SIXTH FRAMEWORK PROGRAMME
PRIORITY 8.1
Scientific Support to Policies (SSP)

Deliverable 5.2 Report on policy options of biodiversity management

Project acronym: **COCONUT**

Project full title: **Understanding effects of land use changes on ecosystems to halt loss of biodiversity due to habitat destruction, fragmentation and degradation**

Proposal/Contract no.: **044346**

Date of delivery: **30th of April 2009**

Project home page: **www.coconut-project.net**

Comment:

– DELIVERABLE report –

COCONUT - Understanding effects of land use changes on ecosystems to halt loss of biodiversity

Contract No **044346**

Impacts on biodiversity from land use change and habitat degradation - implications for policy

Jakob Lundberg[1] & Riccardo Bommarco[2]

[1]Stockholm University, Sweden

[2]Swedish University of Agricultural Sciences, Sweden

COCONUT in a nutshell

Policy recommendations

- Management of Natura 2000 sites should be extended to include their immediate surroundings
- Stop the decreasing trend of the area of semi-natural grasslands through effective agri-environment schemes. Agri-environmental schemes should be spatially coordinated at the landscape level
- An early assessment of extinction debt in all habitats that have been perturbed within the last decades should be performed.
- Increase monitoring of biodiversity and land use and develop European-level monitoring and evaluation of the effects of national agri-environmental schemes. Improve quality, resolution and coverage of biodiversity and land cover data
- Promote communication between policymakers and scientist. Improve institutional uptake of policy supporting research results

Main findings

- Habitat loss and the quality of the landscape surrounding the habitat drives biodiversity loss
- Species with different life history traits run different extinction risk
- Extinction debts exist in fragmented landscapes mainly for vascular plants
- Habitat quality to biodiversity has deteriorated around but not within Natura 2000 sites in the years 1950 to 2000
- The quality of CORINE and available biodiversity information from Natura 2000 areas is insufficient to allow for biodiversity modelling
- Scenarios models predict biodiversity declines in Natura 2000 sites with increasing land use intensification

Purpose

- Provide decision basis to meet EU target to halt biodiversity by 2010 and beyond
- Improve understanding on how terrestrial biodiversity is affected by historic and current land use changes

Approach

- Assemble existing data on land use change (GIS) and its effects on organisms from literature and existing databases
- Focus on Natura 2000 sites and habitat types
- Perform meta-analysis and statistical modelling
- Incorporate results in policy driven land use scenario models

See further: www.coconut-project.net

Background, aims and findings

As a result of increasing human pressure, the quality and the extent of natural habitats has decreased dramatically across Europe over the last centuries. This has lead to a massive biodiversity loss. In fact, if the current rate of loss of biological resources is continued, within a few generations that will lead to unprecedented consequences for humankind.

The EU and other states have set an objective to halt or significantly reduce the current rate of loss of biodiversity by 2010. Biodiversity is critical to ecological resilience and the provisioning of ecosystem services essential for human well-being.

High biodiversity has been suggested to improve the resilience of ecosystems. Therefore, high diversity ecosystems may act as an important buffer to future environmental changes, such as those predicted as a result of climate change.

Land use and land cover changes play a major role for ecosystems, habitats and associated species. Land use changes and habitat loss may result in serious consequences to the generation of ecosystem services such as pollination and pest control provided by insects. However, there is a large information gap on the effects of land use change on important biodiversity groups. This information is critical to support correct policy decisions that mitigate biodiversity loss.

Thus, the translation of this threat to biodiversity into tangible and quantifiable factors for use by policy-makers in decision-making processes is challenging, but vital for conservation.

The COCONUT project

A two-year, research project founded under the European Commission Sixth Framework Programme. COCONUT is coordinated by the Swedish University of Agricultural Sciences and involves 11 partners from 8 countries.

The main aims of the COCONUT project are to (1.) Gather existing and new data on both historical and current species richness and land use (GIS) across Europe. (2.) Synthesise these data and perform meta-analyses to assess the current extent of biodiversity loss and to understand how land use change affects biodiversity. (3.) Assess historical trends of biodiversity and land use inside and in the surroundings of the Natura 2000 areas. (4.) Use the results to parameterise predictive models to project future land use and biodiversity change in response to socio-economic scenarios. (5.) Develop and disseminate decision tools and policy options for main EU-policy areas for mitigating biodiversity loss based on the main findings of the project.

The COCONUT approach -What's new?

