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Strategies of wetland restoration in the Waasen/Hanság (northern Burgenland)

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Abstract

Severe human impact has led to a massive degradation of former vast fens in the Hanság. Economic considerations are decisive as well for the necessity of an ecological restoration of that area. As scientifically profound basic knowledge is essential for its planning and successful development, the paper at hand, on the basis of vegetation ecological studies, seeks to name the components of that ecosystem and explain the causes and consequences of degradation. Two central issues result from that: A description of the ecological restoration potential of the Hanság and the assignments and tasks derived from that.

As components of the ecosystem, operable vegetation types and their conservation status were surveyed in representative landscape plots in the area of interest. The species composition of the types reflects the consequences of the massive drainage measures and agricultural use in that area.

The environmental variables collected in the course of biotope mapping and GIS analysis were studied with regard to their effect on the vegetation types with the help of various statistical methods. The findings indicate that there is an equally distributed, high nitrogen concentration in the soil and a much too low groundwater level. That explains the strong decrease or complete extinction respectively of fen-specific vegetation types.

Moreover, a *Morphological Spatial Pattern Analysis* of the mapped biotopes was performed in order to illustrate the differences between the landscape plots with regard to their landscape structure and their low connectivity.

Finally, possible restoration activities could be derived from the results. Pushing back of competitive species and nutrient removal from eutrophic soils by means of a spatio-temporally coordinated grazing and mowing regime in combination with topsoil removal have proved to be promising measures. Degradation of several vegetation types by drainage could be reversed by rewetting. Furthermore, measures for establishing a biotope network system were discussed.

In addition to that strongly practice-oriented approach, selected concepts of restoration ecology were presented and elaborated with regard to their importance for the Hanság. The area with all its conflicting priorities of the most diversified interests in which this cultural landscape is situated was described and the importance of a broad-based agreement in society for its positive development was emphasized.

Keywords

Hanság; Fens; Vegetation; Wetlands; Restoration ecology; MSPA; TWINSPAN; Landscape structure; Biotope network system

Introduction

The Hanság is a fen of really vast proportions resulting from siltation of one part of Lake Neusiedl. By massive human impact, this natural landscape has undergone transformation from an open forest landscape to an intensively used agricultural landscape (Löffler 1982). Judging from the remnants of former fen vegetation the potential for the recovery of wetlands in the Hanság can be estimated and ecological restoration can be taken into consideration.

The fact that profound ecological studies are essential for the success of restoration activities was motivation for this diploma paper. The central question of this paper was: How can the ecological restoration potential of the Hanságbe described? A comprehensive survey of the vegetation and of environmental factors was the consequence. On the basis of those findings, concrete restoration activities were to be formulated and discussed. The intention of applying selected concepts of restoration ecology to the Hanság was to provide a prospect on the effects of different restoration goals and objectives. That is of particular interest with regard to the central and isolated position of the national park section and its embedding in the agricultural landscape.

Methods

In the area of interest, 5 plots with an area of 1 km² each were investigated and the essential abiotic and biotic factors collected. The available geodata provided all information with regard to types of soil, groundwater levels and landforms. Land cover and land use regime were surveyed in the course of selective biotope mapping and sampling of vegetation using the relevé-method according to Braun-Blanquet.

Vegetation classification was performed on the basis of the *Two Way Indicator Species Analysis*(TWINSPAN, Hill 1979). In addition to that, the average ecological indicator values according to Ellenberg (Ellenberg 1974ff) were calculated for nutrient and moisture as well as diversity indices for each relevé.

In order to illustrate that diversity in the relevés depended on indicator values and diversity indices, linear regression analyses were performed. In the course of the indicator value analysis, the distribution of vegetation types along the moisture and nutrient gradients was shown. The Constrained Correspondence Analysis (CCA) was supposed to show the distribution of vegetation relevés in multidimensional ecological space. Furthermore, vegetation maps were created in GIS.

