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Validation of LCA biodiversity impact assessment in agriculture across Europe – The example of SALCA biodiversity

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61st LCA Discussion Forum

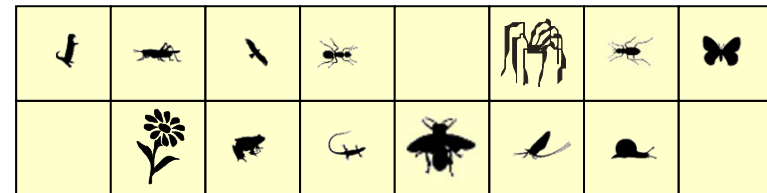
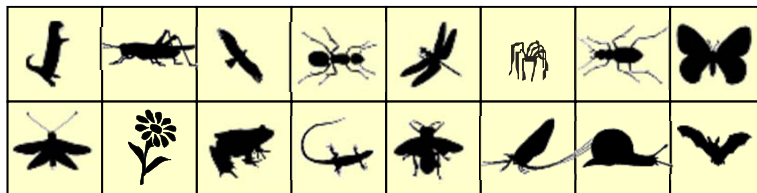
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Biodiversity and the agricultural land use – the context

Components of agricultural land use with impacts on biodiversity:

Proportion of semi-natural habitats, type and diversity of crops





Agricultural land use and biodiversity – the context

Management of crops and care of semi-natural habitats

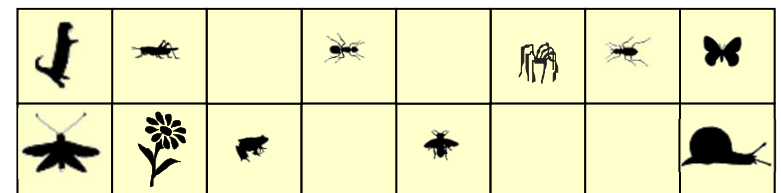
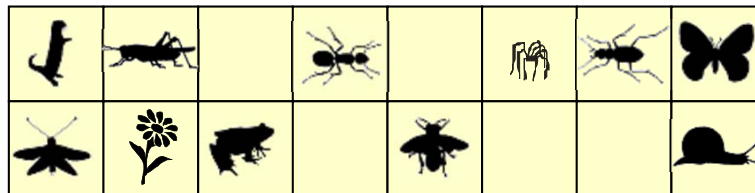
Farming practices like fertilization, mowing, grazing, tillage, pesticide application, etc.