We performed cross continental meta-analyses to assess how land use change affects biodiversity change and how species with shared life-history traits vary in their sensitivity to land use change. We grouped biodiversity components into trait groups which provided guidelines for more efficient targeting conservation efforts and monitoring of especially

threatened components of biodiversity. We have developed novel methods to assess shifts in habitat and landscape level quality for biodiversity in Natura 2000 sites in Europe. We provided quantitative evidence for land cover change processes. Based on our results, we addressed and disseminated policy options for main EU-policy areas aimed at mitigating biodiversity loss.

Main findings

- Habitat loss and fragmentation, and also the quality of the landscape surrounding the threatened habitat, are key drivers for biodiversity decline. This was found for several biodiversity groups including pollinating insects, butterflies, and moths.
- Habitat quality to biodiversity has deteriorated around but not within Natura 2000 sites during the period 1950-2000. Nevertheless, habitat quality for areas immediately outside Natura 2000 sites has deteriorated in many sites, especially between 1950 and 1990, for the majority of the groups of organisms examined (birds, plants, butterflies and bees).
- Land use intensification is predicted to lead to biodiversity decline in Natura 2000 sites in future scenarios
- Not all species react equally to land use change. Instead species with shared life history traits such as diet preference, dispersal capacity or sociality vary in their sensitivity to land use change.
- Mainly plants have extinction debts in fragmented landscapes. We found evidence of delayed extinctions in vascular plants about 50 years after key habitat has been lost. Such extinction debts provide a major challenge for biodiversity conservation.
- The quality of CORINE and available biodiversity information from Natura 2000 areas is insufficient to allow for biodiversity modelling. This information is of too low resolution, quality or consistency to allow for making sensible biodiversity-land use links. By using higher resolution land use information available for case study areas in Europe, we developed tools for assessing and scaling ecologically relevant land use change patterns and modelled these in response to socio-economic scenarios.

Policy implications and recommendations How to halt the biodiversity loss in Europe?

From our research findings, and also from the difficulties we had in pursuing some of our research ideas, several policy implications and recommendations can be drawn:

- Management of Natura 2000 sites should be extended to include their immediate surroundings
- Stop the decreasing trend of the area of semi-natural grasslands through effective agri-environment schemes. Agri-environmental schemes should be spatially coordinated at

the landscape level

- An early assessment of extinction debt in all habitats that have been perturbed within the last decades should be performed.
- Increase monitoring of biodiversity and land use and develop European-level monitoring and evaluation of the effects of national agri-environmental schemes. Improve quality, resolution and coverage of biodiversity and land cover data

Management of Natura 2000 sites should be extended to include their immediate surroundings

Emergence: Traditionally protected area management has focused on within site management in order to ensure protection of the biota. However, evidence from ecological theory and practice suggests that the structure and quality of the surrounding matrix is as important as the protected area itself (Forman 1995). Modifications of the surrounding matrix may include changes in the spatial configuration of the surrounding habitats and changes in the quality of the habitats themselves. Landscape configuration can be the most apparent change around protected sites. However, changes in habitat quality are equally important at a smaller scale for species persistence. Habitat quality can be defined as the ability of the environment to provide conditions appropriate for individual and population persistence (McDermid et al. 2005). Therefore, maintaining habitat quality is a critical component of nature conservation policy. For that reason generic habitat quality indices are commonly employed and habitat quality has been used as a surrogate for rapid species monitoring especially where resources, for expensive species-level survey and monitoring, are limited (Lucque and Vainikainen 2008). Habitats are recognisable entities that can be identified, mapped and managed. They are susceptible to intervention in a form that is recognisable to land managers, conservation officers etc.

Problem: It is becoming clear that although the Natura 2000 designation is an important step towards biodiversity protection in Europe a static designation is no longer adequate and that we need a more dynamic approach to conservation to ensure that the conservation targets are achieved (Commission of the EC 2008). Preliminary results of the COCONUT project highlight that there is a need to monitor activities beyond the Natura 2000 boundaries since understanding the spatial pattern of habitat patches and the character of the intervening matrix is of utmost importance for the ecological structure and function of protected areas (Forman 1995).

Public Policy: Although policy for protection within protected areas is specific and can be implemented, currently there is no clear and specific policy for planning and protecting land in the immediate surroundings of these areas (i.e. the matrix). The role of the matrix in supporting and buffering biodiversity in Natura 2000 sites is poorly understood and at the national level relevant conservation actions are usually absent.

Chronology: The Natura 2000 network was derived from the Birds Directive (1979) and the Habitats Directive (1991), which constitute the backbone of the EU's internal policy on biodiversity. According to the Commission (Commission of the EC 2008) one of the EU's

main targets is to halt biodiversity loss of most important habitats and species by 2010, with these habitats and species showing substantial recovery by 2013. This target should be implemented within Natura 2000 sites but also in the wider countryside (Headline Targets under Objectives 1 & 2) .