Subsequent statistical evaluation included the presentation of absolute frequencies of dominant vegetation types per landscape plot in graphs. By means of logic regression it was attempted to measure the dependency of stands of vegetation types on the environmental variables surveyed. In order to present the spatial patterns of the wetlands and woodlots in the individual landscape plots, a MSPA (*Morphological Spatial Pattern Analysis*) was performed. This segmentation process subdivided the geodata as binary image into seven MSPA classes (e.g. Core, Islet and Bridge) (VOGT 2010).

Results

The syntaxonomic classification of 80 relevés resulted in 34 plant communities, which were arranged in a synoptic table. The analysis of absolute frequency of the dominant vegetation types (fig. 1) allowed for conclusions on the landscape structure of the individual landscape plots and on the moisture gradient prevailing in the area.

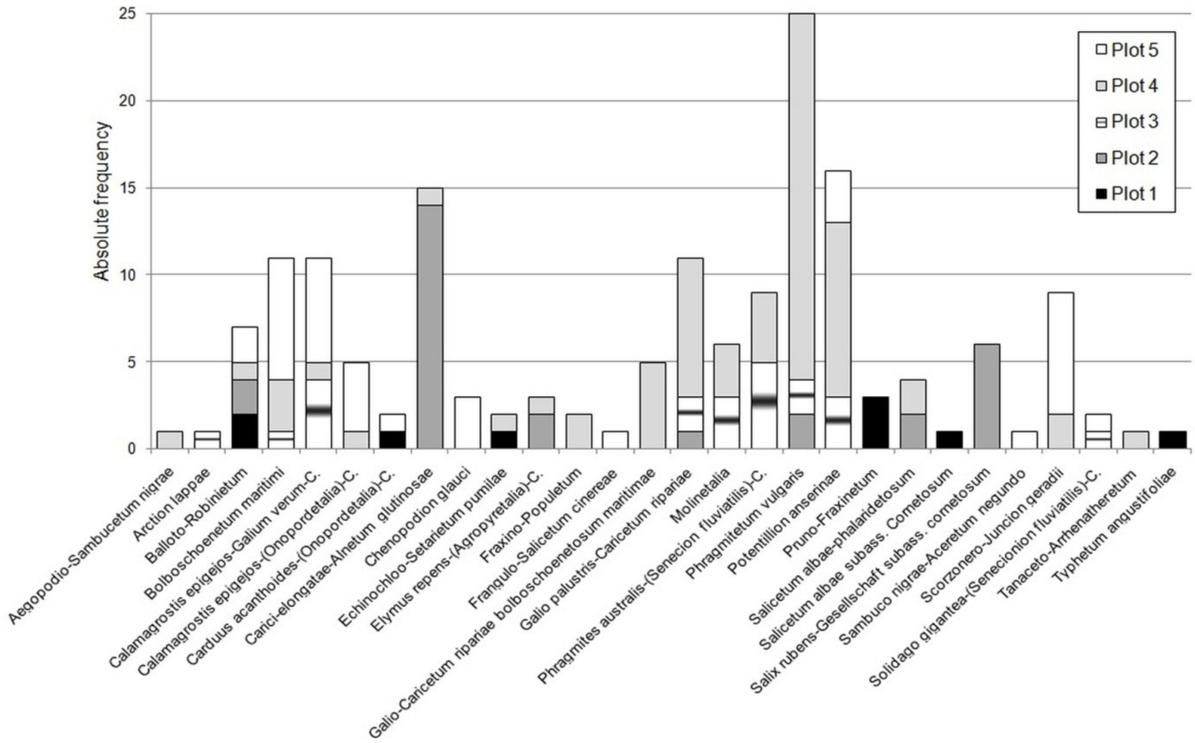

Fig. 1. Absolute frequency of dominant vegetation types per plot. C. = Community.

The CCA triplot of the woodlots showed that the moisture gradient explains the highest ratio of variance in species composition of the relevés. In the triplots of biotopes without woodlots, the division of the relevés was clearly visible because of the intensity of use.

The indicator value analysis of the average moisture values (fig. 2) showed the high ratio of dry site indicators, which significantly reduced the moisture values of wet soils. A comparison of the average nutrient values of the vegetation types revealed a focus in the sites of intermediate fertility to richly fertile places.