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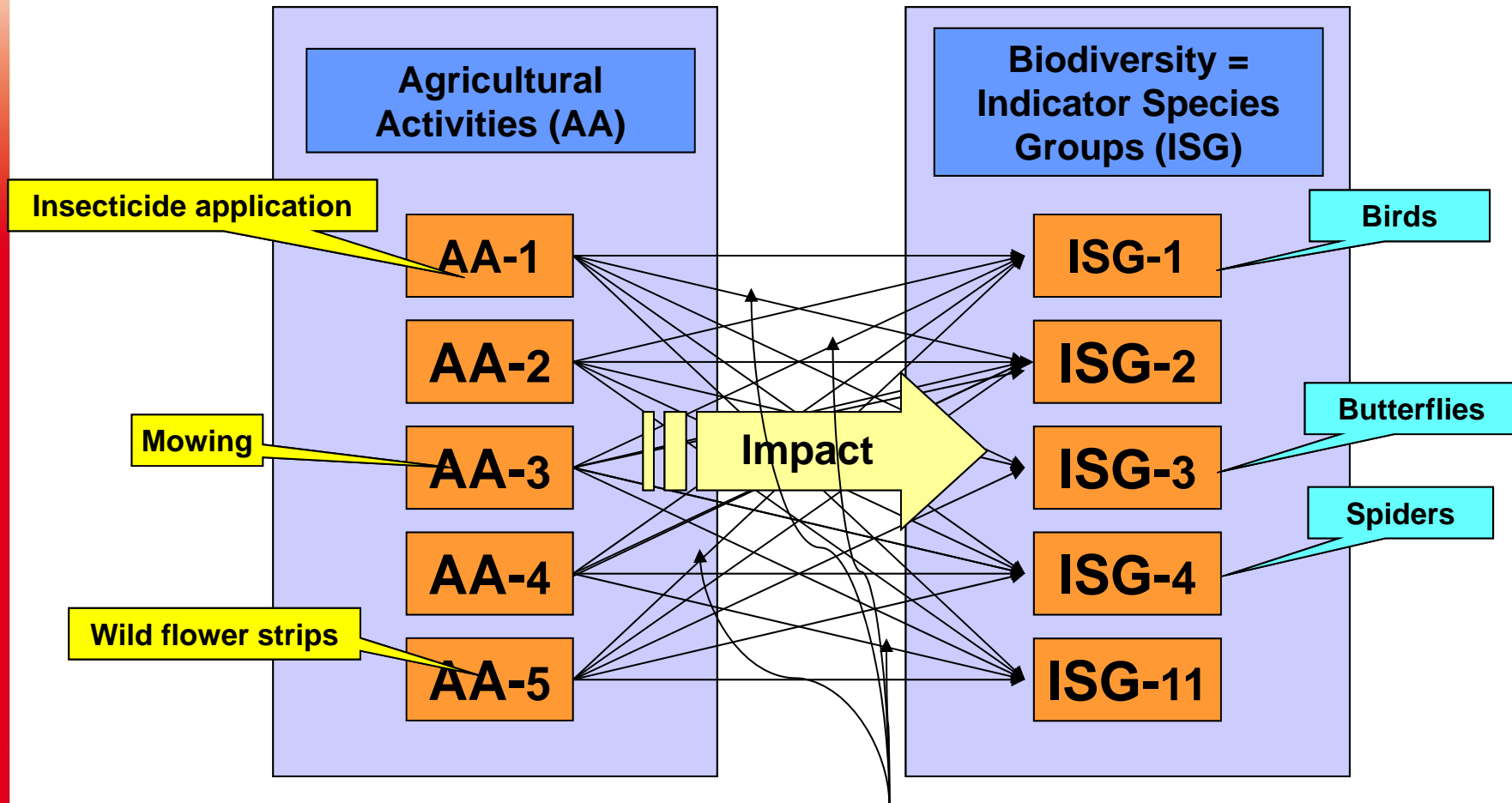
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SALCA-Biodiversity

