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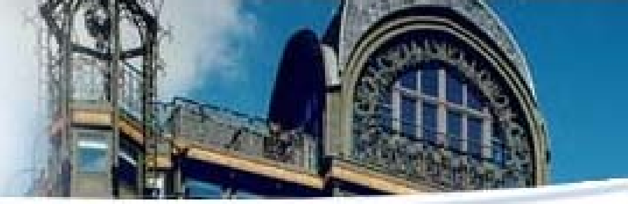

Belgian Biodiversity Platform

Proceedings of the 5th meeting of the

European Platform for Biodiversity Research Strategy

2-4 December 2001 – Brussels

SCIENTIFIC TOOLS FOR BIODIVERSITY CONSERVATION: MONITORING, MODELLING AND EXPERIMENTS

Federal science policy

WEB VERSION – PART 3

Meeting under the Belgian EU Presidency

Edited by

H. Segers, E. Branquart, A. Caudron & J. Tack

BIOplatform EUROPEAN PLATFORM FOR BIODIVERSITY

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Proceedings

5 Key-note contributions

5.1 Monitoring biodiversity in agricultural landscapes: the dilemma of conflicting value systems and indicators

Abstract

Various biodiversity indicators are currently in use, but none of them have been tested for their correlation with the particular aspect or entity of biodiversity that they are meant to indicate. We propose a procedure to design value-specific indicator sets based on the main motivations of stakeholders to protect or enhance biodiversity in cultivated landscapes: species conservation, ecological resilience, and ecosystem functioning such as biological control or pollination. The approach includes the following steps:

1. Defining the value systems and measuring the appropriate aspects and entities as thoroughly and comprehensively as possible in national test areas for biodiversity assessment.
2. Measuring or calculating (by rarefaction) all kinds of indicators within the test areas and correlate their values with the “reality” of the assessed value systems.
3. Group the best concordant indicators into value baskets to form an index, e.g. the “biodiversity index for conservation”.

Introduction

All over Europe, billions of Euros are spent each year for some form of agri-environment schemes (European Community, 1997), but so far we seem to be unable to show significant improvements of biodiversity in monitoring programmes. A publication in the renowned journal Nature by Kleijn et al. (2001) has alarmed both governmental officials, conservationists and scientists by stating that management agreements were not effective in protecting the species richness of the investigated species groups: no positive effects on plant and bird species diversity were found. Hover flies and bees showed modest increases in species richness on fields with management agreements. What is going wrong?

There is an immediate need to analyse the reasons for the apparent lack of significant, positive changes in agricultural biodiversity. One hypothesis is that improvements take more time. Maybe the methods applied so far were not adequate. Another hypothesis is that simply declaring ecological compensation areas not always brings along real changes on a landscape level. Yet another hypothesis is that we are not measuring the right thing. The present contribution focuses on that last point.

Most people, public agencies, scientists or NGO’s who want or have to monitor and evaluate biodiversity depend on indicators or surrogates. In most cases, the chosen indicators do not indicate biodiversity *per se*, but selected aspects or entities of biodiversity, such as the species richness of birds, butterflies or vascular plants. The choice of biodiversity indicators is usually circumstantial, depending on what specialists are available and payable at the moment.

Value systems

The various stakeholders in an agricultural landscape have different motivations to preserve or enhance biodiversity. Their value systems focus on different aspects or entities of biodiversity. Agri-environmental schemes to promote ecological compensation more or less explicitly include the goal to increase biodiversity in depleted landscapes. But what aspect of biodiversity? It is a revealing experience to ask stakeholders in agriculture, forestry, landscape planning, or tourism for their motivation to protect or enhance biodiversity. For agricultural ecosystems in industrialised countries, the motivations can be roughly grouped into three major value systems:

- *Species conservation*

The motivation is primarily ethical and socio-cultural. The fascination for all things rare and endangered is a basic human trait. Conservation can also be compared to art: Many people suffer emotionally and intellectually if deprived from any form of art. The same is true when people are faced with the loss of an appealing plant or animal species threatened by extinction.

- *Ecological resilience*

The motivation is primarily ecological, based on the paradigm of the “balance of nature” (Pimm, 1991). It is linked to the concept of sustainability: More species can fill more ecological niches, more genetic variety provides a better insurance against the dangers of sudden environmental change.

- *Ecosystem functioning*

The motivation is both ecological and economical. The basic ecological reasoning is the same as with ecological resilience, but clearly focused on a particular ecosystem function. Examples are biological control (preventing pest outbreaks and the use of pesticides in agriculture and forestry) or pollination.

Other motivations to maintain or enhance biodiversity are

- to further basic scientific knowledge (ecology, evolution, biology, etc.)
- prospecting for genetic resources for medicine, pharmacology, cosmetics, etc.
- to protect and promote cultural heritage, sense of place (Gustafson, 2000)
- the fascination for wilderness

In addition, many stakeholders in cultivated landscapes have only economical or political motivations when dealing with biodiversity. For their arguments they rely on the motivations and value systems of others.

Indicators

The best indicators for biodiversity are tested linear correlates to the entities and aspects of biodiversity, which the stakeholders have considered to be relevant. Obviously, each value system requires its own set of indicators. And it is not surprising to see that indicators for different value systems often do not correlate or even show a negative correlation. Conservationists focus on rare and threatened species, while for ecologists the more abundant species are of prime concern. The hypothesis of an almost vicarious relationship between the motivations of species conservation and ecological resilience is shown in Fig. 1. Red list species (stars in Fig.1) are usually present only in very low numbers, so they are not likely to have a measurable ecological influence. Abundant species or ubiquits, on the other hand, may be of ecological significance, but they are not appealing to people with a focus on conservation. A growing number of investigations show that there indeed is no significant correlation between the number of species in a given area and the number of red list species or stenotopic specialists (Prendergast et al., 1993; Foster et al., 1997; Duelli & Obrist, in press).

The term biodiversity is so broad and fuzzy that every person, and even more so different stakeholders, can hold their own view on the aspect or entity to be relevant for monitoring and assessing biodiversity. One of the main goals of ecological compensation measures in agricultural areas is to increase biodiversity. But an increase of what, in particular?

- More species of birds, butterflies, or orchids?
- More species altogether?
- More very rare and threatened species – of regional, national or even global importance?
- More antagonists of potential pest organisms?
- More indicators for undisturbed wilderness?
- Or at the genetic level: more breeds of domestic stock or field crops?
- More alleles in a stand of *Bromus erectus*?

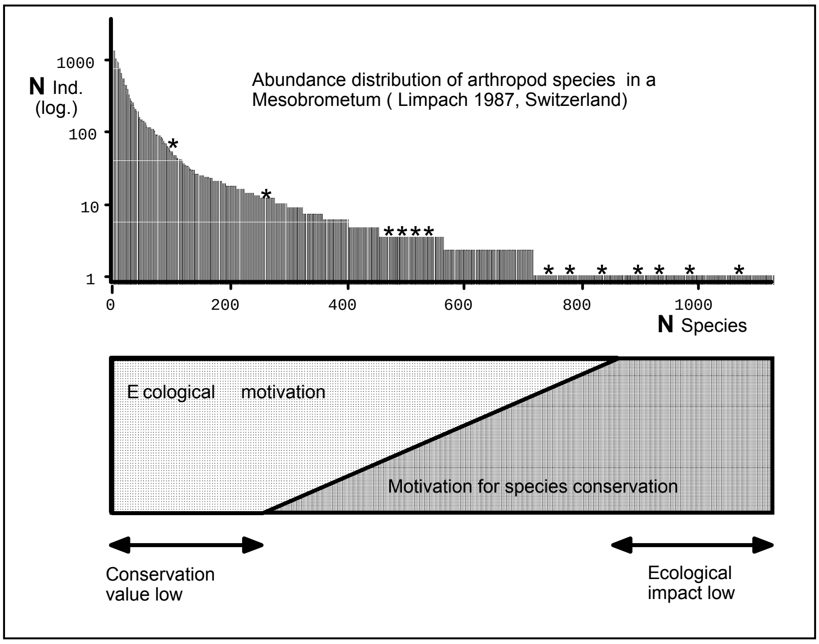

Figure 1. The vicarious relationship between the two value systems for conservation and ecological resilience. Abundant species may have a high ecological impact, but low conservation value, whereas very rare species are of high conservation concern, albeit with an immeasurably low ecological impact (from (Duelli & Obrist, in press). Upper graph: Number of individuals (N Ind (log) are plotted versus number of species (N species) in a semidry meadow in western Switzerland (Duelli & Obrist, 1998)

When evaluating the biodiversity of a particular habitat such as a Mesobrometum, the entity to measure or estimate can be the number of species or alleles within a given area (alpha-diversity). However, the **conservation value** of that Mesobrometum is not indicated by the overall number of species present, but rather by its contribution to the biodiversity of a larger surface such as a region or nation (beta-diversity). Common and widespread species will contribute little to regional or national biodiversity, while exceptional species contribute much. The best examples are raised bogs. They harbour very few species (little alpha-diversity), but in a country like Switzerland, where raised bogs have almost all been drained, the few remaining bogs with their very particular flora and fauna contribute significantly to national biodiversity.

Designing Value-specific biodiversity indices

Once there is agreement on a particular aspect or entity of biodiversity to be evaluated, a number of pertinent indicators can be designed. Similar to McGeoch (1998), a step-wise approach is proposed here to overcome the often inadequate and politically delicate use of biodiversity indicators in monitoring programmes and assessment schemes:

1. Define the value system (motivation) and the appropriate measurable aspect or entity of biodiversity (e.g. conservation value, alpha-diversity, potential for biological control, sustainability, pollination, cultural heritage, wilderness, etc.).
2. Measure that aspect or entity in a representative number of locations as thoroughly and diligently as possible.
3. In a third step, existing and proposed indicators are measured in the same areas, or calculated by rarefaction from the empirical data pool. Their performance can be tested against the assessed “reality”. Linear correlation power and costs decide, which of the indicators are the best, the fastest, the cheapest.
4. Group the best concordant indicators into “value baskets”. The result is an index per basket, e.g. “the biodiversity index for conservation”, or “the biodiversity index for ecological resilience”, just like the “Dow Jones index for industrial average”.

The most costly and tedious step is the exact measurement of a particular aspect or entity of biodiversity in a representative number of places. But without that crucial step, we will never attain scientifically tested and widely accepted indicators.

If biodiversity is seen as the whole taxonomic spectrum of plants and animals present per unit area (alpha-diversity), the pertinent entity to be quantified thoroughly with reasonable effort can be the number of terrestrial arthropods and plants, since they constitute most to overall species richness (Hammond, 1992). Species lists and relative abundances have to be assembled in a number of different habitats. At the same locations, potential indicators have to be measured. A straight-forward approach is to extract selected subsamples from the comprehensive data set by rarefaction techniques and test them for their linear correlation with the overall species richness per sampled location. Following that procedure in an agricultural landscape (Duelli & Obrist, 1998), the insect order Heteroptera (true bugs) turned out to be the best indicator, considering effort (costs) and yield (correlation). Extending the same procedure into forested areas, the bees and wasps (Hymenoptera aculeata) rated better (Duelli & Obrist, in press).

A further step for designing optimal indicators can be to reduce the effort by collecting only for a short period (Mühlenberg, 1993; Duelli et al., 1999). Yet another reduction of effort and costs can be to limit species identification to the level of morphospecies only (Oliver & Beattie, 1993).

The crucial point in all these rarefaction trials for designing an optimal indicator set is the initial quantification of the entity or aspect of biodiversity the stakeholders agreed upon for their particular motivation or value system. For motivations such as species conservation or biological control of pest organisms, the entity to be measured thoroughly has as yet to be defined. Only after that entity has been identified and quantified in a number of places, the search for designed indicators can be performed.

