

## Summary

A base of knowledge needs to be provided to abide by the standards of the Directive 2001/18/EC and other related guidelines for risk assessment and the monitoring of genetically modified organisms (GMO). To create this base of knowledge data concerning the vegetation and butterflies within agro ecosystems throughout Austria was processed. This was done within the scope of a biodiversity-study.

The data regarding the distribution, endangerment and ecology of relevant plants, biotopes and butterflies was sorted using an application-oriented GIS-supported database.

Indices for biodiversity in agricultural landscapes (oriented on a geographically 3x5 minutes grid) were created based on four parameters. These parameters are endangerment, relative frequency (abundance), species richness and habitat preference. The indices were calculated separately for plant species of field-ecosystems and butterflies. Areas with the highest diversity index-value were revealed as **hotspots of biodiversity** within agricultural landscapes (centers of diversity).

This expertise is a study of diversity which was specially designed to aid in the handling of questions concerning the risk assessment of GMOs in agro ecosystems. Responsible authorities now have the ability to use this flexible and highly efficient instrument to:

- judge whether or not hotspots of biodiversity are suitable to release or placing on the market GMOs
- run risk analysis on a case by case basis according to Austrian circumstances
- declare specific areas, where adequate monitoring is required.

A **“hotspot of biodiversity”** is an area of high importance for the conservation of national diversity of both plants and agro-associated butterflies. Additionally, it is an area of high value for national nature conservation, characterized by the high prevalence of valuable objects of nature protection. These hotspots are generally at a significantly higher risk of damage if disturbed. The effects of such disturbances can more easily lead to the threshold of sensitivity. This is because of their high significance in nature conservation (concept of significance). Because of their high sensitivity, hotspots of biodiversity are generally considered areas of high risk within an ecological risk assessment.

For reasons of uncertainty, hotspots of biodiversity are important for risk assessment of GMO in the sense of the precautionary principle. These uncertainties

are emphasized in the guidelines of Annex II to the Directive 2001/18/EC (European Commission 2002). For example, indirect and delayed effects cannot be predicted in risk assessment. Considering the precautionary principal, hotspots of biodiversity generally have to be proofed as GMO free zones.

The following areas in Austria show abundant frequencies of hotspots of **flora and vegetation**:

1. Southern Wiener Becken
  - a. The highest concentration of quadrants (grids) identified as hotspots throughout Austria is found in the region around Wiener Neustadt, between "Hoher Wand" and "Rosalien-mountains". Shallow soils that show a richness in gravel located in the so called "Steinfeld" are mainly responsible for the high value of this area.
  - b. Thermalregion at the eastern end of the alps, between Vienna and Bad Vöslau.
  - c. "Feuchte Ebene" in the south of Vienna, between Schwechat and Ebreichsdorf.
2. The slopes of the Leitha-Mountains
3. The surroundings of Lake Neusiedl
4. The area around Neckenmarkt-Ritzing (Middle-Burgenland)
5. The region between Güssing and Günser-Mountains (South-Burgenland)
6. The lower March-Valley south of Angern (Marchfeld)
7. The area of the Leiser Mountains and the Falkensteiner Mountains
8. The surrounding north of the Manharts-Mountain to Retz
9. The surrounding of Gmünd (Waldviertel)
10. The area of Gars am Kamp (Waldviertel)
11. The northern alpine foothills between Linz and the Wachau
12. The region of Braunau in the western Innviertel
13. The area of Knittelfeld in the middle Mur-Valley (Aichfeld-Murboden)
14. The basin of Klagenfurt (east of Klagenfurt and Krappfeld)
15. The Inn-Valley

Regarding the **butterflies** following hotspot-regions were determined:

- Vorarlberg: Rhein-Valley
- Tyrolia: single quadrants in the Inn-Valley and near Innsbruck
- Salzburg: centers of biodiversity around Salzburg, Flachgau, Tennengau, Pinzgau, Lungau
- Upper-Austria: Region Attersee, Völkermarkt, Gmunden, Region Linz, Region Aigen
- Lower-Austria: Region Gmünd, western Danube-Valley, Wachau, southern Waldviertel and Dunkelsteiner Forest, lower Kamp-Valley and Tullnerfeld, Region Retz, single quadrants within the northeastern part of the Weinviertel, eastern Marchfeld, Region Vienna, Feuchte Ebene, Steinfeld, Ybbs-Valley.
- Burgenland: Leitha-Mountains, areas within the Middle-Burgenland and South-Burgenland

- Styria: centers of biodiversity in the Mur-Valley near Judenburg, single quadrants within the east-styrien highlands and near Admont
- Carinthia: Basin of Klagenfurt, Gail-Valley near Hermagor and Villach, Möll-Valley.