Estimation of impacts on biodiversity



Bottom-up approach: Scores based on scientific and expert knowledge



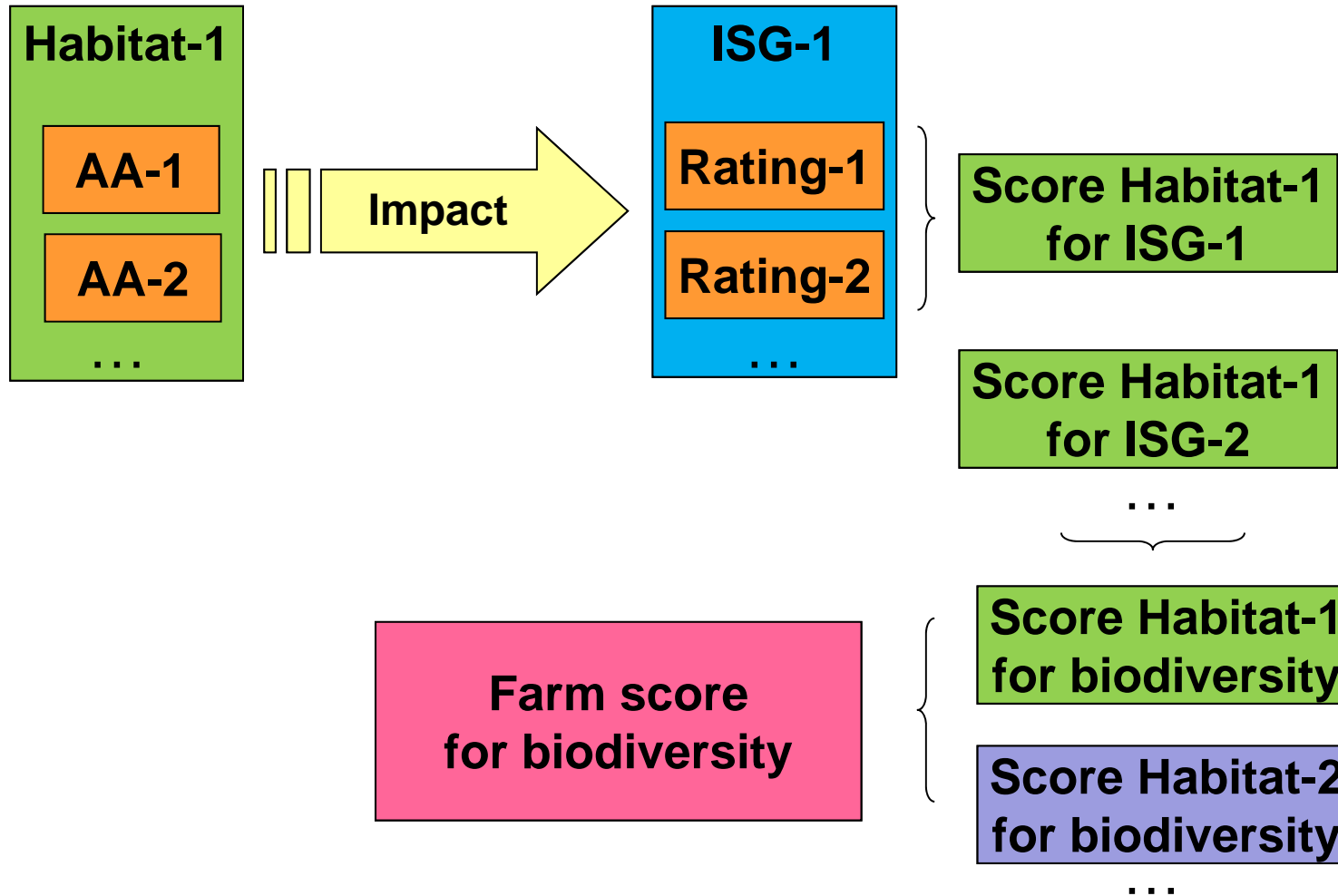
Impact of agricultural activities on biodiversity selected indicators

Habitat type	Practice - Level I	Practice - Level II	Option	Rating
Meadow	Cutting	Number of cuts	no cut	5
Meadow	Cutting	Number of cuts	cut = very extensively used meadow	4
Meadow	Cutting	Number of cuts	cut = extensively used meadow	4
Meadow	Cutting	Number of cuts	cut = low input meadow	2
Meadow	Cutting	Number of cuts	cut = fairly intensive meadow	1
Meadow	Cutting	Number of cuts	cut = intensive meadow	1
Meadow	Cutting	Number of cuts	cut = too intensive meadow	1

- Impact of every option on each indicator is estimated with a **rating** between 0 and 5, impact of options are rated relatively to each other, there is no ;
- Habitat type and practices have **coefficients** reflecting their significance for the indicator;
- Coefficients and ratings are estimated according to published investigations and expert knowledge;
- Coefficients and ratings are grouped to **scores**.



Agregation steps





Peculiarities and comparison to other approaches

- Bottom-up approach: impact of single farming practices to farms to regions
- Very detailed inventory of farming practices and land use types
 - Detailed analysis of farming systems and land use types possible
 - Other approach required if information on detailed farming practices and impact on indicator species groups are missing
- Coefficients of habitat types may be considered characterization factors of occupation impacts of a land use type (De Baan et al. 2013, Müller et al. 2014)