For the conservation value, the most obvious entity to be assessed would be the number and status of threat of all red-listed species in an area. Unfortunately, only a few percent of all organisms have been evaluated for their status of threat. So even the most comprehensive inventory will be biased by the choice of only a few taxa. The best value-designed indicators for the conservation value will be those subsets of red-listed taxa with the highest correlation with the entity “all red-listed species”. Methodological rarefaction can bring further optimisation, e.g. “number of red list butterfly species in seven 1km-transects per year”. While many standardised inventory methods of that kind are already in use, for none of them their correlation to the “real entity” of the conservation value has ever been tested. Yet another way of optimisation of effort and yield can be to combine methods and taxa, such as “red list species of breeding birds and vascular plants”.

Accordingly, the best set of designed indicators for the “biodiversity index for biological control” will be a set of linear correlates to the entity “taxonomic spectrum of beneficial organisms”. Crop protection specialists may have to define the actual entity to be measured and quantified for comparison. Here again, an obvious choice would be the overall number of species known to act as antagonists against potential pest organisms. Candidates for designed indicators are species numbers of selected predatory or parasitoid arthropods (carabid beetles, spiders, hover flies, tachinids, parasitoid wasps, etc.) or combinations of selected species groups.

Conclusion

The stepwise approach proposed here for designing and testing value-specific biodiversity indicators is a prerequisite for reliable and generally accepted biodiversity indices. But reality has shown that the effort and costs to be invested in a comprehensive measurement of even one aspect or entity of biodiversity are too high to be performed by single research units. However, with only one “national playground for biodiversity research” in each of several European countries, the statistical requirements could be fulfilled to develop designed standardised biodiversity indicators for national and international monitoring.

References

- **Duelli, P., & Obrist, M. K.** 1998 - In search of the best correlates for local organismal biodiversity in cultivated areas. *Biodiversity and Conservation, 7*(3), 297-309.
- **Duelli, P., & Obrist, M. K.** in press - Biodiversity indicators: the choice of values and measures. *Agriculture, Ecosystems & Environment*.
- **Duelli, P., Obrist, M. K., & Schmatz, D. R.** 1999 - Biodiversity evaluation in agricultural landscapes: above-ground insects. *Agriculture, Ecosystems and Environment, 74*, 33-64.
- **European Community.** 1997 - *Agenda 2000, Vol. L: For a stronger and wider EU*. Luxembourg.: Office for Official Publications of the European Communities.
- **Foster, G. N., Blake, S., Downie, I. S., McCracken, D. I., Ribera, I., Eyere, M. D., & Garside, A.** 1997 - Biodiversity in Agriculture. Beetles in Adversity? *BCPC Symposium Proceedings No. 69: Biodiversity and Conservation in Agriculture*, 53-63.
- **Gustafson, P.** 2000 - Meanings of Place: Everyday Experience and Theoretical Conceptualizations. *Journal of Environmental Psychology, 21*, 5-16.
- **Hammond, P. M.** 1992 - Species Inventory. In B. Groombridge (Ed.), *Global biodiversity, status of the Earths living ressources* (pp. 17-39). London: Chapman and Hall.
- **Kleijn, D., Berendse, F., Smit, R., & Gilissen, N.** 2001 - Agri-environment schemes do not effectively protect biodiversity in Dutch agricultural landscapes. *Nature, 413*, 723-725.
- **McGeoch, M. A.** 1998 - The selection, testing and application of terrestrial insects as bioindicators, *Biol. Rev* (Vol. 73, pp. 181-201).
- **Mühlenberg, M.** 1993 - *Freilandökologie*. Heidelberg: Quelle und Meyer.
- **Oliver, I., & Beattie, A. J.** 1993 - A possible method for the rapid assessment of biodiversity. *Conservation Biology, 7*, 562-568.
- **Pimm, S.** L. 1991 - *The balance of nature? Ecological issues in the conservation of species and communities*. Chicago: University of Chicago Press.
- **Prendergast, J. R., Quinn, R. M., Lawton, J. H., Eversham, B. C., & Gibbons, D. W.** 1993 - Rare species, the coincidence of diversity hotspots and conservation strategies. *Nature, 365*, 335-337.

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5.2 Biodiversity interactions within agricultural landscapes

Abstract

Individual taxa and habitats on farmland do not exist in isolation. The occurrence (and size, shape, age, quality etc) of other landscape features (e.g. woodlands, wetlands, river corridors) can not only have a major influence on the biodiversity value of the farmland, but the farmland itself can also influence the biodiversity value of these associated features. However, most farmland biodiversity research to-date has simply looked at individual taxa and/or has been conducted at the level of an individual field (or smaller) and/or has been targeted solely at individual farming practices (e.g. grazing, cutting, drainage) or components in the landscape (e.g. heather, arable, grassland, woodland, hedges, field margins). In addition, those few projects that have considered the interactions between a range of taxa at the landscape level (such as the SEERAD-funded Farmland Biodiversity Projects highlighted here) have only been able to concentrate effort across a range of open farmland habitats. There is therefore a need for a greater understanding of the ecological processes and drivers influencing biodiversity at a scale (such as a catchment) much greater than an individual field, protected area or farm. Only with a full understanding of the interactions between (and contributions arising from) farmed and non-farmed habitats will it be possible to make informed assessments of what landscape characteristics need to be retained or introduced to an area in order to maintain or enhance biodiversity value. Such an understanding would also help in judging the likely impact of broad land-use changes or, at the other extreme, in the choice of best locations to target agri-environment actions. Encouraging a greater consideration of the functional (rather than species) composition of the taxa under consideration could also allow more effective comparisons between geographical areas.

Introduction

Agricultural land covers over 75% of the United Kingdom and contains a rich diversity of habitats, supporting a wide variety of flora and fauna, much of which is of high conservation interest. In recognition of this importance of agricultural land to conservation and biodiversity, the University of Glasgow (UG), Scottish Agricultural College (SAC) and Macaulay Institute collaborated between 1998 and 2001 on a Scottish Executive Environment and Rural Affairs Department (SEERAD) funded project (*Modelling plant and animal biodiversity in a Scottish catchment devoted to agriculture*) investigating the relationships between plants, invertebrates, and birds on Scottish farmland at the landscape level (Dennis *et al*., 1998, 1999; McCracken *et al*., 2000; Cole *et al*., 2002). This project built on an earlier project (*Functional analysis of plant-invertebrate-bird biodiversity on Scottish agricultural land*) conducted by UG and SAC in which minimal multiple-regression models were developed for the different biological groups using Generalised Linear Interactive Modelling (e.g. Abernethy *et al*., 1996; Ribera *et al*. 1999a, 1999b, 2001; Downie *et al*., 1999, 2000; Wilson *et al*., 2003). These earlier predictive models provided estimates of species numbers on the basis of site characteristics (such as altitude and soil moisture content) and farm management practices (such as grazing pressure and input of inorganic fertiliser). The model produced for plants showed the highest predictive rigour, emphasising the extent to which vegetation is dictated by management practices. Spiders, which are closely associated with the vegetation, were the next best estimated, while the model for ground beetles, with their greater mobility, was less accurate. In general birds were poorly predicted and while estimates for many sites were close there were others which were considerably inaccurate. Variation in scale was recognised as the main factor limiting successful estimation of species biodiversity across the different groups.

This problem of spatial heterogeneity at different scales was addressed in the subsequent SEERAD-funded project by using appropriate methods of spatial modelling in combination with a GIS (Dennis *et al*., 1998, 1999; McCracken *et al*., 2000). Bryophytes, vascular plants, selected surface-active and soil-dwelling invertebrates, small mammals and ground-feeding birds were sampled at 75 independent sites representative of the major agricultural land-uses (ranging from intensive lowland arable situations through grasslands used for livestock grazing or silage production to upland heather moorlands) within 400 km^2 in central Scotland.

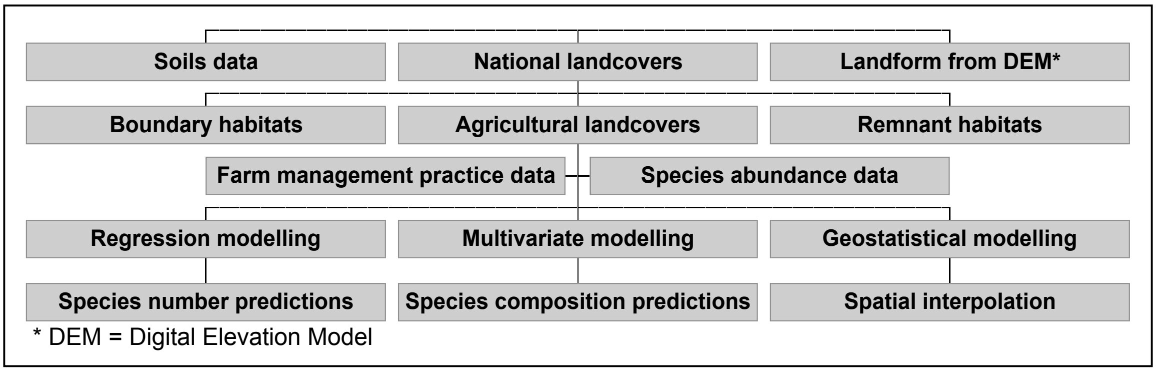

Figure 1 Type of data and modelling approaches utilised in the study

Predictive models were developed using three modelling approaches (regression, multivariate and geostatistical) in order to (a) identify the relative influence of landform, land use and land management practices on the species richness of each of the biological taxa under consideration and (b) interpolate the data on biodiversity collected at the field level to the target area of the river catchment.

Figure 1 provides an indication of the different levels of data collected and utilised in the study. Standard field methods were used to obtain species composition and abundance data for vascular plants, bryophytes, ground beetles, spiders and ground-feeding birds within each of the fields sampled. Data on land form and land cover were extracted from national landcover, soils and digital elevation databases, while field survey was used to provide finer resolution data on agricultural land cover, boundary habitats and surrounding remnant semi-natural and/or non-farmed habitats. Data on the detailed farm management practised within each of the fields was collected through interview of the farmers and landowners concerned. Abernethy *et al.* (1996) and Dennis *et al*. (1998, 1999) provide further detail on the data collection methods.

The models produced for vascular plants, spiders and ground beetles were particularly good, accounting for 61% (beetles), 65% (vascular plants) and 70% (spiders) of the observed variability in species richness across the study sites (Table 1). These three taxa differed markedly in terms of the number of species of each found to occur in farmland. In addition, different sets of broad and fine-scale variables were found to act as effective predictors for each. The combination of approaches used proved successful in providing a simple but effective (in terms of predictive power) set of models of the complex relationships between the biodiversity value of a particular field or area of farmland, and the associated (and surrounding) land form, land use and wider environmental variables.

Potential value of the approaches taken

Given the range of taxa under consideration (and the overall number of species involved), the different modelling approaches being taken are considered to be the only feasible way of obtaining an indication of the main influences of (and difference between) land form and agricultural land use at the landscape scale. Not only are all three approaches complementary, but they can also contain different combinations of broad and fine scale variables. Consequently, there is much scope for further improvement and refinement of the models (e.g. by further filtering of the species included in the datasets and/or by incorporation of finer scale variables and/or by incorporation of variables measured at more appropriate spatial scales). It is, however, essential that any modelling exercise keeps in mind not only the relevant scale at which the land management issues under consideration operate but also the relevant scale at which the biota of concern function. With this qualification in mind, the approaches taken in these studies are considered as being potentially useful at two main levels:

At the level of an individual catchment through allowing an assessment to be made of the likely impact on biodiversity of changes of land-use and patterns in the landscape. Such impacts could come about through a change in the overall amount of a certain type of agricultural land cover (taking place, for example, as a result of particular changes in agricultural policy or product prices - such as a new crop or cropping practice). Alternatively the impacts could be driven not by a change in agricultural land cover but rather in the occurrence and pattern of the surrounding non-farmed elements (taking place, for example, as a result of changes in hedgerow or woodland management unrelated to ongoing agricultural practice).