Trends: Research carried out under the COCONUT projects demonstrates that habitat quality inside Natura 2000 sites has generally remained constant between 1950 and 2000. However, habitat quality for areas immediately outside Natura 2000 sites has deteriorated in many sites between 1950 and 1990 for the majority of the groups of organisms examined (birds, plants, butterflies and bees). Changes are less obvious for the period 1990 to 2000. Using contrasting land use scenarios to predict changes in the future and in turn changes in habitat quality a clear pattern emerges where "development" rate is inversely related to habitat quality.

Stop the decreasing trend of the area of semi-natural grasslands through effective agri-environment schemes. Agri-environmental schemes should be spatially coordinated at the landscape level

Emergence: Semi-natural grasslands are one of the most species-rich habitats in Europe and thus crucially important for the conservation of biological diversity. Since 1992 support for the management of semi-natural grasslands has been increasingly included in agri-environment schemes in EU countries. However, the existing measures have proven ineffective in attempts to halt the decline in biodiversity of agricultural areas, and negative trends of many organism groups are still continuing despite European Union's target to halt biodiversity loss by 2010. Moreover, even though research has shown that the current measures are ineffective, it has proven difficult to introduce changes in the agri-environment policies once they were established.

Problem: The continuous decrease in the area of these important habitats has resulted in a strong decline in populations of numerous organisms inhabiting agricultural environments in many European countries. These declines may have serious consequences for ecosystem services like pollination and pest control provided by pollinating and predatory insect species, since these insect groups are largely dependent on the occurrence of open areas in the agricultural landscape. Current European policies have been failing in halting biodiversity loss and the decline of semi-natural grasslands. This failure may partly be due to the fact that many measures in agri-environment schemes were not implicitly planned to maintain biodiversity, but for example to prevent nutrient leaching to water systems..

Public policy: New measures for large-scale habitat management in agricultural areas have to be taken and the existing agri-environment schemes should be revised. These measures should include incentives that encourage farmers to maintain and eventually increase the area covered by semi-natural grasslands at the farm scale. The amount of support should be related to the biodiversity value of the managed habitats. It could also be required from all farms receiving support through agri-environment schemes that the area of open semi-natural habitats would not decrease from the current level. In addition to habitat management, large-scale habitat restoration needs to be promoted at the European scale, prioritising areas in which the potential for habitat restoration is bigger.

Options that are nowadays dependent on individual choices or payments could be strategically selected and placed in the landscape. For example, linking up linear features, such as field margins, would increase the connectivity between semi-natural areas reducing fragmentation.

An early assessment of extinction debt in all habitats that have been perturbed within the last decades should be performed

Emergence: Time delayed extinction of species after environmental perturbation will cause numerous extinctions in the near future, if counteractions are not immediately started.

Problem: The biodiversity in the EU is threatened to an unforeseen extent because of extinction debt (time delayed extinction of populations and species) in habitats, which have been perturbed within the last decades. Especially semi-natural habitats have been destroyed within the last 50 – 100 years throughout Europe. Our data indicate that an extinction debt must be expected particularly for long living species such as perennial plants. These species react slowly but will go extinct in the future if no counteractions will be started immediately. Importantly this will also negatively affect many associated short-living animals in the future.

Public policy: The EU has committed itself to halt loss of biodiversity through a range of policies (e.g Natura 2000; cross compliance requirements for CAP payment; environmental protection policies). An early assessment of extinction debt is necessary in all habitats, which have been perturbed within the last decades (e.g. semi-natural grasslands). An immediate restoration of these habitats is necessary to prevent future species loss due to extinction debt.

Increase monitoring of biodiversity and land use and develop European-level monitoring and evaluation of the effects of national agri-environmental schemes. Improve quality, resolution and coverage of biodiversity and land cover data

Emergence: When the new measures to halt the decrease of semi-natural habitats have been introduced in different EU countries, coordinated monitoring of the impacts of these measures on plants and animals needs to be launched.

