UNIVERSITY OF TARTU
INSTITUTE OF GEOGRAPHY

PUBLICATIONES INSTITUTI GEOGRAPHICI
UNIVERSITATIS TARTUENSIS
92

IALE European Conference 2001

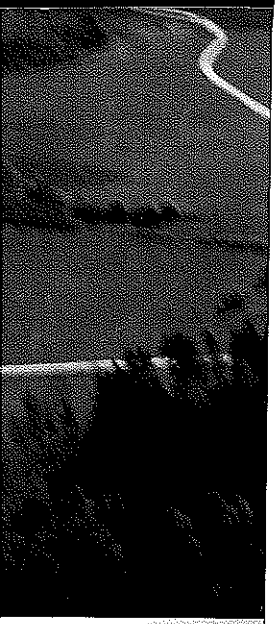
DEVELOPMENT OF EUROPEAN LANDSCAPES
Conference proceedings

Volume II

International Association for Landscape Ecology (IALE)
University of Stockholm
University of Tartu

Edited by:
Ülo Mander, Anu Printsmann and Hannes Palang

Tartu 2001



Publisher:
Institute of Geography University of Tartu
46 Vanemuise St.
51014 Tartu
ESTONIA
http://www.geo.ut.ee
geogr@ut.ee

Edited by:
Ülo Mander, Anu Printsmann and Hannes Palang
mander@ut.ee and palang@ut.ee

Layout by:
Age Koppelmaa

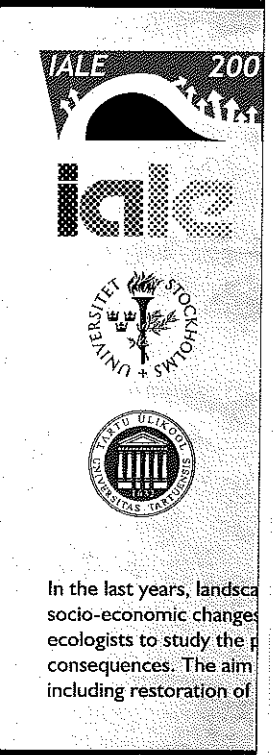
Cover designed by:
Vahur Puik

Cover photos by:
Valdo Kuusemets

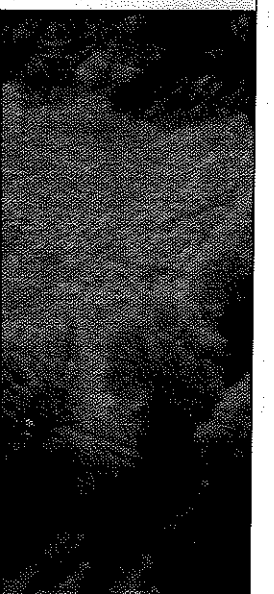
Conference logo designed by:
Vahur Puik

ISSN 1406-3069
ISBN 9985-4-0195-6

Tartu Ülikooli Kirjastuse trükikoda
Tiigi 78, Tartu 50410
Tellimus nr. 397



In the last years, landsca
socio-economic changes
ecologists to study the p
consequences. The aim
including restoration of



Vulnerability of biodiversity in the agro-ecosystem as influenced by green veining and land-use intensity: the EU project GREENVEINS

R.J.F. Bugter (co-ordinator)[1], F. Burel[2], M. Cerny[3], P.J. Edwards[4], F. Herzog[5], J. P. Maelfait[6], S. Klotz[7], P. Simova[8], R. Smulders[9] and M. Zobel[10]

[1]ALTERRA Green World Research, Wageningen, The Netherlands
[2] University of Rennes, France
[3]Institute of Forestry Ecology Research, Jilove u Prahy, Czech Republic
[4]Swiss Federal Institute of Technology, Zurich, Switzerland
[5] FAL, Zurich, Switzerland
[6]Institute for Nature Conservation, Brussels, Belgium
[7]UFZ-Centre for Environmental Research, Leipzig-Halle, Germany
[8]Administration of the protected landscapes of the Czech Republic, Prague, Czech Republic
[9]Plant Research International, Wageningen, The Netherlands
[10]University of Tartu, Estonia

The EU project GREENVEINS started at the beginning of 2001. The principle objective of the project is to develop procedures for the identification of vulnerability of biodiversity in the agricultural landscape. This will be accomplished through a survey of 26 agricultural landscape sites across the Temperate Zone of Europe. At these sites, both biodiversity data and landscape data will be collected. Analysis is aimed at describing the relationship between biodiversity (i.e. species, species groups (taxonomic as well as functional) and metapopulations of species differing in spatial scale level) and (changes in) landscape structure and land-use intensity. Results will be used to get consensus with stakeholders over interpretation in terms of vulnerability of biodiversity. Project results and conclusions will be used for guidelines, tool proposals and a demonstration application.