Table 1 An indication of the relationships found after multiple regression of species numbers of biota (spiders, vascular plants and ground beetles) and land form, cover and management variables across 61 independent sites from central Scotland used in model construction.

	Spiders	**Vascular Plants**	Ground **Beetles**
Aspect		-	
Altitude	+		
Slope			-
Soil Impenetrability		+	
Inorganic Input		-	
No. Plant Species	+		+
No. Hedge Plants			+
Landcover Turnover			+
Diversity non-farm (150 m)	-		
Diversity non-farm (500 m)		-	
Arable diversity (750 m)			-
R^2 fit	*0.70*	*0.65*	*0.61*

At the level of the individual field through helping to identify the best focus for agri-environment actions. For example, an improved understanding of the effect on biodiversity of changes in land management within or around a particular field (taking place, for example, as a result of normal crop rotation practice) would allow a more informed choice of the best location for different types of management prescription to implement within or next to that field.

Implications for research priorities

The studies mentioned above have highlighted the fact that there is an extremely complex relationship between the biodiversity value of a particular field or area of farmland and the associated land form, land use and wider environmental variables. Only when a detailed understanding of all the interactions involved is available will it really be possible to put together an appropriate farmland biodiversity conservation strategy - one that takes into account the importance of pattern in the agricultural landscape and which can predict the impact of land-use change upon this pattern and the associated biodiversity value. Hence, there is a need not only to integrate nature conservation needs into farming practices (e.g. through the agri-environment programme), but also to recognise the important role of additional landscape factors in affecting the likely success of particular management actions, or the different priorities that should be set for particular biological groups at individual sites.

To this end, research programmes are required within which studies:

Are focused at a large enough scale (such as a catchment) in order to obtain an understanding of the wider impacts of land use change on the different biodiversity elements occurring across the area as a whole, rather than focusing solely on individual sites or areas;

Do not focus on particular habitats or features (such as agricultural land, woodland, river corridors) in isolation but instead consider and quantifies the importance for biodiversity of the interactions between all of these elements (farmed and non-farmed) in the landscape;

Provide a more detailed understanding of the role of management practices (particularly the temporal aspects) in maintaining and enhancing biodiversity in agricultural landscapes (which by their very nature are dynamic);

Consider the effects and impacts of all these aspects on a range of different biological taxa, so that the full implications for a wide range of different components of biodiversity can be assessed and taken into account;

Include other, more meaningful measures of biodiversity value than simply species richness. Such measures could for example incorporate measurements of the rarity of the species occurring at a site into an overall site quality score (e.g. Foster *et al.* 1997);

Take an ecological or functional approach (e.g. considering the life traits of the species involved rather than focusing solely on the species or assemblages) to the assessment of land use impacts on biodiversity. Such an approach is likely to be the only way to allow a comparison of the effects of any type of impact on similar habitats in different geographical areas of Europe (where the species concerned are likely to differ but the functions performed by the species present are likely to be more directly comparable).

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References

- **Abernethy V.J., McCracken D.I., Adam A., Downie I., Foster G.N., Furness R.W., Murphy K.J., Ribera I., Waterhouse A.J. & Wilson W.L.** 1996 - Functional analysis of plant-invertebrate-bird biodiversity on Scottish agricultural land. In: I.A. Simpson & P Dennis (Eds), *The Spatial Dynamics of Biodiversity: Towards an Understanding of Spatial Patterns and Processes in the Landscape*. International Association for Landscape Ecology (UK Region), Aberdeen, UK.: 51-59.
- **Cole L.J., McCracken D.I., Dennis P., Downie I.S., Griffen A.L, Foster G.N., Murphy K.J. & Waterhouse A.** 2002 - Relationships between agricultural management and ecological groups of ground beetles (Coleoptera: Carabidae) on Scottish farmland. *Agriculture, Ecosystems & Environment* **93**: 323-336.
- **Dennis P., Downie I.S., Milligan A.L., Murphy K.J., McCracken D.I., Milne J.A., Foster G.N., Waterhouse A. & Furness R.W.** 1999 - Modelling the contribution of land cover and crop heterogeneity to biodiversity in a Scottish river catchment. In: M. Maudsley & E.J.P. Marshall (Eds), *Heterogeneity in Landscape Ecology: Pattern and Scale*. International Association for Landscape Ecology (UK Region), Long Ashton Research Station, Bristol, UK: 31-40.
- **Dennis P., Downie I.S., Milligan A.L., Abernethy V.J., McCracken D.I., Foster G.N., Murphy K.J., Waterhouse A. & Furness R.W.** 1998 - Modelling plant and animal diversity in a Scottish catchment devoted to agriculture. In: J.W Dover &

R.G.H. Bunce (Eds), *Key Concepts in Landscape Ecology*. International Association for Landscape Ecology (UK Region), Preston, UK: 161-166.

- **Downie I.S., Ribera I., McCracken D.I., Wilson W.L., Foster G.N., Waterhouse A., Abernethy V.J. & Murphy, K.J.** 2000 - Modelling populations of *Erigone atra* and *E. dentipalps* (Araneae: Linyphiidae) across an agricultural gradient in Scotland. *Agriculture, Ecosystems & Environment* **80**: 15-28
- **Downie I.S., Wilson W.L., Abernethy V.J., McCracken D.I., Foster G.N., Ribera I., Murphy K.J. & Waterhouse T.** 1999 - The impact of different agricultural land-uses on epigeic spider diversity in Scotland. *Journal of Insect Conservation* **3**: 275-288
- **Foster G.N., McCracken D.I., Blake S. & Ribera I.** 1997 - Species biodiversity and conservation value in agriculture: ground beetles as a case study. In: L.V. Fleming, A.C. Newton, J.A. Vickery & M.B. Usher (Eds) *Biodiversity in Scotland: Status, Trends and Initiatives.* The Stationery Office, Edinburgh: 219-227.
- **McCracken D.I., Dennis P., Milligan A.L., Cole L.J., Downie I.S., Murphy K.J., Furness R.W., Waterhouse A., Foster G.N. & Milne, J.A.** 2000 - Biodiversity and landscape interactions on Scottish farmland. In: T. Clare & D. Howard (Eds), *Quantitative Approaches to Landscape Ecology.* International Association for Landscape Ecology (UK Region), Bangor: 97-106
- **Ribera I., Dolédec S., Downie I.S. & Foster G.N**. 2001 - Effect of land disturbance and stress on species traits: a three table analysis of ground beetle assemblages. *Ecology* **82**: 1112-1129
- **Ribera I., Foster G.N., Downie I.S., McCracken D.I. & Abernethy V.J.** 1999a - A comparative study of the morphology and life traits of Scottish ground beetles (Coleoptera: Carabidae). *Annales Zoologici Fennici* **36**: 21-37
- **Ribera I., McCracken D.I., Foster G.N., Downie I.S. & Abernethy V.J.** 1999b - Morphological diversity of ground beetles (Coleoptera: Carabidae) in Scottish agricultural land. *Journal of Zoology* **247**: 1-18.
- **Wilson W.L., Abernethy V.J., Murphy K.J., Adam A., McCracken D.I., Downie I.S., Foster G.N., Furness R.W., Waterhouse A. & Ribera I.** 2003 - Prediction of plant diversity response to land use change on Scottish agricultural land. *Agriculture, Ecosystems & Environment* **94**: 249-263.

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5.3 DIVERSITAS: an international framework for biodiversity research

Abstract

The current extinction crisis we are experiencing differs from the previous ones in that it is occurring at an unprecedented rate, and is the direct result of human activities. Biodiversity loss is a matter of concern not only because of the aesthetic, ethical and cultural values attached to biodiversity, but also because it could have numerous far reaching consequences on our life support systems. In order to address the complex questions posed by the loss and change of biodiversity globally, scientific efforts need international co-ordination.

The new science plan of DIVERSITAS, provides such an international scientific framework to biodiversity research, integrated across disciplines. It is articulated around three Core Projects:

- Core Project 1, “Discovering biodiversity and predicting its changes”, assesses (1) how biodiversity is changing, by contributing to the development of the scientific tools of biodiversity monitoring, (2) why it is changing, by investigating the ecological and evolutionary processes involved in species extinction and speciation, and (3) how it is expected to change, by developing biodiversity scenarios for the future.
- Core Project 2, “Assessing impacts of the biodiversity changes”, assesses how biodiversity changes affect ecosystem functioning and thereby the provision of ecological goods and services of relevance to human societies, with a particular emphasis on human health.
- Core Project 3, “Developing the science of conservation and sustainable use of biodiversity”, studies the effectiveness of current regulatory measures and incentives to protect biodiversity, investigates alternative social, political and economic motivators for biodiversity protection, and establishes a scientific approach for optimising multiple usage of biodiversity.

Why do we need an international programme on biodiversity?

During the long history of life, Earth has experienced several periods of mass extinction. But the current extinction crisis differs from the previous ones in that it is occurring at an unprecedented rate, and is the direct result of human activities. Erosion of biodiversity occurs at various levels, from the genetic diversity of many natural and domesticated species to the diversity of our planet's ecosystems and landscapes, through the tremendous richness of species. Current human-induced rates of species extinction are estimated to be about 1,000 times greater than past background rates.

Biodiversity loss is a matter of concern, not only because of the aesthetic, ethical or cultural values attached to biodiversity, but also because it could have numerous far-reaching, often unanticipated, consequences for our life-support system. The capacity of natural and managed ecosystems to deliver ecological services such as production of food and fibre, carbon storage, nutrient cycling and resistance to climate and other environmental changes, could be reduced. Assessing the causes and consequences of biodiversity changes, and establishing the bases for the conservation and sustainable use of biodiversity, are major scientific challenges of our time.

The past decade has seen the birth of the Convention on Biological Diversity (CBD), of many conservation programmes aimed at protecting biodiversity, as well as many national research programmes dedicated to developing biodiversity science. Scientific efforts, however, need international co-ordination to address the complex scientific questions posed by the loss and change of biodiversity globally, as well as a research framework integrated across disciplines. DIVERSITAS provides such an international framework.

History of DIVERSITAS

The international global change programme on biodiversity, DIVERSITAS, was initiated by three partners, IUBS (International Union of Biological Sciences), SCOPE (Scientific Committee on Problems of the Environment) and UNESCO (Man And Biosphere programme of the United Nations Educational, Scientific and Cultural Organization), in 1991. In 1996, the partnership was enlarged to include three additional sponsors, ICSU (International Council for Science), IUMS (International Union of Microbiological Societies) and IGBP (International Geosphere-Biosphere Programme). DIVERSITAS mission was to provide an international framework for biodiversity research to promote biodiversity research nationally and internationally, and to provide scientific input to the Convention on Biological Diversity. From 1991 to 1999, five core projects were established. The main themes were inventorying and monitoring biodiversity; understanding why and how biodiversity is changing; and conserving biodiversity.

Following a fund raising campaign initiated by its five current sponsors, ICSU, IUBS, IUMS, SCOPE and MAB-UNESCO, the secretariat of DIVERSITAS reopened in March 2001 for a second phase. An international consultation of scientists and policymakers on scientific priorities for biodiversity research was carried out during the summer of 2001. This was followed by a meeting of an international group of experts who drafted a new science plan for DIVERSITAS.