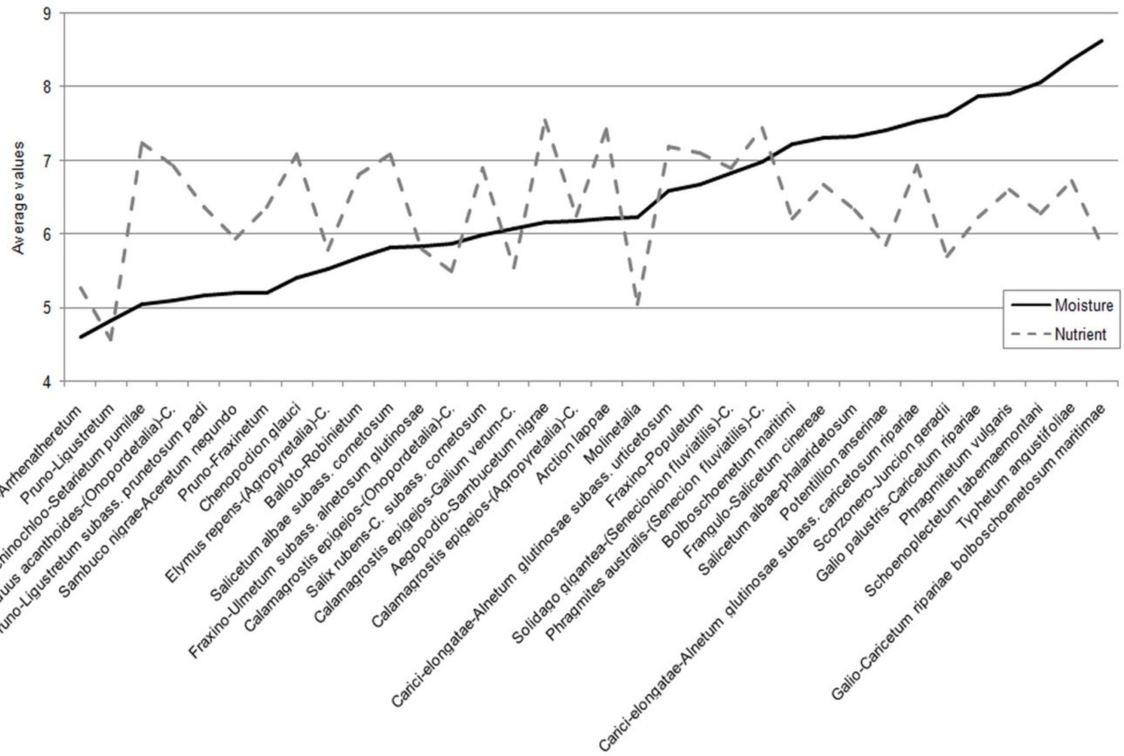

Fig. 2. Average moisture and nutrient values according to Ellenberg (2001) of vegetation types. C. = Community.

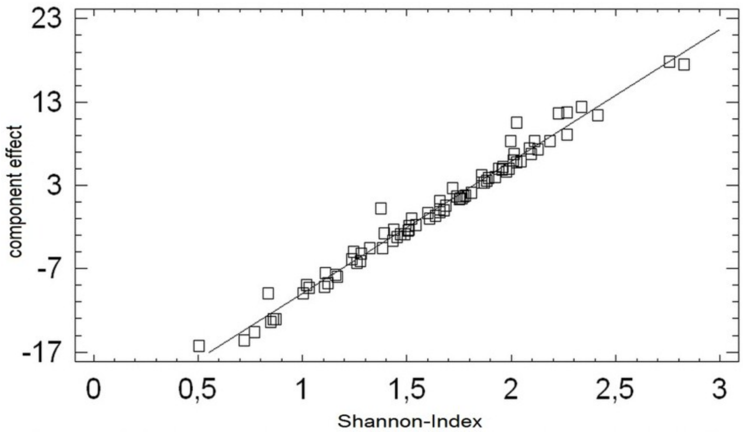

Fig. 3. Multiple Regression: Effect of number of species on diversity indice
e.g. Shannon-Index (Linear model: N_species=10,9321+15,8109*Shannon
2,59266*Simpson-39,5309*Evenness. n=80. r²=94,31%. p=0,0000).