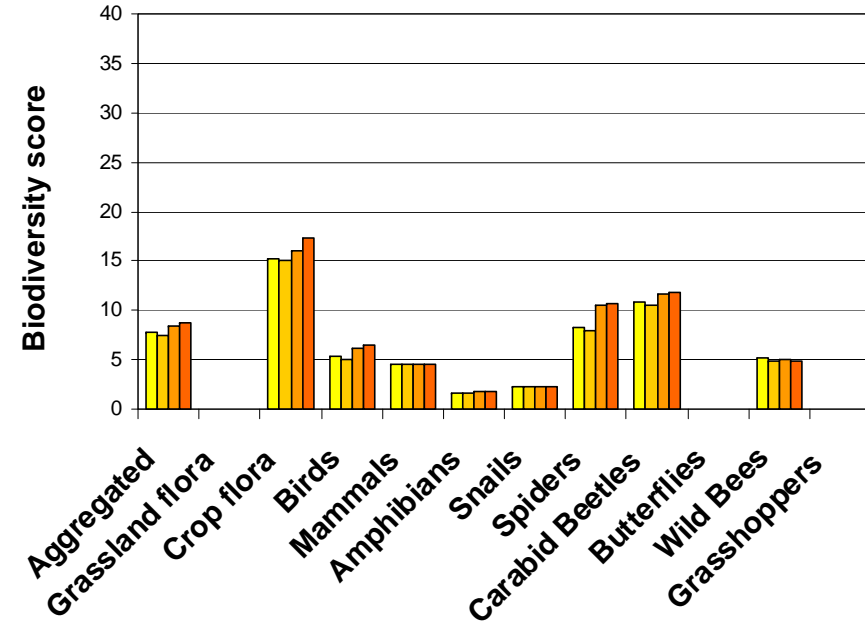
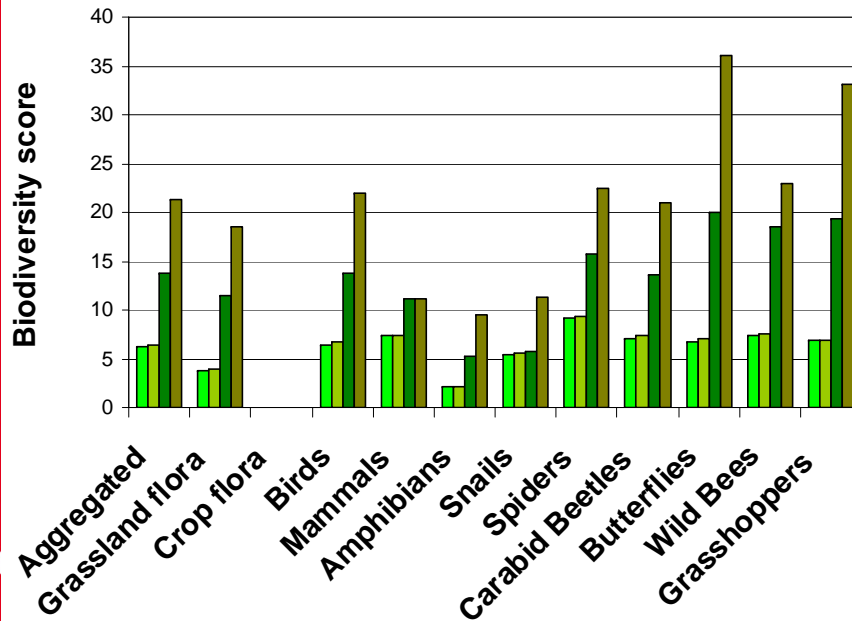


Comparison of winter wheat and grassland systems – Biodiversity scores

Grassland systems (hay production)		Management characteristics and production
A	Intensive	5 cuts/year, fertilised with slurry; 11t DM/ha
B	Fairly intensive	4 cuts/year, fertilised with slurry; 9t DM/ha
C	Low intensive	3 cuts/year, fertilised with solid manure; 5.6t DM/ha
D	Extensive	1 cut/year; no fertilisation; 2.7t DM/ha