The mission of DIVERSITAS is:

1. To promote integrative biodiversity science, linking biological, ecological and social disciplines in an effort to produce socially relevant new knowledge;
2. To provide the scientific basis for an understanding of biodiversity loss, and to draw out the implications for policies for conservation and sustainable use of biodiversity.

The overall structure of DIVERSITAS is presented in Figure 1. A scientific committee (SC-DIVERSITAS) of 12 members chaired by Prof. Michel Loreau, provides scientific advice to the programme. A small secretariat, established in Paris, implements the decisions made by the SC-DIVERSITAS, regarding:

- Development of Core Projects and Cross-cutting Networks;
- Fund raising activities and collaboration with IGFA (International Group of Funding Agencies for global change research);
- Collaboration with other international programmes, especially IHDP (International Human Dimension Programme on global environmental change), IGBP (International Geosphere-Biosphere Programme) and WCRP (World Climate Research Programme) with which DIVERSITAS established a partnership called the Earth System Science Partnership (ESS-P);

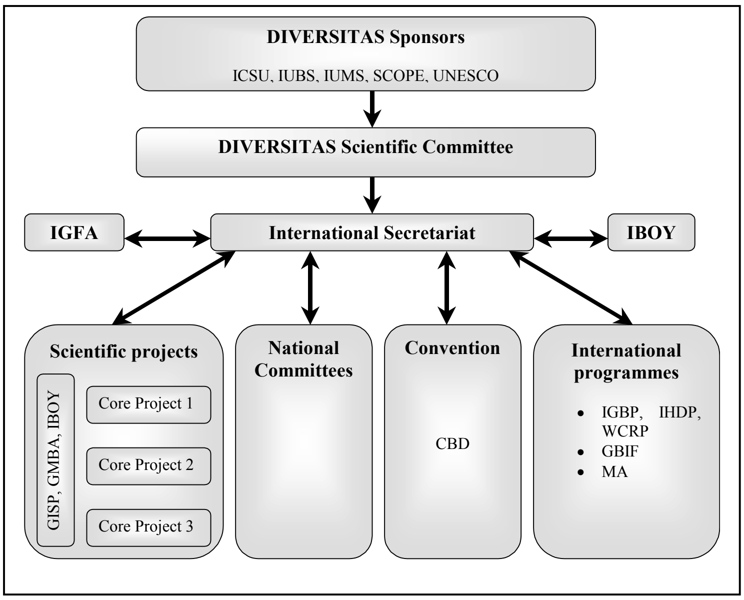

Figure 1. DIVERSITAS structure

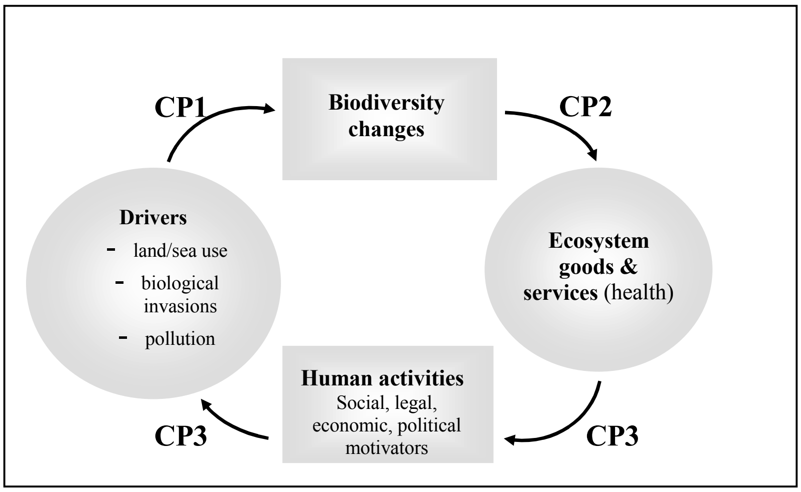

Figure 2. DIVERSITAS Science Plan: sustainable use of biodiversity

- Providing scientific input to the Convention on Biological Diversity;
- Establishing a network of national committees in order to have a strong link with national research programmes.

DIVERSITAS Science Plan

The new DIVERSITAS Science Plan was endorsed by the SC-DIVERSITAS in April 2002. It is articulated around three complementary and interdisciplinary core projects (Figures 2 and 3). Core Project 1 focuses on biodiversity changes. It looks at how much biodiversity we have, how it is changing and what the drivers of biodiversity change (including socio-economic drivers) and their mode of action are. Core Project 2 looks at the impact of biodiversity changes on ecosystem goods and services. Core Project 3 incorporates knowledge gained in the two other core projects to design economic and policy incentives which would lead to less pressure on biodiversity.

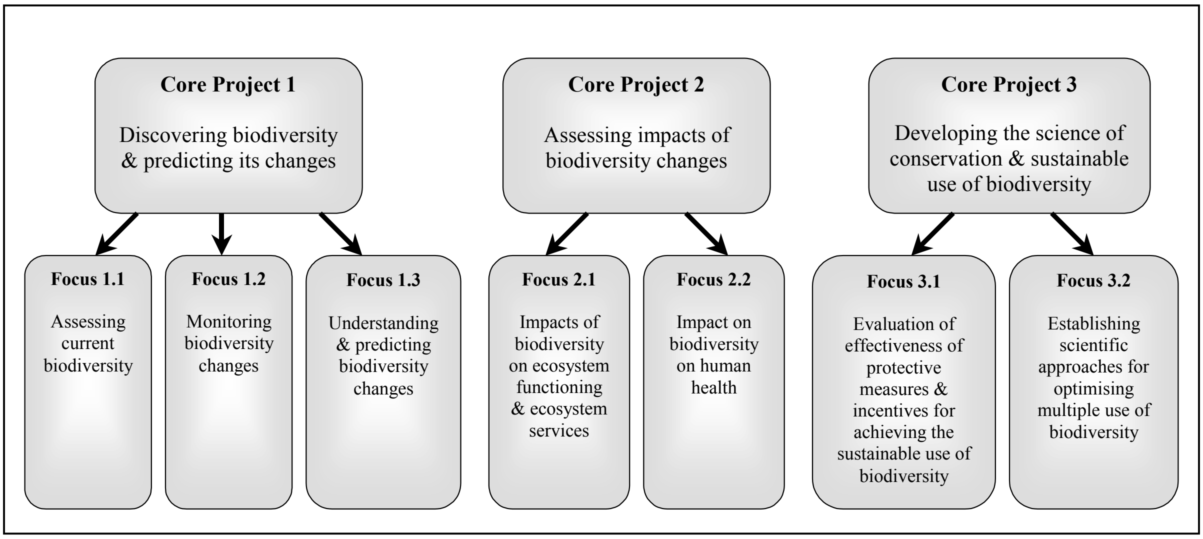

Figure 3. DIVERSITAS Core Projects

More specifically, Core Project 1 addresses the following questions:

1. How much biodiversity is there? (Focus 1.1)

Despite the growing interest in biodiversity during the last decades, our knowledge of the true diversity of life that inhabits our planet is still very limited and fragmentary. This focus was designed specifically to promote research on poorly known organisms, and on habitats and geographic areas that have received insufficient attention. Of special importance are micro-organisms, including, bacteria, archaea, and many protist and fungal lineages. New molecular techniques lead to the discovery of many new micro-organisms (e.g., in the ocean, Lopez-Garcia et al. 2001). Many of these organisms probably fulfil important functions in biogeochemical cycles, from local to global scales, which remain largely ignored.

2. How and why is biodiversity changing? (Focus 1.2)

The assessment of the state and change of biodiversity requires monitoring at the relevant scales of space and time. These scales can vary from days to years and from fractions of a metre to thousands of kilometres. Monitoring is essential to evaluate the success or failure of conservation and restoration measures (e.g. in the framework of the Convention on Biological Diversity) and to calibrate and validate models and scenarios and thereby improve their performance. The objective of this focus is to develop the scientific basis for monitoring biodiversity, as well as the tools of monitoring and the use of these tools. It also aims at promoting the integration of biodiversity monitoring and monitoring tools into global networks of observatories that are under development by other programmes.

3. How can we predict biodiversity changes? (Focus 1.3)

The aim of this focus is to improve our capacity to predict and hence to respond to biodiversity loss. The basic knowledge obtained will help identify the likely biodiversity effects of anthropogenic changes at different spatial and temporal scales, and the sensitivity of those effects to variation in climatic and economic conditions. This knowledge is essential if decision makers have to be able to assess the relative costs and benefits of different resource use options. It will support a range of decision-tools, including scenario building. The goal of Core Project 2 is to understand the consequences of biodiversity changes on ecosystem functioning and goods and services (Focus 2.1, Figure 3). This Core Project will actively promote the development of research in this area, building on the existing collaboration between DIVERSITAS and IGBP-GCTE (IGBP-Global Change and Terrestrial Ecosystems). It will investigate how the biodiversity changes studied and predicted in Core Project 1 affect ecosystem functioning and ecosystem services, thereby influencing strategies for the conservation and sustainable use of biodiversity (Core Project 3, see Photo 1 for an illustration of the concept of ecosystem services). A particular emphasis, within the context of ecological services, will be placed on impacts of biodiversity changes on human health (Focus 2.2, Figure 3).

Historically, approaches to the study of emerging diseases in humans have focused on treating infectious agents and producing medicines to combat them. These approaches have not generally placed infectious agents (virus, parasites, microbes) in their ecological context, nor examined the complex factors leading to emergence of diseases. The ultimate goal of this ecological approach is to contribute to developing a broader, predictive science of infectious diseases.

Core Project 3, will assess the effectiveness of current regulatory measures and incentives to protect biodiversity, investigate alternative social, political and economic motivators for biodiversity protection, and establish a scientific approach for optimising multiple use of biodiversity, considering possible trade-offs between economic and environmental goals. The first focus of Core Project 3 (Figure 3) has two objectives:

1. The scientific evaluation of the effectiveness of existing conservation measures;
2. The identification of the socio-economic causes of the failure of conservation measures.

The two objectives of the second focus (Focus 3.2, Figure 3) are:

1. To identify the economic consequences of biodiversity change in particular systems or landscapes, to evaluate the trade-offs involved in alternative strategies, and to identify the scope for biodiversity enhancement;
2. To develop the scientific basis of precautionary decision-making, and to apply this in specific cases.

In addition to these three thematic core projects, a few integrated transversal networks, which embrace issues addressed in all the core projects, are and will be developed around particular topics or ecosystems. The Global Mountain Biodiversity Assessment (GMBA) co-chaired by Prof. Christian Körner and Prof. Bruno Messerli was launched in 2000. It just released the first assessment of mountain biodiversity (Körner & Spehn 2002) and is currently contributing to the Convention on Biological Diversity in the context of the International Year of the Mountain. A new transversal network, "Greening agriculture", is proposed.

Lastly, IBOY, the International Biodiversity Observation Year is an initiative of DIVERSITAS that spans the whole programme. It is a one-time event to celebrate biodiversity, which has been ongoing since 2001 and will end in December 2002. IBOY is a window in time in which scientists and educators across the world are joining forces to increase communication of important science-based information about biodiversity to a broad audience. At the centre of IBOY is a diverse portfolio of Core Network and Satellite Projects. IBOY provides opportunities for networking and cross-collaboration, and explains their significance to a broad audience. This is achieved by the organisation of special events (e.g. annual meeting of the American Association for the Advancement of Science, 2002), the publication of scientific papers (e.g. the special issue of Trends and Ecology, 2001) and of press releases. A special emphasis has been placed on educating the public on biodiversity issues (Australian Biodiversity Month, September 2002; American Month of Biodiversity, May 2002).