The diversity-hotspots of vegetation and butterflies match for the most part. The small differences within the hotspots emerge from the stronger abundance of butterflies to the diversity of structure outside the arable fields (habitat islands within agricultural landscapes). Whereas the vegetation in the fields is characterized more strongly by abiotic factors (soil, moisture, etc.) as well as methods of cultivation.

Some differences result from a lack of data relating to the butterflies.

### **Flora and Vegetation**

14,1% of all "quadrants" (geographic grids) throughout Austria can be designated as hotspots for biodiversity-categories 7-9. Biodiversity-categories 8 and 9 cover 6%.

An outstanding piece of data is the dense concentration of biodiversity hotspots in the Pannonian Area of Austria. Whereas, the western parts of Austria contain only isolated hotspots. This is a result of a general decline in biodiversity from eastern to western Austria. The Pannonian Area in the eastern part of Austria has a large number of species. Therefore, by carrying out a general analysis of the whole of Austria, it can be said that the western part is being underrated in comparison to the eastern part. Thus, Austria is particularly responsible for the preservation of species and habitats of the Pannonian Area.

Altogether, this result emphasizes the consistent use of the often expressed aspect of regionalism in context with risk assessment of GMO (TRAXLER et al. 2000, 2001, TRAXLER 2002). The risk assessment of GMO depends strongly on the biogeographical Region since animal and plant communities also have varied distribution according to their region. Considering evaluation criteria, the Pannonian Area will have the highest "regional risk" regarding plant species. A universal risk assessment for GMOs throughout all member states of the European Union does not fit the requirements of the principle of regionalism.

The principle of regionalism is also embodied in the guidelines of Annex II from Directive 2001/18/EC (European Commission 2002).

The calculation of the biodiversity-indices is based on two sets of data. First, 72.189 species-records contained in 3.423 plant-sociological vegetation records. Secondly, approximately 1.950.000 sites of discovery from 4.600 species records contained in the "Floristische Kartierung Österreichs". These combined databases can be considered very sound as they cover the whole state of Austria. After examination by experts there were no appreciable data gaps. The calculations of biodiversity-hotspots were done according to standardized criteria and verified by expert examination. Just two grids showed the existence of obsolete data. With several supplementary detailed-analysis the distribution of hotspots could be logically proved correct.

This way to calculate the diversity-indices is just one of many possibilities which can be executed with the available data.

This study is not only comprised of the creation of a data base and the presentation of hotspots. It also represents a nature conservation expertise concerning the distribution and endangerment of flora and vegetation.

An analysis of the decline of species amongst the flora was made for some areas. The results show that within the last decades there was a recognizable decline in species-diversity and in species from the red list of endangered plants. These analyses show the threatening situation of endangerment to species within the agro-associated vegetation.

If you compare the group of agro-associated biotopes with the group of biotopes "mires and fens" from the red list of endangered biotopes in Austria (TRAXLER et al. 2005, p.170 & p.179), a similar degree of endangerment can be observed. Whereas the alarming threat of endangerment to the wetlands is generally known, the agro-biotopes are often neglected. A large part of wetlands is protected via national nature conservation, e.g. in protection-areas or via voluntary nature conservation-agreements while agro-biotopes are very poorly protected by national nature conservation laws.

Further analyses were done with ecological indicator values of agro-vegetation. It was proved that within the Austrian agro-vegetation the amount of indicator-species for warmth and poorness of the soil show good indicator-features for species-rich agro-biotopes.

The "red list of endangered biotopes" (TRAXLER et al. 2005) as well as plant-sociological analyses were used in this study to characterize the collected data material.

## **Butterflies**

On the subject of the butterflies 24.300 data-records based on the 3x5 minutes quadrants were available.

Within the 215 species of butterflies detected in Austria, 152 appear in agricultural landscapes and therefore in contact to GMO's in agro-cultural areas (e.g. pollen of transgene Bt-Maize). Therefore they are potentially affected. The risk-hypotheses of the effects of GMOs on butterflies are laid out according to the recent scientific literature in chapter 5.6 of this study.

In addition to the analysis of the biodiversity-hotspots, a hypothetical case study of Bt-Maize was designed involving the parameters "pollination time from Maize" and "larval development of butterflies". The result is an Austria-wide risk-map that shows the areas with the highest risk of relevant negative effects.

Authors: Dr. Andreas Traxler; Mag. Edith Minarz, Dr. Helmut Höttinger,  
Mag. Josef Pennerstorfer, Mag. Alice Schmatzberger, DI Gebhard Banko, DI Kerstin Placer,  
DI Michael Hadroolec und Dr. Helmut Gaugitsch

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