Symposium: Biodiversity in Agricultural Landscapes March 15, 2002

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Biodiversity in agricultural landscapes has strongly declined during the last decades. In the symposium “Biodiversity in agricultural landscapes” on 15 March 2002 we analysed the factors that have caused this decline, but we also discussed the perspectives to stop the losses of diversity that have occurred until now. The complexity of many agricultural landscapes has changed due to fragmentation and the loss of small natural habitats. The question is whether these changes in spatial structure have had important impacts on the interactions between wild plant and animal populations. Recent experimental results show that such effects may lead to significant changes in important functional relations like pollination, herbivory and parasitism. Such changes do not only affect the success of wild plant populations, but also the production of agricultural crops.

The population declines of many species in the agricultural landscape are closely correlated with increasing agricultural intensification. Likely key factors have been: increases in fertilizer and pesticide application, increases in livestock densities, lower groundwater levels, and changes from spring to autumn sowing of cereals. The consequences of these changes for birds, insect and plant populations will be analysed. Subsequently, new strategies for the conservation and restoration of wild plant and animal populations on farms will be discussed. Agri-environment schemes are one of the main tools to achieve this goal, but it will be questioned whether their management prescriptions are sufficient for the maintenance of the former levels of diversity. The perspectives for the combination of nature conservation and farming will be discussed on the basis of present ecological knowledge.

Organisation

Organisation:
Prof. Dr. Frank Berendse, Nature Conservation and Plant Ecology Group, Wageningen University, Wageningen.
Prof. Dr. Hans de Kroon, Experimental Plant Ecology, University of Nijmegen, Nijmegen.

Logistics: Marieke Bootsma, Netherlands Institute of Ecology.

Advice and overview: Hans de Kroon

For practical questions:
currentthemes@nioo.knaw.nl

Biodiversity in agricultural landscapes

15 March 2002, Wageningen

Programme

09.30 – 10.00	Welcome and coffee
10.00 – 10.45	**Teja Tscharntke** (University of Göttingen): Biodiversity and plant-insect interactions in the agricultural landscape
10.45 – 11.30	**Felix Wäckers** (Wageningen University, NIOO-KNAW Heteren): Can we tailor diversity in agro-ecosystems to optimize biological control?
11.30 – 12.15	**Dan Chamberlain** (British Trust for Ornithology): Agricultural intensification and declining farmland birds: Evidence from monitoring studies
12.15 – 13.30	Lunch
13.30 – 14.15	**David Kleijn** (Wageningen University): Agri-environment schemes: from intentions to achievements
14.15 – 15.00	**Prof Dr Jan Bakker** (Groningen University): Restoration of plant species diversity in agricultural landscapes
15.00 – 15.30	Tea
15.30 - 16.15	**Dr Geert de Snoo** (Leiden University): Impacts of pesticide drift on biodiversity
16.15 – 17.00	**Jeff Harvey** (Netherlands Insititute of Ecology): Perspectives for biodiversity in agricultural landscapes

The following speakers gave a talk during the symposium day:

Teja Tscharntke (University of Göttingen):
Biodiversity and plant-insect interactions in the agricultural landscape.
Felix Wäckers (Wageningen University, NIOO-CTE):
Can we tailor diversity in agro-ecosystems to optimize biological control?
Dan Chamberlain (British Trust for Ornithology):
Agricultural intensification and declining farmland birds: Evidence from monitoring studies.
William J. Sutherland (University of East Anglia):
Roles of genetically modified organisms, intensive agriculture, agri-environment schemes and wilderness in the agricultural landscape?
David Kleijn (Wageningen University):
Agri-environment schemes: from intentions to achievements.
Jan Bakker (Groningen University):
Restoration of plant species diversity in agricultural landscapes.
Geert de Snoo (Leiden University):
Impacts of pesticide drift on biodiversity
Jeff Harvey (Netherlands Insititute of Ecology):
Perspectives for biodiversity in agricultural landscapes.

Biodiversity and plant-insect interactions in agricultural landscapes

Prof. Dr. Teja Tscharntke, Agroecology, University of Göttingen
Waldweg 26, D-37073 Göttingen, Germany
Email: ttschar@gwdg.de;
Website: www.gwdg.de/~uaoe