References

- **Lopez-Garcia P., Rodriguez-Valera F., Pedros-Alios C. & Moreira D**, 2001 - Unexpected diversity of small eukaryotes in deep-sea Antartic plankton. *Nature* 409: 603-607.
- **Körner C. & Eva Spehn E.**, 2002 - *Mountain Biodiversity - A Global Assessment*, Parthenon Publishing, Switzerland, 350 pp.

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5.4 Scientific tools to assess, understand, monitor and sustainably manage marine biodiversity exploited by humans

Abstract

Effective and sustainable management of marine resources will be facilitated if the tools exist for effective conservation of species and related resources (e.g. habitats). To achieve the ultimate goal of sustainable management requires an understanding of the marine ecosystem (and its interaction with terrestrial and atmospheric systems) across a spectrum of spatial and temporal scales.

Assessment: The assessment of marine biodiversity is a necessary pre-requisite if we are to fully understand the likely impact of human activities on the marine environment. At present, our knowledge of marine biota and habitats is, in general, restricted to surveys composed of disparate sampling stations with large unsampled gaps in between. Such approaches have been necessitated by resource restrictions. However, modern technology such as swath bathymetry and other large-scale remote sampling techniques provide us with the means to map large areas of our seabed resources. Large-scale mapping of the seabed would enable us to target more intensive sampling studies in a more effective manner. To date, much attention has been given to the identification and mapping of individual species. However, I would argue that effort would be better focussed on the identification of the structure and composition of functional groups of biota. The conservation of the ecological function of an assemblage of biota is of more relevance in ecological terms than the decline or increase of a particular species.

Understanding: In the exploitation of marine ecosystems, humans typically remove biota (e.g. fishing) or habitat structure (e.g. aggregate extraction) or increase ecological disturbance through pollution (e.g. aquaculture wastes). All of these processes are likely to lead to some measure of alteration in population, community and/or habitat structure. Hence it is imperative for us to understand how this affects the diversity of affected assemblages and what the consequences of increased or decreased diversity are for that particular system. Recent small-scale experimental approaches using mesocosms have revealed how alteration of diversity affects community function in terms of the services provided (e.g. nutrient cycling). Greater emphasis is required in this area and in particular, studies should be scaled-up to more realistic scales (> km^2). We also require an understanding of the degree of natural variation that occurs in community composition in order to assess the importance of changes induced by human activities. The latter is best achieved through suitable monitoring at appropriate levels of the marine ecosystem.

Monitoring: Effective monitoring of marine resources is necessary if we are to understand natural levels of temporal and spatial variation that occur in marine systems. This requires a long-term commitment to data collection at a variety of scales. The nature of marine systems is such that far-field environmental changes can have implications at a more localised level. Hence the scale of monitoring needs to encompass large-scale processes (> 10000 km^2) down through diminishing scales to < 1 m^2. Monitoring systems for exploited resources such as fishes are already well defined, however, these would benefit greatly from an integration of environmental and biological data collected at a variety of scales. Only these types of approaches will permit a more ecosystem approach to the management of our marine resources.

Sustainable management: The management of exploited marine resources is entering a new era as we move beyond single species approaches and embrace a more ecosystem approach to management. We now realise that the effects of exploitation have far reaching consequences for components of the marine system other than the target species or resources. For example, it is well known that fishing also affects the habitats in which fish live and breed. The protection of essential habitats may be equally as important as the protection of the adult spawning stock. The setting of objectives is an important step towards sustainable

management. This applies both to single species and ecosystem indicators such as diversity. However, it is probably more relevant to use the presence or absence of functional components within ecosystems as indicators of ecosystem quality rather than single species. While one species may decline through natural events, it may be replaced by another species that performs the same function, therefore maintaining ecosystem function.

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5.5 Conserving forest biodiversity: how to facilitate survival of species in managed and natural boreal forests?

Abstract

European forest ecosystems have experienced dramatic human-caused changes during the past centuries and decades. Such changes can be seen locally in the characteristics of forest structures but also at the regional and landscape scales. The environmental alterations have had a strong influence on forest-dwelling species. For example, recent assessment (2000), based on the IUCN guidelines, of the biodiversity in Finland pointed out that over 1000 forest-dwelling species have been or are negatively affected: 646 of these are currently threatened, 71 extinct and 455 near threatened.

The research aiming at creating the scientific basis for forest biodiversity conservation has been very active recently, and has provided some new insights and tools to approach the current conservation problem. It is nowadays clear that the conservation of boreal biota requires that we address simultaneously the possibilities of the protected areas and the managed forests. There are, however, still major challenges to be rigorously addressed. These can be classified into two broad categories, namely to questions that address:

- basic patterns and processes that affect and maintain forest biodiversity in natural and human-dominated systems;
- the relative potential contribution that managed and protected areas can have on species conservation in different areas.

The first category addresses biodiversity patterns and their dynamics. Forests and especially the boreal forests are disturbance-driven successional ecosystems. Thus, many forest-dwelling species are likely to be adapted to ecosystem change. The main question is how disturbances occur in the natural forests and how the human-caused disturbances differ from the natural ones. When we know the basic differences, it is possible to bring the human-caused disturbance closer to the natural ones. The challenge is major, because different forest types may behave in a different ways and their current degree of naturalness may vary depending on the past human activity. To understand how these activities affect the forest-dwelling species, there is a need to compare managed and natural forests and their associated biota. Because the forest biota is very diverse (for example, the estimated no. of forest species in Finland alone is 22-25 000), there is also a need for a broad and systematic taxonomic coverage. However. In terms of biodiversity conservation the threatened species and their habitat requirements are the most important ones. Majority of such species are very rare and thus difficult to study but the research should be aimed directly on the rare and threatened species in each taxonomic group. Research activities and conservation guidelines based on more common species may not reliably provide the information most urgently needed for the biodiversity protection. Only after the systematic coverage of different species and forest habitats is attained, we can reliably proceed to indicators and monitoring based only on a few, easily measured environmental characteristics and indicator species.

The second category of major research challenges addresses the issues related to the balance between managed and protected areas in promoting species and habitat conservation. In the European circumstances the protected areas will always be in the middle of managed forests, and the protected areas typically cover only a fraction of the landscape. Based on recent results several of the threatened species may also survive in the managed areas, if enough attention is paid to biodiversity-oriented forest management. But currently it is quite unclear what species do require strictly protected areas and what species may survive also in the managed areas. The answer naturally depends on the exact management practises applied in the silvicultural treatments. Different management practises and their consequences need more attention. In principle, very intensive management is likely to require large strictly protected areas whereas management that maintains natural forest properties may lower the need to large protected areas. The most cost-efficient balance between the conservation activities is a major research challenge, currently hampered by the lack of systematic understanding of forest biodiversity patterns and human influence upon these.

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5.6 Biodiversity of natural and managed forests – from genes to ecosystems

Abstract

The Ministerial Conferences on the Protection of Forests of Europe held in Strasbourg (1990) and Helsinki (1993) paid attention to the gene conservation and biodiversity topics and accepted two resolutions S4 and H2 in which the signatory parties focused on the national implementation of gene conservation strategy and the Convention of Biological Diversity.

Comparison of the biodiversity of natural and managed forests is in a large part of western Europe almost impossible, since the examples of pristine (virgin) forests are missing. There are, however, still parts of Europe in which both categories – natural and semi-natural forests – as well as artificial forests exist. To such regions belong the Carpathians and a part of Balkan, where the last remnants of the pristine forests could serve as model examples of the climax forest ecosystems.

Natural character of the forest ecosystems of Carpathians made it possible to develop the phytosociological classification based on the vertical zonation of forest ecosystems – forest vegetation belts. Tree species composition within the forest vegetation belts serves not only as the measure of species diversity within the tree layer, but also as the measure of its deviation from the indigenous tree species composition. The species and ecological diversity of natural and
semi-natural forests of Carpathians have served as model examples for developing the sylvicultural systems based on natural regeneration and selection forests.

The forests of Carpathians were, from a historical point of view, the melting point during the postglacial migration of tree species. Eastern and southeastern European refugia were the source of genes, which remained after glaciation and migrated towards the central and the Western Europe. The western Carpathians served, at the same time as the contact zone of the Hercynian and Carpathian migration routes. At present, the indigenous tree populations are considered the source of the highest genetical diversity for many species of economic importance (e.g. beech, silver fir, Norway spruce, pedunculate and sessile oaks), which was shown not only in the population genetic studies using gene markers but also in many provenance trials evaluating growth performance and adaptive traits. Examples of different

phylogenies within the Carpathians could be seen from the results of larger population genetic inventories using both isozyme and molecular markers (cpDNA).

Natural and semi-natural forests and their counterpart – artificial forests – serve as a tool for the investigation of the processes running on the population level – mating system and gene flow. These processes are securing the transfer of genetic information and gene diversity from one generation to subsequent one and they could be influenced by the population structure and density. Sustainable character of gene transfer between generations has been proven by numerous analyses of the genetic effect of sylvicultural methods in one-species or mixed forests.

The topics of the further research investigations are based on simultaneous evaluation of genetic, species and/or ecological diversity under different population structures and ecological conditions as well as on the recommendations of introducing the diversities in the monitoring of the state of forest ecosystems.

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5.7 River restoration along the Meuse, a matter of dynamics and spatial cohesion

Abstract

River restoration objectives along the Meuse River are dependent on the natural reference situation defined for it. This natural reference should be defined in relation to the natural processes currently or potentially available in and along the river. Consequently, especially in river corridors, the emphasis in biodiversity conservation should be on safeguarding dynamic boundary conditions inherent to the river system rather than on species or habitat conservation as such.

As soon as the dynamics in habitat configuration are known, an assessment can be made of the population viability of specific species or species groups. The model LARCH (LAndscape ecological analysis and Rules for the Configuration of Habitat) can provide such assessments. This is demonstrated for the whole Meuse river basin for several species under various scenario conditions.

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5.8 Biodiversity in natural marine ecosystems: patterns, functioning and conservation

Abstract

Marine ecosystems cover over two thirds of the Earth's surface and occupy a volume that vastly exceeds that of terrestrial ecosystems. Life appeared in the oceans, and the oceans remain the greatest repository for the diversity of life at the level of phyla.

In general, the diversity of marine environments is lower than that of terrestrial environments, primarily as a consequence of the high mobility of the organisms, the wide passive dispersal of their organisms by currents and the low structural heterogeneity of the environment. Marine ecosystems are characterized by low biomass and very high ratios of production to biomass, while terrestrial ecosystem have biomass several orders of magnitude higher, and a much lower production/biomass ratios. Food webs are more complex in the sea than on land.

The productivity of marine systems ranges from algal reefs and upwelling areas that support the richest fisheries on earth, to nutrient-poor regions in the centres of the largest oceans, where biomass and production are extremely low. Marine disturbance regimes range from constant actions by large waves or annual scouring by ice flows, to the nearly constant physical conditions of the deep-sea benthos. Thus the marine environment provides an ideal opportunity for comparative evaluation of the predictions of the dynamic equilibrium model (Huston, 1979) explaining biodiversity patterns. The four marine systems that will be discussed in relation to the dynamic equilibrium model are the rocky intertidal zone, central oceanic regions, deep-sea benthos and coral reefs.

