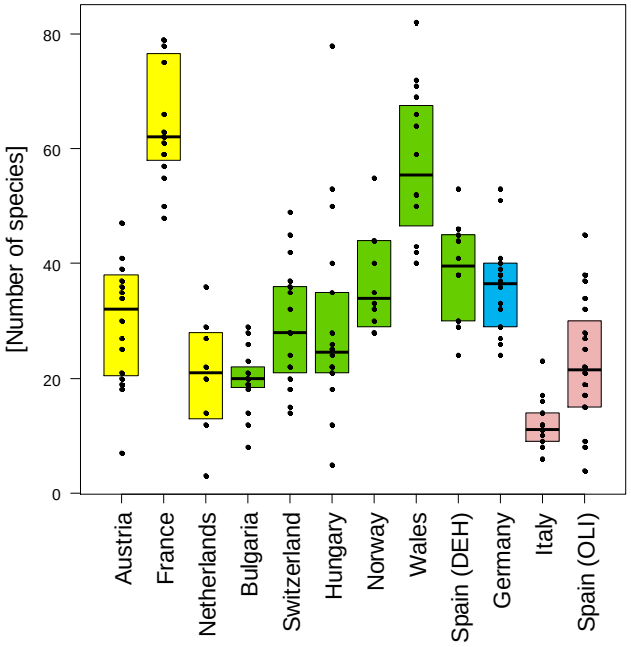
Data collection method

Equipment: handheld GPS, stopwatch, a flexible plastic sample tube of 0.357 m internal diameter x 0.4 m height, five 30 x 20 cm polyethylene zip seal bags for each sample plot, permanent marker pen, motorised leaf blower, 5 l fuel can, a 50 cm long, tapering gauze bag (mesh < 0.5 mm) with Velcro retaining strips on the outside hem of the net and around the outside of the 11 cm diameter intake nozzle to intercept the arthropods, two cool boxes with freezer packs, one 90 x 60 cm polyethylene bag per farm.

Female (left) and male (right) Silometopus elegans, a money spider species common in grasslands (left).

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. At each farm, once surveyors have located the plot to be sampled, they must randomly select five locations for sub-samples to represent the characteristic fine-scale variability in the vegetation of each of the areal or linear features. A modified leaf blower is used to suck material for each sub-sample. Firstly, a flexible plastic sample tube is positioned over the vegetation and held firmly in place by an assistant. The leaf blower motor is then immediately started and nozzle with fitted net lowered inside the sample area and moved around the enclosed vegetation for 30-45 seconds on full power. On completion, the nozzle is removed and raised upright, the engine stopped and the contents of the sleeve inverted into the pre-labelled polyethylene bag, ideally labelled and provided by the assistant. The fabric net stays fixed to the nozzle of the leaf blower at all times unless wetted by rain or dew fall or torn by thorny vegetation or general wear and tear. The sampling procedure is repeated for all five sub-samples of the sample plot, each being added to the same polyethylene sample bag (or stored separately if needed). This is then stored in the cool box until transfer to a domestic freezer at the end of the sampling day. This method is not appropriate in wet weather or for wet habitats because the net will become waterlogged and spiders will become trapped on the water film in the net and be transferred to the next sample, thus becoming a source of error. Sampling will need to stop following the onset of rain, nets dried and sampling can only recommence once the vegetation has sufficiently dried out. All monitoring sites of a region should be sampled in a 10 day period for each of three sampling events: spring, early and late-summer.

Modified leaf blower sampling spiders from circular frame in a degraded habitat within upland grassland in Wales, UK (top left). Fitting of fabric sleeve to nozzle of leaf blower before the start of sampling (top right). Transferring of spiders with leaf matter and soil to zip-sealed bag (left) and sorting and transfer of spiders from other sample material for transfer to small tubes with ethanol in the laboratory (bottom left). Photos: Peter Dennis. Aberystwyth University



Distribution of indicator 'Spider species diversity'
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.

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). Since juveniles can hardly be identified at species level, they are excluded from the indicator calculation.

Synergies with other indicators

There is a relationship with the indicator farm gamma species richness of 'Vascular Plants' (in 7 of 12 case studies), of 'Wild Bees and Bumblebees' (6 of 12 case studies) and of 'Earthworms' (in 4 of 12 case studies). In most of the farms, spider species richness was not significantly correlated to indirect management indicators recorded at farm level. Spider species richness was significantly correlated to the sub-indicators 'Diversity of Semi-natural Habitats' (in 4 case studies) and 'Diversity of Linear Habitats' (in 5 case studies). In Austria, spider species richness was positively related to the 'Tree Cover'. 'Percentage of Farmland with Shrubs' and 'Length of Grassy Linear Features' were correlated to the spider species richness in 4 case studies. Spider species richness may add valuable additional information and deviate from a strong relationship with other habitat and management indicators. For instance spiders will respond both to the natural variation in architecture of different plant species and to the effects of cutting and grazing regimes that modify such vegetation structure.

Estimated effort and costs (labour effort required, analysis)

The field sampling for a typical farm of 15 sample plots is estimated at 2.16 person days per farm for the 3 visits. The 45 samples yielded per farm each year will contain an average of 14 specimens per 0.5 m^2 sample. These require an estimated 3.5 person days for sorting and 1.5 person days for identification per farm.

Spiders as an indicator

Spiders species richness will be a function of a combination of the structural characteristics of vegetation (habitat x botanical diversity) and the variety of major prey species available (botanical diversity). Shrubs, trees and hedges should contribute many spider species but this will not be fully represented in a protocol where there is emphasis on sampling under or adjacent to such features. Spiders are sensitive to pesticide applications on arable and horticultural crops and the number of recorded species may be significantly lower than expected from the vegetation structure for some time after such applications.

Interpretation

A reduction in indicator value (change in state) can reflect reduced incidence of semi-natural habitats, increased uniformity of vegetation caused by high stocking densities of livestock or mortality caused by increased inputs of pesticides. Favourable changes in this state indicator may also be a response to the application of agri-environmental policies, e.g., increased linear elements and rank grassland which provides greater opportunity for web-building spiders.

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