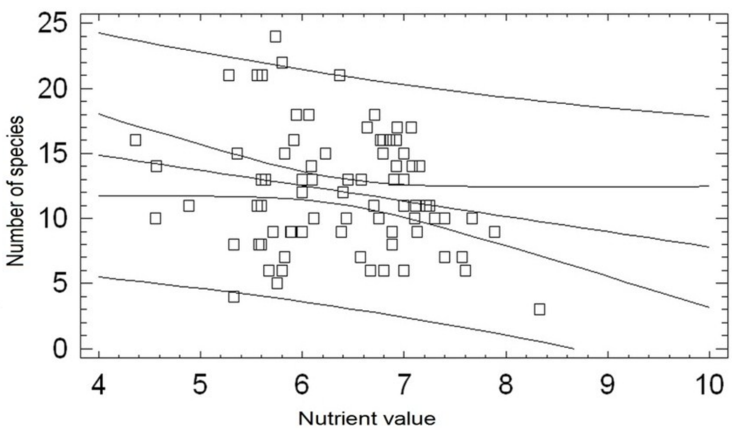

Fig. 4. Simple Regression: Effect of nutrient indicator values (Ellenberg 2001) on number of species (Linear model: No_species=19,5953-1,17917*nutrient. n=80. r²=4,3 %. p=0,0649).

The effect of diversity indices on the number of species (fig.3) that was investigated in the course of a multiple linear regression, as expected, showed a close correlation. No effect of the nutrient values according to Ellenberg on the number of species could, however, be proven by linear regression (fig. 4), which suggests an equal nutrient distribution in the area of interest. Furthermore, a weak relationship could be found between the moisture values according to Ellenberg and diversity (fig. 5). Both regression lines showed a tendency of decreasing species diversity with regard to increasing moisture and nutrient content.

Logic regression illustrated that the occurrence of vegetation types can be explained by extremely different combinations of environmental variables. This is mainly the result of incomplete data material in particular with regard to groundwater levels.

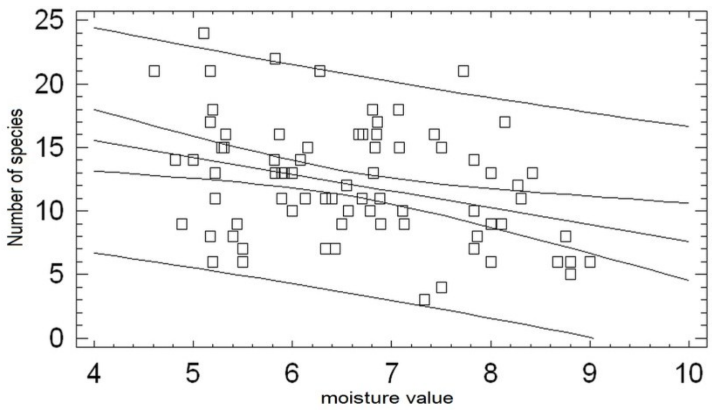

Fig. 5. Simple Regression: Effect of moisture indicator values (Ellenberg 2001) on number of species (Linear model: No_species=20,8927-1,33241 *moisture. n=80. r²=11,05 %. p=0,0026).

The MSPA of woodlots demonstrated their minor expansion and fragmentation in the area of interest. The analysis for plot 3, for the national park section, was omitted as there were no woodlots in that part. The spatial patterns of the fens and fen meadows revealed big differences between the plots with regard to their landscape structure. Whereas in plots dominated by agriculture they only occurred as linear corridors or small patches, they formed the matrix in others.

Discussion

The survey of vegetation types revealed a strong expansion of problematic species such as *Calamagrostis epigejos, Phragmites australis and Solidago gigantea*, which have a diversity decreasing effect. In many projects extensive grazing in combination with mowing has proven to be an appropriate measure for regulating those species (KORNER et al. 2008).