Biodiversity can be examined at all organizational levels, from the large-scale diversity of ecosystems to the genetic diversity within a particular population. In most cases, studies on biodiversity focus on species diversity as the primary indicator of changes. Species diversity may be divided into four components:

- species richness - the number of species present;
- species evenness - the relative abundances of different species
- species composition - the nature of the species present (i.e. species list)
- species interactions- the effects of a species on the composition of the community and its temporal and spatial variation

One of the major current topics of debate is that of functional redundancy, i.e. more species are present in communities than are needed for efficient biogeochemical and trophic functions. Recent data however show that this is not the case and the higher the number of species in a community, the greater the efficiency of biogeochemical processes.

Most of the threats in marine biodiversity are in the coastal zone: habitat loss, global climate change, overexploitation and other effects of fishing, pollution, eutrophication and related problems such as pathogenic bacteria and algal toxins; radionuclides; species introductions/invasions; water-shed alteration and physical alterations of coasts, tourism; marine litter; and the fact that humans have little perception of the oceans and their marine life. All the reviews agree that the most critical threat is habitat loss.

Declining yields in many fisheries and the decay of treasured marine habitats such as coral reefs have heightened interest in establishing a comprehensive system of marine protected areas (MPAs). In designing a system of marine reserves and protected areas, the complete spectrum of habitats supporting marine biodiversity should be included with emphasis on safeguarding ecosystem processes. One of the best-supported goals of MPAs is to conserve and restore marine biodiversity - that is, to maintain species diversity and the natural balance of species interactions. Connectivity among reserves should be a factor in the design of MPA networks to prevent genetic isolation of populations and to ensure that dispersal of early life stages and re-colonization are facilitated. Moreover, properly networked MPAs will promote

habitat linkages necessary for various life stages and ensure continuity of life processes within MPA networks.

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6 Poster session: abstracts

6.1 List of posters

Theme 1 : biological indicators and other monitoring tools

An index of biotic integrity (IBI) and biological monitoring of fish biodiversity in African freshwaters *TEUGELS G. et al.*

Assessment, restoration and management tools in the conservation of biodiversity of temperate and tropical forest ecosystems *KOEDAM N. et al.*

Beetles, spiders and flies as bio-indicators in forests: a large scale research project in Flanders (Belgium) *DESENDER K. et al.*

Biodiversity of heterotrophic bacteria in microbial mats from Antartic lakes *VAN TRAPPEN S. et al.*

Biological assessment and management of forest edges in the Famenne and the Ardennes, Southern Belgium *PAQUET J.-Y. et al.*

Chances of nature development on soils with a former intensive agricultural use in Flanders: site quality assessment by using invertebrates *GROOTAERT P. et al.*

Conservation of diatom biodiversity: issues and prospects *VYVERMAN W. et al.*

Intermediary Atlantic heath : the Natuurpunt approach *DEBEELDE T. et al.*

Density assessment of Ctenidae (Araneae) for the monitoring of rain forest in Eastern **I**vory Coast *JOCQUE R. et al.*

Development of an authenticity-index for forests, as a performance-evaluation-tool for forest management in function of biodiversity *VANDEKERKHOVE K. et al.*

Eco-ethological studies of bats demonstrate the need for a propitious large-scale landscape management to improve their conservation status *KERVYN T. et al.*

Ecosystem disturbances: an opportunity for biodiversity subsistence *PATINY S. et al.*

Fish used as a tool for the evaluation of the ecological water quality. *GOFFAUX D. et al.*

Historic habitats mapping in the southern North Sea: a preliminary investigation. *HOUZIAUX J.-S. et al.*

Impact of forest management systems on the biodiversity of vascular plants, nesting birds and carabid beetles in south Belgium *DU BUS G.*

Macrozoobenthos biodiversity and biological quality monitoring of watercourses in Wallonia (Belgium) *JOSENS G. et al.*

Maintaining native levels of shallow-water holoturian biodiversity in the Western **I**ndian Ocean *SAMYN Y. et al.*

Monitoring of native and exotic breeding birds in Wallonia and the Brussels area *JACOB J.-P. et al.*

Monitoring of species diversity and vegetation development in strict forest reserves as important reference tools for nature-based forest management. *DE KEERSMAEKER et al.*

Monitoring the biodiversity and population ecology of fish in the Belgian Meuse River using fishpasses. A 12-years study at the Visé-Lixhe dam *PHILIPPART J.-C.*

Pheromone-trapping of **I**ps typographus in the city of Brussels: a good model for dispersal studies of invasive pests. *PIEL F. et al.*

Seaweeds as indicators of biodiversity in marine benthic ecosystems *COPPEJANS E. et al.*

Scientific tools for nature reporting TACK J. et al. **S**ignificance of co-ordinated databases on sites of biological interest and threatened species occurrence to design regional strategy for biodiversity conservation *DUFRENE M.*

Spatio-temporal dependence of the estimation of ant species richness *LEPONCE M. et al.*

Taita Hills Biodiversity Project: a multidisciplinary approach by a multicultural team *BYTEBIER B. et al.*

Theme 2 : species and habitat modelling

Theme 3 : experimental approaches and habitat restoration

Theme 4 : conservation genetics

6.2 Theme 1 : biological indicators and other monitoring tool

6.2.1 An index of biotic integrity (IBI) and biological monitoring of fish biodiversity in African freshwaters

Guy Teugels, André Kamdem Toham, Essetchi P. Kouamelan & Tidiani Kone

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The Index of Biotic Integrity (IBI) is a multimetric index that rates the composition, structure and functional organisation of fish populations in a particular environment, compared to similar environments with high-quality ecosystems. A fundamental assumption in choosing fish as indicators of environmental degradation is their sensitivity to most forms of human disturbance. We successfully developed an IBI to quantify the impact of industrial deforestation in southern Cameroon.
Recent studies on the effect of a hydro-electrical dam on the fish population of a coastal river in Ivory Coast, based on a two years monthly biological monitoring, revealed considerable changes in the species composition and their biology (species loss; hybridisation) and in the local commercial catches since the construction of the dam. The dam is amongst the oldest on the African continent (1959); regular monitoring of the rivers is absolutely necessary to guarantee the sustainable use of the available resources.

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6.2.2 Assessment, restoration and management tools in the conservation of biodiversity of temperate and tropical forest ecosystems

Nico Koedam, Farid Dahdouh-Guebas, Sandrine Godefroid, James G. Kairo, Vladica Sivcev, Anouk Verheyden, Jared O. Bosire, Thiery Dubois & Paul T. Obade

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The laboratory of General Botany and Nature Management in part concentrates its *in situ* biodiversity research on two types of forest ecosystems in different geographic regions. In our temperate region, efforts of rehabilitation of degraded areas in order to maintain biodiversity and ecosystem functioning is concentrated on forests in and around Brussels (e.g. Sonian Forest), whereas in tropical regions such biodiversity assessment, inventory, restoration and monitoring activities are entirely focused on mangroves (*e.g.* in Kenya, Sri Lanka, India en Mauritania). This presentation overviews the objectives, research tools, results and conclusion highlights of the research in a comparative way. In both forest ecosystems remote sensing and geographical information systems are used as important research tools for mapping and modelling biodiversity, and regular fieldwork missions are set-up in order to collect a time-series of data on the diversity of fauna and flora and on their linkages with the environment. Socio-economic and/or ethnobiological studies are carried out in the same sites in order to understand the broader relationships between people, plants, animals and the environment, and to draft more comprehensive guidelines with respect to biodiversity conservation and management issues. Results show the intrinsic understory dynamism (*e.g.* change in species composition) of both types of ecosystems and its importance for future predictions. As an integral part of an effective management strategy, popular dispersion of research results through the internet, is done both for the Belgian research (http://www.vub.ac.be/APNA/jungle.html) and for the mangrove research abroad (http://www.specola.unifi.it/mangroves/).

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6.2.3 Beetles, spiders and flies as bio-indicators in forests: a large scale research project in Flanders (Belgium)

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In 1997, a research project was started on the occurrence, diversity and bio-indicative value of terrestrial invertebrates in 56 forest stands distributed over 40 woods in the entire region of Flanders (Belgium). A complete year cycle of samples was taken (continuous pitfall trapping for soil surface active invertebrates and coloured pan traps for flying insects). The forest plots were characterised by the forest floor texture, soil and litter chemistry, vegetation structure and composition and their landscape ecological setting (area isolation, fragmentation history, …). The target model organisms: ground beetles Carabidae), spiders (Araneae) and flies (Empidoidea) were chosen because of their well-known taxonomy and biology, their high diversity, availability of Red Data Books and their abundance in the forest. DCA and DCCA multivariate analyses gave very similar results in each case (most key factors included in this study). Spiders and flies primarily react to soil texture and related variables. Ground beetles first oppose large ancient forests to humid lowland forest communities and in the second place react to soil texture and productivity (they are indicators of historical and recent ecology of forests).
These results have direct implications for conservation management of our forests and serve as a necessary baseline for future site-assessment studies, investigations on the influence of forest management practices and studies aimed at elucidating the influence of single environmental or historical factors on the diversity and recent distribution of forest invertebrates in the region of Flanders.

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6.2.4 Biodiversity of heterotrophic bacteria in microbial mats from Antarctic lakes

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Microbial mats in Antarctic lakes are unique and very diverse habitats where micro-organisms are confronted with extreme life conditions. As such they have been under a high selection pressure and are potentially belonging to endogenous, as yet undescribed taxa, with potential industrial applications. The taxonomic diversity of almost 800 heterotrophic bacteria was investigated. The strains were characterised using fatty acid analysis and 16S rDNA sequence analysis assigned representative strains to different branches within the *Proteobacteria*, Gram-positives and to the *Flavobacterium-Cytophaga-Bacteroides* branch. To investigate potential new taxa more in detail, rep-PCR fingerprinting and DNA:DNA hybridisations were performed. The results indicate that the strains belong to different, potentially new species, which are ubiquitous in Antarctic lakes and are related to recently described Antarctic species.

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6.2.5 Biological assessment and management of forest edges in the Famenne and the Ardennes, Southern Belgium

J.-Y. Paquet, D. Liesse, E. Branquart, E. Skelton, P. Jeanmart, X . Vandevyvre, J.-L. Doucet & W. Delvingt

Gembloux Agricultural University, Forestry Unit

In terms of biodiversity, forest edges are often inhabited by a higher number of species than nearby open and woodland habitats and constitute biological corridors. The biological quality of forest edges is largely dependent on the vegetation structure diversity and the "structural" gradient between the two habitats. For management purpose, a more detailed knowledge of forest edge parameters that can enhance biodiversity is needed.
The present study was designed to assess biodiversity of forest edges in two ecological zone of the Walloon region (Southern Belgium): the Famenne Orientale and the Ardennes. The following indicator groups were monitored: vascular plants, hoverflies, butterflies and birds. Forest edges were assigned to 5 different structural types, from a blunt transition between forest and open habitat to a large gradient including herbaceous strip and fully developed bush belt extending from the open habitat to the forest interior.
Vascular plant, bird and butterfly abundances are highly correlated with forest edge structure diversity. The Famenne forest edges are specially important for butterflies: half of the species of the Walloon list has been found in those edges and 30 species found are considered as in regression in the Walloon Region.
A preliminary analysis shows that in the Ardennes region, forest edges are less diverse in terms of vegetation structure and consequently biodiversity is lower than in their Famenne counterparts. However, Ardennes forest edges can possibly contribute to the maintenance of certain species at the regional level and their rational management can lead to the creation of biological corridors and refuges in a landscape dominated by spruce forest.