The focus in ecology is changing from traditional study of simple systems and interactions to approaches that consider spatio-temporal variability multitrophic-level interactions. Consideration complexity found nature includes realization landscape structure directly affects local need populations at different spatial scales.
In fragmented cropland-grassland landscapes, the disruption of habitat continuity may be accompanied by a disruption of interactions between species, showing the functional significance of biodiversity. Local abundance of functional groups may depend on different spatial scales of the surrounding landscapes, which will be shown by case studies on pollinators, herbivores, and parasitoids. The landscape structure may determine the outcome of the plants' pollination, seed set, and seed predation. In Centaurea jacea, the number of flower-visiting bees, but also the proportion of flower heads damaged by seed predators increased with landscape complexity. In contrast to expectation, the mean number of seeds per flower head did not increase with the proportion of semi-natural habitats in a landscape, presumably due to the counterbalancing effects of pollination and seed predation. Solitary bees responded to changes in landscape complexity at small, but honey bees only at large spatial scales. Fruit damage of the annual oilseed rape (Brassica napus) also changed with complexity of landscapes. In simple landscapes with a low percentage of noncrop area and a high intensity of agricultural land use damage of oilseed rape by the rape pollen beetle (Meligethes aeneus) was lower than in complex landscapes. Reduced damage levels were associated with high levels of mortality of rape pollen beetle resulting from parasitism. These examples show how plant populations may be influenced by antagonistic as well as mutualistic interactions and that the local importance of these interactions may change with landscape context.

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Can we tailor diversity in agro-ecosystems to optimize biological control?

Dr. F. L. Wäckers, Department of Entomology, Wageningen University,
PO Box 8031, 6700 EH Wageningen, the Netherlands
Netherlands Institute of Ecology,
PO Box 40, 6666 ZG Heteren, the Netherlands
e-mail: waeckers@cto.nioo.knaw.nl

Biological control workers have long been aware of the fact that the impact of parasitoids or predators in biological pest control may be constrained by the lack of diversity in agricultural cropping systems. Non-crop elements can serve as refuges, as a source of alternative prey/hosts, or as a source of insect food, such as nectar and honeydew. This realization has translated in an increased interest in diversification of agro-ecosystems as a means of enhancing the efficacy of biological control. Despite the growing popularity of this approach, we know little about questions of how the composition of non-crop elements impacts the effectiveness of predators and parasitoids.

This paper will focus on the role of food provision by non-crop elements. First, I will present data on how field edges affect the nutritional status of parasitoids in the field. Subsequently, I will compare different nectars and honeydews with respect to their suitability as arthropod food sources. In particular I will address the issues of food detectability, accessibility and nutritional suitability. In addition, I will address the serious problem that many pest insects may benefit from sugar sources as well. Strategies to avoid this potential pitfall will be presented.

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Agricultural intensification and declining farmland birds: Evidence from monitoring studies

Dr. Dan Chamberlain, British Trust for Ornithology,
The Nunnery, Thetford IP24 2PU, UK
e-mail: dan.chamberlain@bto.org

Bird monitoring data from national schemes co-ordinated by the British Trust for Ornithology have been largely responsible for identifying declines in farmland bird populations in the UK. Population declines for several species closely match general measures of agricultural intensification. A correlative approach using a range of monitoring data provides compelling evidence for five key factors that are likely to have driven farmland population declines: change from spring to autumn sowing of cereals; changes in land use diversity at both the landscape and farm scale; increases in artificial fertilizer and subsequent changes in grass and cereal sward structure; increases in livestock densities; and loss of rough grazing. Likely mechanisms underlying the declines can be inferred from annual nest monitoring and analysis of ringing recovery rates. Generally, changes in survival rates and decreases in the number of breeding attempts are implicated as the most likely underlying causes for several declining species. Due to the wide range of species affected and the multiple factors underlying the declines it is difficult to identify those individual aspects of farm management that are of most importance to the recovery of farmland bird populations. We suggest that a general extensification of agriculture, rather than implementation of management prescriptions for individual species, will be most likely to benefit the farmland bird community. This can be achieved through agri-environment schemes in conjunction with widespread initiatives to reduce the intensity of farm management over large areas.

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Roles of genetically modified organisms, intensive agriculture, agri-environment schemes and wilderness in the agricultural landscape?

Prof.Dr. William J. Sutherland, University of East Anglia

e-mail: w.sutherland@uea.ac.uk

It is widely accepted that current EU agricultural policies are unsatisfactory for farmers, consumers, biodiversity and the taxpayer. Within the United Kingdom there is a widespread acceptance that radical changes are necessary. I will review the history of this change in attitude, show how the consequences of intensification (such as that from genetically modified crops) can be predicted, and suggest that we combine targeted agri-environment schemes with large scale habitat restoration. Such restoration provides the opportunity to deal with several problems simultaneously, such as sea-level rise, flood defense and water catchment protection.

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Agri-environment schemes: from intentions to achievements.

Dr. David Kleijn. Nature Conservation and Plant Ecology Group, Wageningen University,
Bornse steeg 69, 6708 PD Wageningen, The Netherlands.
e-mail: David.Kleijn@staf.ton.wau.nl.

Throughout the European Union, agri-environment schemes have been implemented to ameliorate the adverse effects of agriculture on environment and biodiversity. Aims of these schemes are usually formulated in broad terms, but it may be expected that the diversity of target species or species groups is higher on fields, or in areas where schemes are being implemented. Although in some countries these so-called agri-environment schemes have been implemented for well over a decade, few detailed studies exist that examine their ecological effects.