Introduction and objectives

Despite the vast urban expansion during the last century, agricultural landscapes still cover more than half of the European Union surface area. For the member states in the temperate climate zone, this percentage is even higher (EUROSTAT, 1998). Consequently, the potential impact of the agricultural landscape on total biodiversity is enormous. This is especially true for small scale, extensively used, and structurally diverse landscapes which are able to support very high

biodiversity levels. A mosaic of cultivated and fallow arable fields interlaced by all kinds of (semi-)natural elements (referred to as GREEN VEINING), offers very diverse opportunities and can therefore harbour a large array of species.

However, biodiversity in the agricultural landscapes of Europe is seriously threatened. In the 20th century both intensification of land use and a decreasing Green Veining structure have caused a dramatic change in the landscapes all over Europe. This change was accompanied by a large decline of biodiversity for which it is generally considered to be responsible (Wilson *et al.*, 1999).

But not all changes in the landscape cause the same amount of biodiversity loss, and not all loss occurs immediately. Plant and animal species will only disappear when their amount of habitat becomes critical or when isolated habitat patches go 'accidentally' extinct (Andren, 1994; Thomas, 2000). For instance, annual and biennial plant species may survive very long in small isolated patches, and will only disappear when a-biotic and biotic habitat conditions do not longer fulfil their requirements, especially those for germination. Therefore, many species can still be present in a landscape even though the conditions for their persistence have become marginal or even have disappeared altogether. Since many species in the agricultural landscape seem to operate on about the same spatial scale level, the existence of a kind of 'collapse threshold' for biodiversity seems possible (Halley & Lawton, 1996). Based on this, our hypothesis is that a vulnerability or danger zone can be identified where further intensification of land use or loss of Green Veining might (eventually) cause a large collapse of biodiversity. Since little is known about the relationship between biodiversity loss and landscape changes (i.e. about the form of the loss curves), it is at the moment impossible to determine if such a danger zone really exists and consequently, when biodiversity in a landscape is in danger. But for a sustainable exploitation of agricultural areas in terms of biodiversity, it is paramount to know how to keep landscapes in the safe zone or how to get them out of danger when their biodiversity has become vulnerable. Therefore the **principle objective of the GREENVEINS project is to develop procedures for the assessment of vulnerability of biodiversity in the agro-ecosystem.**

This leads to the following derived objectives:

1. To describe the relationship between biodiversity, landscape structure and land-use intensity;
2. To interpret this relationship in terms of vulnerability or sustainability;
3. To produce guidelines and assessment procedures for Green Veining and land use in relation to various measures of biodiversity;
4. To produce general predictors of biodiversity and sustainability of biodiversity, based on land use structure and intensity data, across western Europe;

5. To propose practical tools to help policy makers to decide between future landscape options.

Biodiversity is determined by both structural complexity of the landscape and by land use intensity, but structural complexity is assumed to be the dominant factor. Structural complexity can be expressed in the percentage and spatial cohesion of the landscape's Green Veining (i.e. semi-natural non-crop elements). Green Veining has the advantage that it can be described adequately and rather easily in GIS-systems (also at a European scale). An adequate description of land-use intensity is much more difficult. Therefore Green Veining is the factor that offers the best opportunities for large-scale biodiversity inventories. In this project we will analyse the effects of both Green Veining and land use intensity on biodiversity, because we want to know their proportional effects. In parameter development, finding usable parameters to describe Green Veining will get the most attention.

The idea that the relationship between landscape changes and loss of biodiversity is not a linear one lies at the heart of this project. However, it is likely that different taxonomic and functional groups of species will react differently to landscape changes (Pitelka, 1993). Some groups may decline already because of minor changes while others only react to larger ones; some groups (e.g. opportunistic species) are even expected to increase at first (Burel *et al.*, 1999) . Also, the effects of habitat fragmentation may lead to rapid extinction, but species may also survive in isolated populations for decades. Therefore, the project will describe the effects of changes in landscape structure as well as land use not only on the species level, but on species group level (taxonomic and functional) and metapopulation level as well. We will describe these effects through the construction of species loss or species abundance decline curves, which will form the basis for our interpretation in terms of vulnerability.

Approach

Short general description

The backbone of the project is a survey of a range of 20 - 25 agricultural landscape sites across the Temperate Zone of Europe. At these sites, both biodiversity data and landscape data will be collected. Analysis is aimed at describing the relationship between biodiversity (i.e. species, species groups (taxonomic as well as functional) and metapopulations of species differing in spatial scale level) *and* (changes in) landscape structure and land-use intensity. Results will be used to construct a theoretical model that describes the expected

biodiversity characteristics from the (recent changes in) structure and use of a landscape. During a workshop with stakeholders we will get consensus over the interpretation of the results in terms of vulnerability of biodiversity in the agro-ecosystem. Project results and conclusions will be used for a demonstration application..

Data collection

Selecting Landscape Test Sites (LTS) During a workshop in the first phase of the project, between 26 landscape test sites were selected from a shortlist. Sites are spread as equally as possible over the whole range of variation in the percentage of Green Veining and land use intensity found in agricultural landscapes in the Temperate Zone (Table 1).