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6.2.6 Chances of nature development on soils with a former intensive agricultural use in Flanders: site quality assessment by using invertebrates

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The future policy for a sustainable nature conservation in Flanders will imply (i) restoration and rehabilitation of ecologically degraded areas; (ii) defragmentation of isolated areas and (iii) optimalization of the actual borders of the areas with a nature purpose. In practice this means that large areas with actually an intensive agricultural use will need to be transformed to "nature" through specific and often expensive nature development measures. The general aim of our study is to evaluate the impact of such actions on different groups of terrestrial invertebrates on three target nature types: heathland and dry oligotrophic grasslands, marshes and wet grasslands and spontaneous developing woodlands.

To assess the nature quality we used 10 different invertebrate groups (ants, ground beetles, spiders, long-legged flies, dance flies, solitary bees, robber flies, hover flies, grasshoppers and butterflies) of which we know the indicator species for the target nature type as well as the Red Data Book species. It is clear that management plays a very important role in nature restoration. When comparing adjacent valuable reference plots to the plots in restoration we can already say that re-establishment of valuable species is very slow and hardly any effects are seen after 10 years of restoration. We could show that restoration of the vegetation through management fastens the process i.e. sowing heath (when absent in the seed bank) on formerly arable land speeds up the re-establishment of indicator species and species considered as “valuable”.

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6.2.7 Conservation of diatom biodiversity: issues and prospects

Wim Vyverman, Koen Sabbe, Victor Chepurnov, Koenraad Muylaert, Christine Cocquyt, Koenraad Vanhoutte & Elie Verleyen

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Despite the crucial ecological role of diatoms in the functioning of marine and freshwater environments worldwide, there are no reliable estimates of global diatom biodiversity nor of their global distribution. In this poster we summarize the results of fine-grained taxonomical, biological and paleo-ecological and biogeographical case studies providing strong evidence that the widely accepted dogma that micro-organisms are predominantly cosmopolitan does not apply in the case of the diatoms. Many diatom species may be endemics and some of them seem to be restricted to a small geographical area. Large spatio-temporal datasets of in situ diatom biodiversity, combined with detailed experimental approaches offer first insights in the nature of diatom biodiversity and in the scales of relevance for the conservation of diatoms.

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6.2.8 Intermediary Atlantic Heath : the Natuurpunt-approach

Tom Debeelde, Jens Verwaerde & Luc Vertommen

Natuurpunt

Intermediary Atlantic Heath (IAH) is a vegetation type with a limited area (i.e. Eastern and Western Flanders). It’s area is nonetheless still decreasing and quality of the remaining biotopes is usually poor. Usually only a fragment of the typical species composition of IAH is present.

In 2000 “Natuurpunt” (the largest Flanders’ NGO nature conservation organisation, managing more than 10 000 hectares) conducted a survey on the presence and quality of IAH. Information on species and biotopes was registered on maps. We were able to cover the complete survey area in the Bruges-Maldegem region.

Our research indicates relics of IAH (indicated by *Molinia caerulea* and *Calluna vulgaris*) are still present, unfortunately in most of the cases lacking many of the typical species (*Polygala spp, Erica tetralix, Drosera rotundifolia* were but sporadically found). Not only distribution is fragmented, also the quality of these patches usually is rather poor.

Nonetheless, through experience, we've been able to prove that it *is* possible to re-establish heath on a short-term basis (years), recovering species from the seed bank. This has been shown in the "Maldemveld" nature reserve. Another nature reserve, namely "Gulke Putten" (Wingene) acts as a very important reference for these kinds of heaths. It is one of the few places where IAH is still present and of good quality.

Our poster exemplifies some of the results of our large-scale survey. We also demonstrate how specific measures in the Maldegemveld nature reserve have lead to the rapid recovery of heath habitats.

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6.2.9 Density assessment of Ctenidae (Araneae) for the monitoring of rain forest in Eastern Ivory Coast.

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Because vertebrates are often selectively eliminated from tropical forests, the use of invertebrates is indicated for the monitoring of these habitats.
A crucial problem though is the estimation of the density of these small animals. In the context of a program for the rehabilitation of West-African rain forests as exploitation forest with conservation of the biodiversity, we studied the Ctenidae, which are large, nocturnal, hunting spiders. Thanks to their reflecting eyes they are easily detected and appeared ideal subjects to be sampled according to the distance sampling method which facilitates density estimations. Since knowledge on their density is a prerequisite for organisms to be used as monitor-species, Ctenidae appear to figure among the few rainforest invertebrates that can live up to that task. Particular species could be selected as positive, a few others as negative indicators for forest quality and thus for biodiversity.

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6.2.10 Development of an authenticity-index for forests, as a performance-evaluation-tool for forest management in function of biodiversity.

Kris Vandekerkhove & Klaartje Van Loy

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Forest ecosystems are important in preserving biodiversity. The engagements taken at the UNCED (CBD) and a number of European initiatives (Helsinki resolution 2, PEBLDS, WP-CEBLDF) urge the identification of indicators for evaluation of biodiversity in forest ecosystems both on national and subnational level.
The main aim of this project was to produce a standardised and practical methodology for the monitoring of some important aspects for biodiversity in forests, that are both easily measurable and susceptible to changes through silvicultural measures:

- stand structure (both vertical and horizontal)

- species composition of the tree- and shrub layer
- species composition of the herbal layer
- dead wood elements (both standing and lying coarse woody debris)

A scoring system was developed for each of these aspects, based on relevant data on a stand-scale level provided by the Flemish forest-inventory, and a tool for automatic calculation was developed, allowing an immediate large-scale application.
Results for the total index and separate parameters are presented, allowing an immediate evaluation of the status of forests in Flanders on these 4 important aspects of biodiversity in forests. Also the results of a validation to actual species diversity are presented. High scores however did not reflect high species diversity of the selected groups.
This index proves to be a useful, powerful and very practical tool for the monitoring of the performance of management measures and policies on some important aspects of forest biodiversity.
The disappointing correlation to absolute species richness however illustrates the complex relation between, generally accepted parameters for diversity, and actual 'species richness'. Other aspects not included in the index, such as forest size, management history, soil and litter type, seem to be more determining for absolute species richness. Therefore the index is not described as a 'biodiversity-index' but as an 'authenticity-index', as defined by Dudley ('a reflection of the extent to which a forest corresponds to a naturally functioning forest in terms of composition and ecology').

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6.2.11 Eco-ethological studies of bats demonstrate the need for a propitious large-scale landscape management to improve their conservation status

Kervyn Thierry, Motte Gregory, Godin Marie-Céline & Libois Roland

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In the bat preservation policy, focus has long been put on the conservation of hibernation caves and, more recently, on their maternity roosts. Research developed by our team since more than five years on different threatened species (*Rhinolophus hipposideros*, *Myotis emarginatus, Myotis myotis,* both *Plecotus, Eptesicus serotinus*) have evidenced the major interest of a third component of the bats life : food and feeding grounds. The study of the diet and of its seasonal and local variations as well as investigations about the habitat use and time budget of these species by radiotracking have shown the major importance of some insect taxa (namely *Aphodius*, different species of cockchafers, tipulids and, in the case of *M. emarginatus*, the blood-fly *Stomoxys calcitrans*) in the energy balance of the bats as well as the predominant use of some habitat features, such as hedges, meadows, deciduous forest edges and some types of deciduous forests. The implication of these results in the bats preservation policy is discussed, particularly in relation with the Natura 2000 programme.

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6.2.12 Ecosystem disturbances : an opportunity for biodiversity subsistence

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Several studies, notably involving long and short tongued bee species but also other groups such as hoverflies, showed that insects are often strongly diversified in *a priori* very inhospitable places. Also, protected areas such as natural reserves but not only, often present weaker diversified entomofauna than the ones related to agricultural lands. Some typical aspects of the insect diversity are briefly presented here as an introduction to more thorough approaches. Some data from our researches will be used to illustrate the evolution of entomological populations according to the considered habitat. Syrphid occurrence in Belgian agro-ecosystems depending on the kind of closed environment (fields, set-aside and woodlands) but also in areas not devoted to agriculture was assessed. Hoverflies from fields closed to woodlands were much more diversified while set-asides increased insect density in crops suggesting the positive impacts of semi-natural patches closed to cultivated plots. High diversity of Bombinae in the Massif Central in France, the biogeographic particularities of Andrenidae in the North of Europe and the general evolution of Apoidea in Belgian agro-ecosystems are also presented to show that ecosystems devoted to agricultural practices are rather highly diversified. Agro-ecosystem management was discussed as potential ways to enhance the insect diversity and abundance in order to increase effect of the beneficial species.

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6.2.13 Fish used as a tool for the evaulation of the ecological water quality.

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This project intended to adapt and standardize to the European ichthyofauna a new index of ecological quality assessment based on the attributes of fish communities, in order to evaluate the global quality, the conservation and restoration of lotic ecosystems in an international river basin (The Meuse). The methodology developed during this project could be used as a tool for the evaluation of the ecological status of water bodies, in close conformity with the recent European Water Framework Directive (WFD). In this aim, two new indices based on the two major approaches, namely the Index of Biotic Integrity methodology previously adapted for Belgium rivers and the Fish-Based Index methodology previously developed for French rivers were developed and the respective performances of these two newly developed indices are compared.

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6.2.14 “Historic habitats” mapping in the southern North Sea: a preliminary investigation

J.-S. Houziaux, H. van Loen & J.L. Van Goethem

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An important component of biodiversity research is represented by long-term studies, since they provide a picture of the environment under a different anthropogenic stress, a basic information needed when considering ecosystems restoration. Between 1899 and 1914, Professor G. Gilson (1859 – 1944) has conducted an ambitious and systematic ecological survey in the southern North Sea. Most of his samples, archives and unpublished data are preserved at the RBINS. A special attention is given to data regarding benthos and soft sediments within a 10 miles wide band along the Belgian coast and in the Hinders banks area. Our aim is to define a “reference point” for the benthic biodiversity of these areas and to study how it has changed within a century of dramatic increase in anthropogenic impacts (pollution, beam trawling, sand extraction, dredging and dumping operations, …). For soft bottoms, sediment parameters (nature, grain-size) and depth are known to be important parameters controlling the communities. Our aim, as a first step to a more integrated long-term ecological approach, is to use Gilson's original sediment data and samples (more than 2,000 sampling points with exact coordinates) in order to provide a "reference map" of "old habitats". In this framework, we examine a sub-set of 691 preserved samples in order to verify that they provide reliable qualitative information on grain-size profiles, enabling the definition of 4-6 grain-size categories, as well as on depths recording. This "quality analysis" of Gilson's data is a pre-requisite for further research on long-term changes in habitats and benthic biodiversity in the Belgian marine areas.

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6.2.15 Impact of forest management systems on the biodiversity of vascular plants, nesting birds and carabid beetles in south Belgium

Gaëtan du Bus de Warnaffe

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Forest management aiming mainly at wood production may participate to biodiversity erosion at landscape level. Our aim is to compare the effect of six forest management systems (FMS) widely used in Europe on the diversity, composition and structure of vascular plants, nesting birds and carabid beettles species assemblages. 134 plots were studied by means of a well controlled sampling structure, based on age, structure and composition of forest stands. First results are: (1) species richness are better explained by forest variables at landscape level than at local level; (2) young stages (0-10 years) and oak stands have particular communities; (3) for plants and carabids, even small cutting areas can produce the "open habitat" effect; (3) for stands of more than 20 years, effect of shelterwood sylviculture and even-aged sylviculture only differs for a few bird and carabid beetles species. Management implications are discussed in reports and papers.