The obvious changes in species composition of the vegetation relevés are consequences of long-term drainage and would be reversible by rewetting of the area. Since restoring the hydrological regime in the whole surrounding catchment area would lead to conflicts of various use claims, locally restricted measures with regard to drainage ditches have proven feasible (ANDEL 2006).

Another diversity decreasing effect is caused by the invasive species *Robinia pseudacacia*, *Acer negundo* and *Elaeagnus angustifolia*. Their removal and planting of site-adequate tree species would be desirable.

High nitrogen concentration in the soil and the reduced groundwater level explain the almost complete extinction of fen-specific *Molinion* communities. An appropriate measure for their advancement would be a removal of biomass by mowing according to adapted time schedules (KORNER et al. 2008). In this connection, sod cutting and/or topsoil removal have/has proven successful (ANDEL 2006).

In landscapes characterized by agriculture, the establishment of landscape elements and extensification of use in the sense of a biotope network system would make sense (JEDICKE 1994). Furthermore, the creation of buffer zones for wetlands and forest edge development would be advisable.

When dealing with concepts of restoration ecology it became clear how important it is that restoration activities are subject to a well-defined restoration goal. The latter should be derived from the respective concept of nature, the level of ambition, an appropriate reference ecosystem and from the definition of restoration ecological targets (ANDEL 2006).

Conclusion

Summing up, it can be stated that an elaborate vegetation survey is essential for the planning and monitoring of restoration projects. Logic regression for establishing habitat models could be a useful tool that helps to predict the effect of different restoration activities on the occurrence of target species and communities. Prerequisite for that is a solid basis of data material which, however, was unfortunately not available when preparing this paper. For the restoration of groundwater-fed vegetation types, precise measuring of the groundwater levels would be indispensable in case of future studies. As this diploma paper can be seen as a preliminary study, a continuation of these scientific investigations on a larger scale and inclusion of zoological expertise might be possible since the operable vegetation types and the methodology are already available.

The restoration activities derived from the findings may be contradictory to each other or might not be feasible for a number of reasons. A successful restoration project would require a fundamental decision which restoration goals to be realized in which spatial and temporal dimension. This would, of course, require broad-based agreement among nature conservation organizations, land users, population and the public authorities. This is the background with all its conflicting priorities against which the national park section Waasen-Hanság has to be seen. For the restoration of site-adequate fen vegetation, large-scale changes in the hydrological regime and in the nutrient balance would be necessary that by far exceed the boundaries of the protected area.

References

ANDEL, J. v. (eds.) 2006. Restoration ecology: the new frontier. Blackwell, Oxford (u. a.)

ELLENBERG, H. et al. 2001. Zeigerwerte von Pflanzen in Mitteleuropa. 3. ed. Scripta Geobotanica XVIII. Verlag Erich Goltze GmbH & Co KG, Göttingen

JEDICKE, E. 1994. Biotopverbund: Grundlagen und Maßnahmen einer neuen Naturschutz-strategie. 2. ed. Zugl. Dissertation an der Univ. Giessen, 1990. Ulmer, Stuttgart

KORNER, I., WRBKA, T., STAUDINGER, M., BÖCK, M. 2008. Beweidungsmonitoring im Nationalpark Neusiedlersee-Seewinkel. Ergebnisse der vegetationsökologischen Langzeitmonitoring-Studien 1990 bis 2007. In: WAITZBAUER, W., KORNER, I., WRBKA, T. (eds.) 2008. Vegetationsökologisches und faunistisches Beweidungsmonitoring im Nationalpark Neusiedlersee-Seewinkel 2000-2006. Abhandlungen der Zoologischen-Botanischen Gesellschaft in Österreich Bd. 37. Verlag der Zoologischen-Botanischen Gesellschaft in Österreich, Wien. S. 1-84

LÖFFLER, H. 1982. Der Seewinkel. Die fast verlorene Landschaft. Verlag Niederösterreichisches Pressehaus St. Pölten-Wien, St. Pölten

VOGT, P., Institute for Environment and Sustainability (IES), European Commission, Joint Research Centre (JRC). 2010. MSPA-Guide. Italien Available at: http://forest.jrc.ec.europa.eu/download/software/guidos/MSPA_Guide.pdf

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