An extensive study in The Netherlands showed that species richness of the target groups was not raised after introduction of agri-environment schemes. The conservation measures were designed to enhance the abundance of waders or the species richness of the vegetation. We made a pair-wise comparison between grassland fields managed to promote biodiversity and nearby conventionally managed fields (39 pairs throughout The Netherlands). On each field, vegetation and breeding birds, as well as bees and hover flies were surveyed. Species richness of farmland birds as well as vegetation was similar on fields with agri-environment schemes and conventionally managed fields. Densities of some wader species were even lower on fields with schemes. In contrast, the species richness of both bees and hover flies was significantly higher on fields with adapted management.

The results of our study are placed in the context of studies in The United Kingdom where positive effects of agri-environment schemes have been established. All such schemes focus on a single target species of which detailed ecological information is available. The merits of schemes tailored to a single species and schemes that aim for positive effects on species groups or even habitat diversity are discussed. Furthermore, the interactions between conservation management and environmental conditions are highlighted as a key to effective agri-environment schemes.

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Restoration of plant species diversity in agricultural landscapes

J.P.Bakker, Laboratory of Plant Ecology, University of Groningen,
P.O.Box 14, 9750 AA Haren, The Netherlands.
e-mail: J.P.Bakker@biol.rug.nl

The focus will be on grasslands exploited for the production of hay or as pasture. Countries with low-intensity farming systems harbour plant communities characteristic of mesotrophic to oligotrophic soil conditions. Haymaking is carried out in small enclosed fields, grazing often in large unenclosed communal areas. In countries with intensive farming, many plant species have been pushed into the margins of fields. Grass is cut for silage several times a year. Grazing is practised in a rotational system in individual fields.

It seems a difficult task to get plant species again out of the margins into the fields in countries with intensive farming. The relationship between yield and species richness in grasslands indicates that grasslands with a low productivity are a prerequisite for higher species numbers. As the number of species per se does not tell much about the plant communities, attention should be paid to the character of the species involved.

Lowering the intensity of farming implies a later cutting date, lower input of fertilizer application. The starting point of the discussion is that the farmer should be compensated for the decreased output of the fields. The question to which extent a change in plant communities takes place is not always asked. It seems that the means of farming activities at a lower intensity has become a goal in itself.

The results with respect to the effects of agri-environmental schemes in fields are not promising with respect to plant communities. I will try to characterize the species composition of fields under organic farming system i.e. without application of pesticides and artifical fertilizers. The focus will be on case studies. Some long-term successional changes from the time of their conventional management are available. Considerable differences are found of the effects of rotational grazing, seasonal grazing and hay-making.

The type of plant communities with nature conservation interest to be maintained or restored in agricultural landscapes should be considered both on the national and the European level.

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Impact of pesticide drift on biodiversity in agricultural landscapes.

Dr. Geert de Snoo, Centre of Environmental Science, Leiden University,
P.O. Box 9518 RA Leiden, The Netherlands
e-mail: Snoo@cml.leidenuniv.nl

In agricultural areas pesticides are measured outside the target area in all compartments: soil, water, air and biota. In some cases above environmental standards. Risk analysis based on laboratory data and bio-assay studies show that effects on biodiversity (flora, fauna and fungi) can be expected. Scenario's for the Netherlands, based on Good Agriculture Practice, show that linear elements like hedgerows and ditch banks will be affected on a large scale. The application of herbicides should have the most impact. However, it is surprisingly that there are so little field data available to validate these type of predictions. Is it so difficult to trace these type of effects? Or do we overestimate the actual effects of low doses of pesticides on biodiversity in the field? In the Netherlands a large scale field study was carried out simulating low dosages of herbicide on off crop vegetation to give an answer on these questions.

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Sustainable development, maintaining agricultural output, and conserving biodiversity: challenges for ecologists

Dr. Jeff Harvey, Netherlands Institute of Ecology,
PO Box 40, 6666 ZG Heteren, the Netherlands
e-mail: harvey@cto.nioo.knaw.nl

Since crops were domesticated some 10,000 years ago, agriculture – the intentional and directed selection and domestication of valuable plant and animal species – has increasingly come to dominate many of the world's terrestrial landscapes. Agriculture is, by definition, an example of biological specialisation, and a narrow range of domesticated species have come to dominate land formerly occupied by natural and often biologically rich forests, grasses, and wetlands. The continued expansion of human numbers, coupled with increases in consumption patterns has had, and is continuing to have, profoundly negative impacts on many natural ecosystems around the world.

In this talk a number of factors underlying the threats of agricultural practices on biodiversity are examined, with a focus on the relationship between population growth and productivity growth on the health of underlying ecosystems worldwide. Data will be presented based from the FAO (UN) and WRI files which highlight a number of environmental problems associated with human consumption patterns and economic expansion. Discussion will also focus on the potential importance of biodiversity in agricultural landscapes, based on a range of ecosystem services generated over variable temporal and spatial scales. Improving agriculture's poor record with respect to biodiversity remains a major challenge for scientists and policymakers.

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