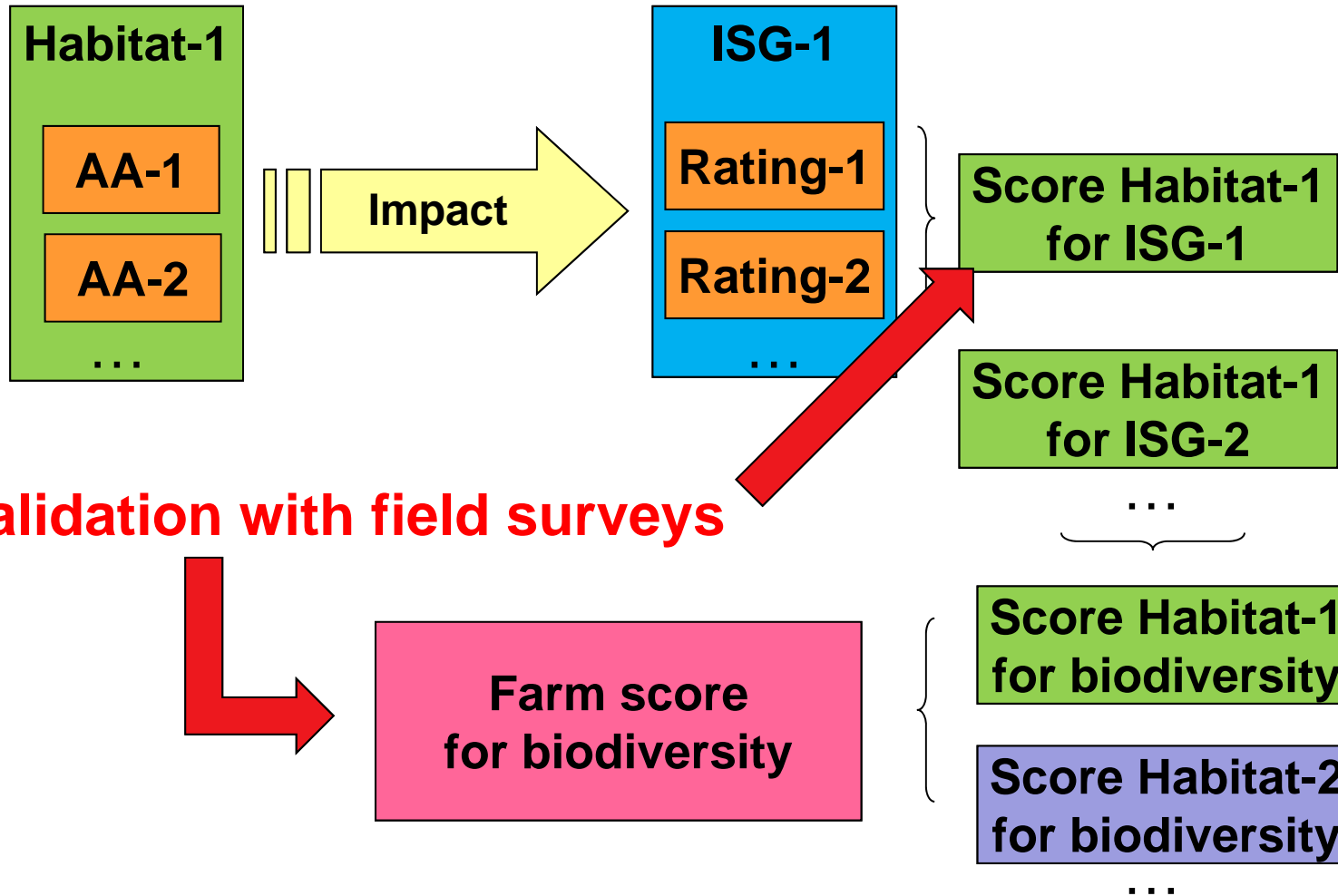
Winter wheat systems		Production
E	Conventional	5.8t DM/ha
F	Integrated- intensive	5.5t DM/ha
G	Integrated- extensive	4.5t DM/ha
H	Organic	3.5t DM/ha