Problem: The quality of the available information for biodiversity and land use has shown to be insufficient for an efficient monitoring of land use change and biodiversity loss. Currently available European data can only be used for broad brush assessment, and is strong limitations for exploring environmental change and policy change impacts at a regional scale. Field data for butterflies and plants did not show any consistent relation with CORINE Land Cover 2000 land cover classes, at 100m and where available 25m resolution. Thus, there is an urgent need for improvement of biodiversity and land use data as a support for the design of monitoring schemes. Monitoring the efficiency and the effect over biodiversity of agri-environmental schemes is difficult since it is hard to distinguish the impacts of these schemes from those of other factors

Public policy: The EU has committed itself to halting biodiversity decline, and attempts to

protect biodiversity through a range of policies (e.g Natura 2000; cross compliance requirements for CAP payment; environmental protection policies). Appropriate monitoring and research is required in order to assess the effectiveness of such efforts, and to explore potential impacts of environmental change and policy reform. This demands to enhance and standardise the quality of biodiversity data, in particular in the areas Natura 2000 Monitoring programs should include the comparison between areas under agri-environmental schemes and control areas where these measures have not been introduced. This is necessary in order to reliably distinguish the impacts of the agri-environment schemes from other factors. Semi-natural grasslands represent the so-called High Nature Value (HNV) farmland areas and therefore should be annually monitored in all EU countries.

Promote communication between policymakers and scientist. Improve institutional uptake of policy supporting research results

Emergence: An important part of the obligations for scientists, especially for EC-funded projects, is the dissemination of results to stakeholders.

Problem: An often-met obstacle, especially when attempting to interact with Governmental Organisations (GO) at the EU-level is the lack of time and opportunity for policy experts and managers to attend such activities.

Public policy: Improve uptake of research results by policymaking and enacting institutions at regional, national and EU levels. Give opportunity to GO policy makers and natural resource managers to participate in dissemination activities and workshops to better take up the results that EC-funded policy supporting research delivers. A possibility is the arrangement of annual science-policy interface conferences where bureaucrats participate. An important component in this effort will be to improve internal communication within institutions, e.g. between Commission DG's.

References

Balmford A., Crane P., Dobson A.P., Green R.E and Mace G.M. (2005) The 2010 challenge: data availability, information needs, and extraterrestrial insights. Phil. Trans. R. Soc. B 360: 221-228.

Butler SJ, Vickery JA, Norris K (2007) Farmland biodiversity and the footprint of agriculture. Science 315: 381-384

Commission of the European Communities (2008) Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: a mid-term assessment of implementing the EC biodiversity action plan.

Commission of the European Communities (2008) Accompanying document to the

Communication from the Commission to the Council, the European Parliament, the European

Economic and Social Committee and the Committee of the Regions: a mid-term assessment of implementing the EC biodiversity action plan.

European Council (2001) Presidency Conclusions, Göteborg Council, 15 and 16 June 2001. SN/200/1/01 REV1, p. 8.

Forman, R. T. T. 1995. Land Mosaics: The Ecology of Landscapes and Regions. Cambridge University Press, Cambridge. 632 pages.

Gimona A, Messager P, Occhi M (2009) CORINE-based landscape indices weakly correlate with plant species richness in a northern European landscape transect. Landscape Ecology 24: 53-64

Helm A., Hanski I. & Pärtel M. (2006) Slow response of plant species richness to habitat loss and fragmentation. *Ecology Letters* **9**, 72-77

Kleijn, D. & Sutherland, W.J. (2003) How effective are European agri-environment schemes in conserving and promoting biodiversity? J. Appl. Ecol. 40: 947-969.

Krauss J., Bommarco R., Guardiola M., Heikkinen R.K., Helm A., Kuussaari M., Lindborg R., Öckinger E., Pärtel M., Pino J., Pöyry J., Raatikainen K., Sang A., Stefanescu C., Teder T., Zobel M. & Steffan-Dewenter I. (in preparation): Assessing extinction debts for plants and butterflies in fragmented grasslands

Kuussaari M., Bommarco R., Heikkinen R.K., Helm A., Krauss J., Lindborg R., Öckinger E., Pärtel M., Pino J., Rodà F., Stefanescu C., Teder T., Zobel M. & Steffan-Dewenter I. (submitted) Extinction debt: a hidden risk for biodiversity. *Trends in Ecology & Evolution* (submitted manuscript)

Lindborg R. & Eriksson O. (2004) Historical landscape connectivity affects present plant species diversity. *Ecology* **85**, 1840-1845

Luque S. and Vainikainen N. (2008) Habitat Quality Assessment and Modelling for Forest Biodiversity and Sustainability. In Lafortezza, R., Sanesi, G., Chen J., & Crow T. R. (eds) Patterns and Processes in Forest Landscapes: multiple use and sustainable management.

Mattison EHA, Norris K (2005) Bridging the gaps between agricultural policy, land-use and biodiversity. Trends in Ecology & Evolution 20: 610-616

McDermid, G., Franklin, S.E., LeDrew, E.F. (2005) Remote sensing for large-area habitat mapping. Progress in Physical Geography 29: 449 - 474