Table 1. Distribution of study areas (Landscape Test Sites) over matrix of green veining vs. land-use intensity. The sites are indicated with a four-letter abbreviation. The first letter indicates the country, the last three indicate the test site.

Land use intensity \ Percentage and cohesion of green veining	LOW	MEDIUM	HIGH
HIGH	D-WAN, D-QFP, E-VMA, F-TCU, F-TOU, H-KLG	N-UN, F-AL, D-FRI	A-BRE, E-VI
MODERATE	N-SA, H-REE, D-KAP	H-NUB, D-MFL, F-VGO, F-FOO, N-TWE	A-GVA, C-SVE
LOW		C-BRO, E-VIH	E-ARE, F-FOD, C-VER

D Germany
E Estonia
H Switzerland
F France
C Czech Rep.
B Belgium
N Netherlands

Assessing biodiversity To allow a broad description of the biodiversity in agricultural landscapes, we have chosen to assess biodiversity on three levels: the species level, species group level (taxonomic and functional) and metapopulation level (to assess effects for species differing in spatial scale and time lag effects). For the first two levels, a number of representative species and species groups will be sampled in a random plot survey to establish their presence and abundance.

Data on metapopulation functioning will be collected in special surveys carried out for a limited number of species representative for dispersal ranges relevant to the agricultural landscape. These surveys will include the mapping of the species habitat, its presence/absence in habitat patches and surveys of the rate of exchange between patches for a limited number of sites.

Measuring landscape structure and land use intensity Digital maps of green veining will be made from aerial photographs and topographical maps. These maps will be used for parameter calculation at a number of scales. Land use intensity will be assessed per LTS from a survey of a sample of land users for fertilisation, stocking rates, use of pesticides, crop successions. Comparisons across landscapes will be based on averages. The landscape changes in previous decades (especially changes in Green Veining) will be assessed from historic maps and aerial photographs. Spatial structure of the habitats of meta-population species will be derived from photographs as well and validated through field surveys.

Getting results

The collected data will be analysed to establish loss curves for several aspects of biodiversity in relation to landscape structure and land use intensity. However, interpretation of these relationships in terms of biodiversity still is a matter of judgement and definition as well. The only good definition of vulnerability of biodiversity in the agro-ecosystem will be a generally accepted one. Therefore we will arrange workshops with end-users in order to get consensus over the interpretation of project results.

Use of results

Description and analysis of biodiversity is most useful if it is translated into practical tools for conservation, reconstruction and development of biodiversity of the agricultural landscape. Therefore, we will develop a model describing the relationship between landscape Green Veining and land-use intensity on the one hand and biodiversity characteristics on the other hand. When agreement over interpretation of these results is reached, this model can be a major contribution to the protection of biodiversity in the agricultural landscape. Guidelines and assessment procedures for the Green Veining and land use in relation to various biodiversity measures will be produced, as well as general predictors for biodiversity and sustainability of biodiversity. A demonstration application will show the use of project results for the interpretation of the effects of landscape

changes on biodiversity. This application will also be used to disseminate project results.

Our project results will also show the relative impact of land use versus landscape structure changes on biodiversity. This can form the basis for the direction a compensation or restoration policy must take: either increase the amount and cohesion of Green Veining or de-intensify land use or a particular combination of both. In this respect GREENVEINS can contribute to the EU Common Agricultural Policy as well as to local landscape development projects. Therefore, we will also use our project results to propose easy tools for policy makers for decision support and landscape planning.

We think that the application of project results will contribute to the well-functioning and thus lower vulnerability of the agro-ecosystem, and consequently to sustainable agriculture and nature conservancy as well. Because the whole range of European agricultural landscapes, from most intensively used to most extensively used, is included in the project, the results will be applicable throughout temperate Europe.

References

Andren, H. (1994). Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. Oikos 71: 355-366.

Burel F., Baudry J., Butet A., Clergeau P., Delettre Y.R., Dubs F., Morvan N., Paillat, G, Brunel, E and Lefeuvre, J.C. (1999). Comparative biodiversity of agricultural landscapes along an intensification gradient., Acta Oecologica 19: 47-60.

EUROSTAT (1998). European landscapes: farmers maintain more than half of the territory. EUROSTAT Statistics in focus. Agriculture, 10 p.

Halley, J.M., and Lawton, J.H. (1996). The JAEP ecology of farmland modelling initiative: spatial models for farmland ecology. Journal of Applied Ecology 33: 435–438.

Pitelka, L.F. (1993). Biodiversity and Policy decisions. In: E.D. Schulze and H.A. Mooney (Eds.) Biodiversity and ecosytem function. Springer Verlag.

Thomas, C.D. (2000). Dispersal and extinction in fragmented landscapes. Proc. Royal Soc. Lond. Biol. 267: 139-145

Wilson, J.D., Morris, A.J., Arroyo, B.E., Clark, S.C. and Bradbury, R. (1999). A review of the abundance and diversity of invertebrate and plant foods of granivorous birds in northern Europe in relation to agricultural change. Agriculture, Ecosystems and Environment, 75: 13-30.