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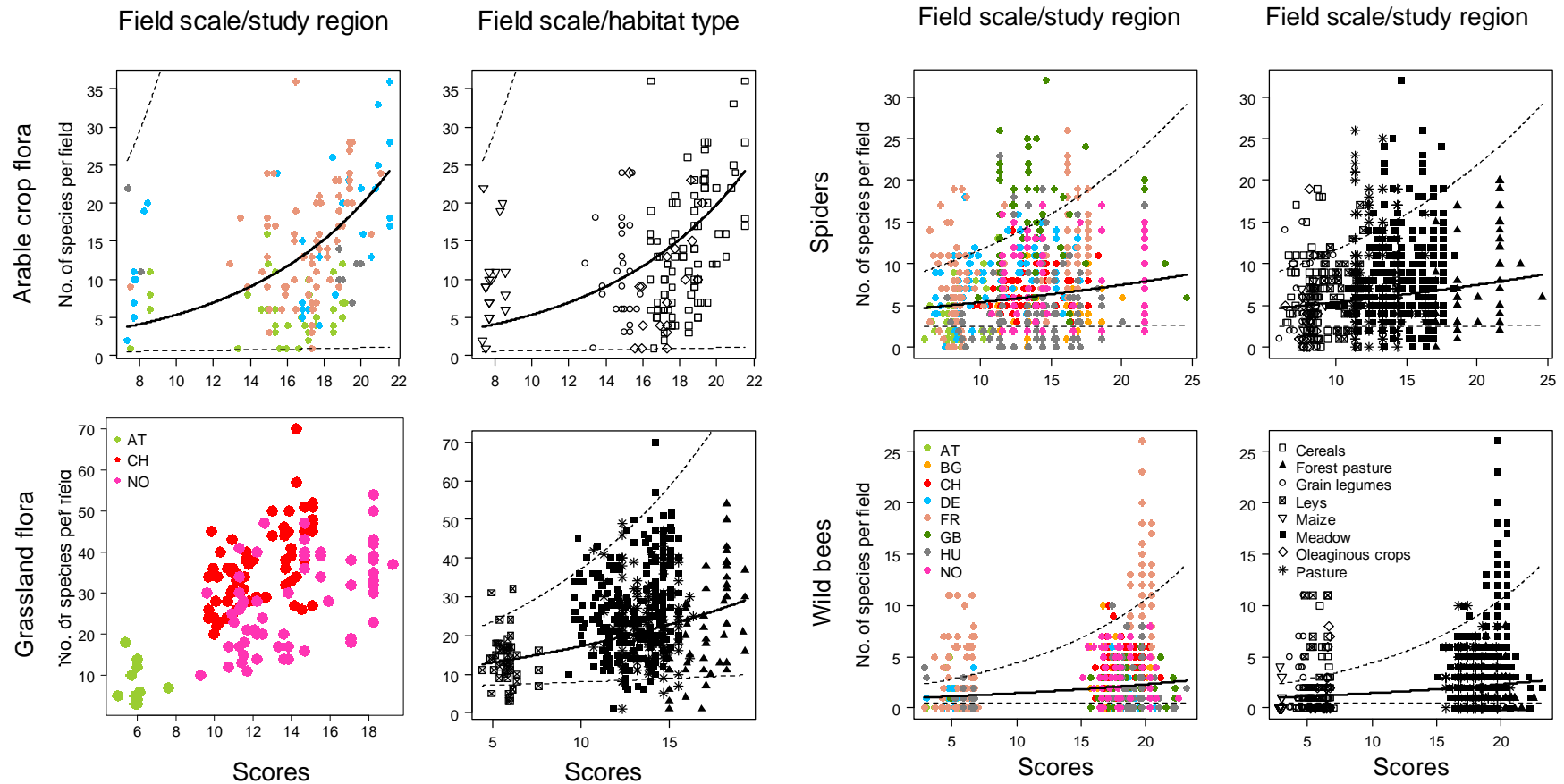
Validation



Validation with field surveys



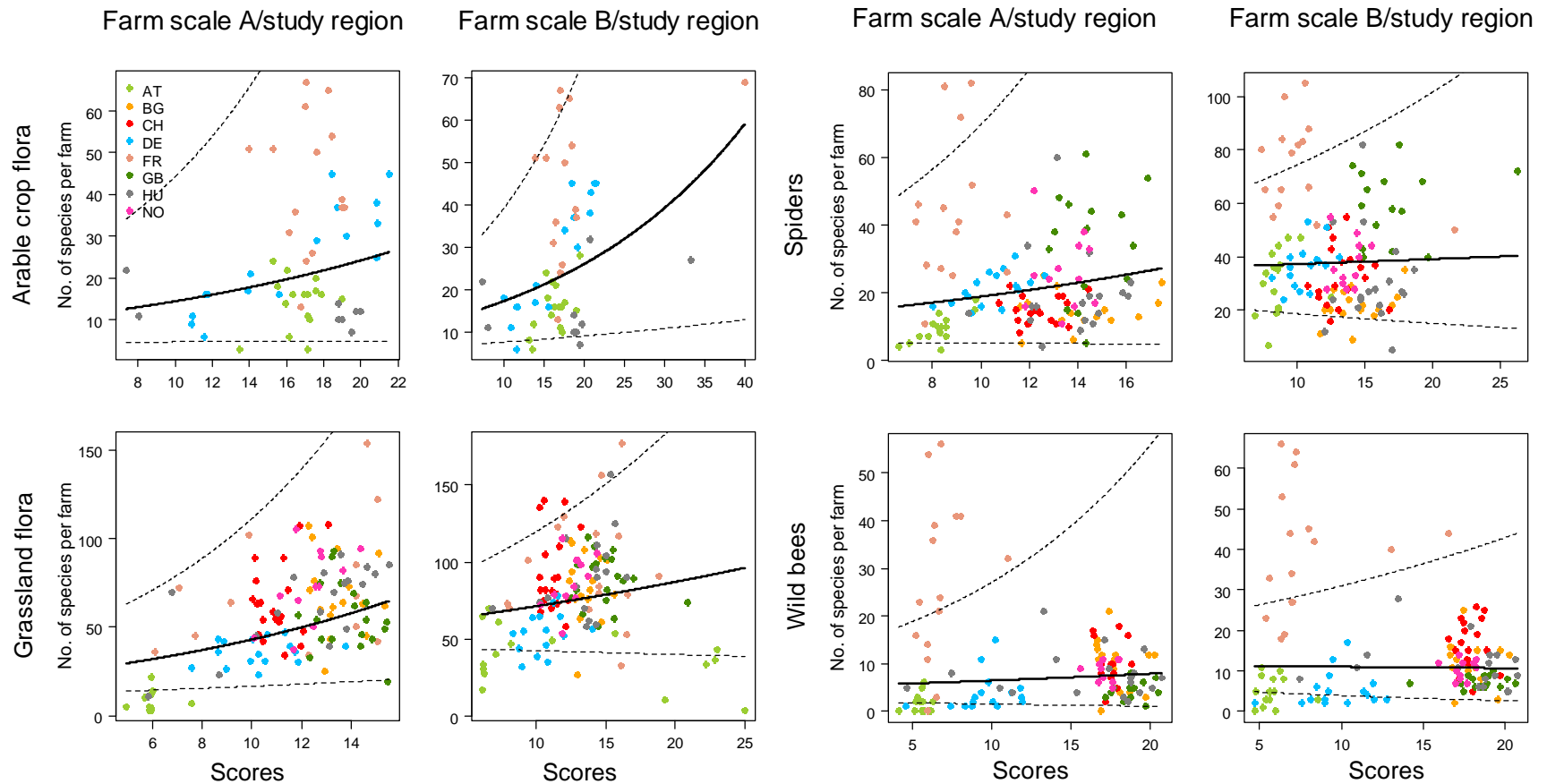
Relationships between expert system output and observed species richness at field scale (n = 667)



Black lines indicate predicted values of best-fit negative binomial generalized mixed effects models over all regions. Dashed lines indicate $\approx 95\%$ confidence interval. Slope (relationship) for each ISG is positive significant in best model with habitat type as random intercept and region as random intercept or slope.



Relationships between expert system output and observed species richness at farm scale (n = 132)



Best model is significant for arable and grassland flora at farm scale without SNH, only for arable crop flora when SNH are included. Aggregation is performed with habitat type proportion of the total area.



Conclusions

- For biodiversity, field surveys are relevant to improve models but are expensive
- Semi-natural habitats are crucial for biodiversity and the expert system (SALCA-Biodiversity) requires more careful consideration of their variability (beta diversity)
- The expert system is suitable for other European regions but coefficients may require adjustment

- Further development will include
 - Functional units
 - Taking consideration of impacts on biodiversity beyond Europe



Thank you for your attention