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6.2.16 Macrozoobenthos biodiversity and biological quality monitoring of watercourses in Wallonia (Belgium)

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The biodiversity of macro-invertebrates is a component of the French biotic index "Indice biologique global normalise, IBGN" (AFNOR, 1992) that has been used for more than ten years to assess the biological quality of watercourses in Wallonia, five-class score system ranks the biodiversity based on the number of families of macro-invertebrates from high to bad (very low). Biodiversity score, biotic index score and indicator group are mapped together in a three-sector circle. Biodiversity and biological quality of the rivers are closely related with some interesting exceptions. Mapping each taxon of all biological groups separately, from class to species level, is another heuristic application of the program.

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6.2.17 Maintaining native levels of shallow-water holothurian biodiversity in the western Indian Ocean

Yves Samyn & Ward Appeltans

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In East Africa, holothurian populations are currently reaching depletion due to extensive harvesting for the bêche-de-mer industry in the Far East. However, conservation and management of this fauna in an *ecosystem approach* is currently hardly feasible, for the simple reason that we still fail to name the different players in the game, let alone to monitor the interactions between these or yet other players in the ecosystem.
We strongly believe that taxonomic accuracy sets the key to understanding both history and future of holothurian biodiversity, and that only such an approach will result in unambiguous hypotheses of species richness in the different parts of the western Indian Ocean. Our efforts reveal that several flaws in the taxonomy persistently obstructed a clear understanding of holothurian biodiversity. The present study compares the poorly investigated East African situation to the better studied South East African one and stresses that an ecosystem approach is difficult to attain before taxonomy has reached sufficient stability.

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6.2.18 Monitoring of native and exotic breeding birds in Wallonia and the Brussels area

Jean-Paul Jacob & Anne Weiserbs

AVES

Census and monitoring methods of the breeding avifauna include several complementary aspects. Distribution and density atlases frame the reference surveys. In the meantime, the monitoring systems allow to determine the common species trends and the evolution of scarce and endangered species. These projects permit to follow up the biodiversity evolution and constitute a conservation means in general and on sites scale. They are based mainly on the contribution of voluntary ornithologists and N.G.O. After a decade devoted to monitoring (since 1990 in Wallonia and 1992 in Brussels), new atlases were initiated. The present results show that numerous non-woodland species are declining and that many specialized species are threatened. On the contrary, a few species increase, especially exotics. The comparison of the results from point counts survey with those from adjacent regions indicates a more unfavourable situation in Wallonia.

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6.2.19 Monitoring of species diversity and vegetation development in strict forest reserves as important reference tools for nature-based forest management

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Since 1993, the new forest legislation in Flanders provides a dynamic strategy for the implementation of forest reserves. Besides their nature conservation value, they are mainly conceived for the study of spontaneous forest dynamics.

Objectives:

- follow-up of the overall development of the total reserve (species composition, successional stages,…)
- better insight in the ecological processes of spontaneous dynamics
- better understanding of the relations between stand development, fauna and ground flora.

The monitoring is based on a combination of a grid of nested circular plots and a core area of about 1 ha. All plots are permanently marked and remeasured every 10 years. The methodology is compatible both with methodologies for monitoring of strict reserves in the surrounding countries, and the methodology of the Flemish forest inventory, thus allowing future comparisons. Next to the monitoring programme, standardised inventories of fungi and fauna will be stimulated, in order to obtain better insight in correlations between stand dynamics and population dynamics of animal and fungal communities.

As the programme only started recently, only few results exist. However the possibilities of the method are illustrated through a number of examples.

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6.2.20 Monitoring the biodiversity and population ecology of fish in the Belgian Meuse River using fishpasses. A 12-year study at the Visé-Lixhe dam.

J.C. Philippart

FNRS & Univ. of Liège, Laboratory of Fish Demography and Aquaculture (LDPA), Zoological Institute

A 'Meuse Salmon 2000' project aiming at restoring an Atlantic salmon run in the Meuse River basin started in 1987 as a contribution of Wallonia to the European Year of Environment. In the course of this currently international programme, most dams (3-8 m in height) obstructing the canalised River Meuse in Belgium and The Netherlands have been fitted with modern fishways in order to defragmentate habitat and restore the free circulation of amphibiotic (Atlantic salmon, sea trout, eel) and holobiotic migratory fish species. Since 1990, a detailed investigation is being carried on at the Visé- Lixhe dam to scientifically register the fish ascending a small fish pass built in 1980 (at the same time as the barrage) and a big one constructed in 1998 to allow the upstream migration of large salmonids. Up till now, about 303,000 fish (12, 000 kg) have been trapped in these fishways, belonging to 33 species (26 autochthonous + 7 allochthonous). Among the species recorded, we found several rare and/or endangered species such as Atlantic salmon (*Salmo salar;* reintroduction in progress), sea trout (*Salmo trutta*), river bleak (*Alburnoïdes bipunctatus*), nase (*Chondrostoma nasus*), barbel (*Barbus barbus*), wild carp (*Cyprinus carpio*), European catfish (*Silurus glanis*) and new aliens such as the aspe (*Aspius aspius*). During this study numerous data have been collected on the ecology (age and growth, reproduction and recruitment, population dynamics) and behavioural ecology (migration periodicity in relation to water temperature and discharge) of the migratory populations of most representative species. Furthermore biotelemetry techniques have been used to describe and analyse the behaviour of migratory individuals confronted with a physical obstacle or a fishway entrance or caught in a fishway and then released above to allow them to move further upstream.

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6.2.21 Pheromone-trapping of *Ips typographus* in the city of Brussels: a good model for dispersal studies of invasive pests.

Frédéric Piel[1], Anne Franklin[1, 2], Eléonore Wolff[1] & Jean-Claude Grégoire[1,]

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[3] Fonds national de la Recherche scientifique

Ips typographus (Coleoptera, Scolytidae) is a well-known forest insect. We were speculating that it regularly enters into the city from the outside. The supposed source of colonization is the «forêt de Soignes» at the south-east, because of the relatively low number of spruces in Brussels. However, spruce is also an uncommon species in the forest itself. Several ways of entrance were considered: the railway track from Brussels to Namur, some segments of the city's «green network», and a transect through private gardens and yards. Pheromone traps set-up along these axes caught overall 2000 beetles; catches were recorded even near the city's centre.
Important catches (about 300 *Ips typographus* into two traps were recorded near Brussels' Harbour. This could correspond to beetles coming from imported timber stored along the canal. Genetical analysis might allow confirmation of the Scandinavian or Russian origin of these beetles, and provide information on their spread and on their mixing with native populations.
This could constitute an excellent model for the study of the spread of invasive species from high-risk points of entry such as ports or railway stations.

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6.2.22 Seaweeds as indicators of biodiversity in marine benthic ecosystems

Coppejans Eric, De Clerck Olivier, Leliaert Frederik, Schils Tom, Engledow Henry & Verbruggen Jeroen

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Seaweeds are often an important component of marine benthic ecosystems, especially those characterised by hard substrate. These marine algae (comprising the Rhodo-, Phaeo- and Chlorophyta) predominantly grow epilithically on rocky shores and coral reefs, or epiphytically on seagrasses and mangroves between the high tide level and the bottom of the photic zone. In the tropics some species are al so able to grow on sandy or even silty substrates. Eutrophication stimulates, in particular, the development of green algae belonging to the genera *Ulva* and *Enteromorpha*. This "greening" of some coasts results in a decrease in species richness (alpha-diversity) of the affected biotopes. Depending on the biotope (e.g. substrate, level related to the tides, climate), indicator species may appear or disappear resulting in information about the "health" of the region (e.g. a coral reef under pollution stress by tourism infrastructure). Proactively, algal species composition can help decision makers to choose areas with the highest biodiversity when delimiting marine protected areas or nature reserves along shorelines under high recreation/commercial utilization pressure.

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6.2.23 Scientific tools for nature reporting

J. Tack, D. Boeye, K. De Roo, M. Dumortier, J. Peymen, A. Schneiders, D. van Straaten, G. Weyembergh & E. Kuijken

Flemish Institute for Nature Conservation

The Flanders Institute of Nature Conservation has the legal obligation to report on the status of nature in Flanders. Results are published biannually in 'Nature Report'. The last edition was published in November of this year.
The 'Nature Report' has to describe the status of the nature in Flanders, to indicate changes and, to predict the future evolution of nature in function of policy decisions.
To reach those objectives the 'Nature Report' is making use of different tools:

1. Inventarisation, monitoring and evaluation of the status of nature in Flanders (biotic and abiotic)
2. Intensive data collection on the status of nature in Flanders and research into the research of cause-effect relations
3. Inventarisation, monitoring and evaluation of the human attitude towards nature
4. Inventarisation, monitoring and evaluation of the policy means and effects

The poster shows an overview of scientific inventarisation and monitoring tools used to study the effects of acidification, eutrofication, and desiccation on biodiversity.

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6.2.24 Significance of co-ordinated databases on sites of biological interest and threatened species occurrence to design regional strategy for biodiversity conservation

Marc Dufrêne

DGRNE

In theory, an "ecological network" is designed to manage and to protect biodiversity, with a focus on threatened or rare species or habitats. In practice, such ecological network is very difficult to design because one needs a lot of scientific information about species distribution, ecological requirements and between species relationships, … and such network should be functional for species from bacteria to large mammals. It is a crucial (crazy? utopia?) scientific responsibility to design ecological network, i.e. to decide where are the 5, or better 10% of a territory that should be reserved mainly for nature and that are necessary to maintain more or less the same biodiversity that those on the whole territory, and to decide how to manage it.
In the Walloon region, an integrated information system is developed since several years to be able to collect and to organise all available information to help people working in conservation domain and to help the design of site networks. Permanent inventory and monitoring programs on main known biological groups and on site of biological interest are supported to know how species distribution are changing, to identify and to monitor main populations and biodiversity hot spots. In each biological group, priority species (threatened, indicator of an habitat, …), are identified and action plans are prepared to protect main populations and to ensure their future. It is only this frame of specific emblematic species or habitats that network of sites can be designed. Each network contributes then to the global or the "meta" ecological network. Such approach, based on the definition of biological aims and functions for ecological networks imply a lot of detailed biological information (demography, ecological requirements, …) and ecological concepts that can be only produced by high quality scientific research that should be encouraged and directed.

Research Centre on Nature, Forests and Wood - Direction de la nature, de la chasse et de la pêche, Avenue Maréchal Juin 23 – B-5030 Gembloux

6.2.25 Spatio-temporal dependence of the estimation of ant species richness

Maurice Leponce & Laurence Theunis

Royal Belgian Institute of Natural Sciences, Conservation Biology Section,

We investigated how estimated species richness at a site was affected by the spatial scale and the time at which it is measured. This study was conducted with ants, which are very abundant in most terrestrial ecosystems and live in sessile colonies, in two contrasted forest types of northern Argentina submitted to marked seasonal variations. Our results show that the measured species-area relationship at a site can vary largely according to both the spatial scale at which it is observed and the sampling intensity. It can thus be misleading to use extrapolations of species-area curves to estimate the total species richness of a region. Furthermore variations in individual abundances at a few months interval stress the necessity of using statistical procedures (rarefaction) before conducting between sites (and between research teams) comparisons of species richness (even when working with a standardized sampling protocol).

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6.2.26 Taita Hills Biodiversity Project: a multidisciplinary approach by a multicultural team

Bytebier, B.[1, 3], Dall'Asta, U.[2], De Meyer, M.[2], Githiru, M.[3,4], Lens, L.[1], Mbuthia, K.W.[3], Mulwa, R.[4], Odhiambo, R.[4], Oguge, N.[4] & Van den Spiegel, D.[2]

[1] *University of Antwerp, Antwerp*
[2] *Royal Museum for Central Africa*
[3] *National Museums of Kenya*
[4] *Kenyatta University*

Between 1996 and 2000 a team of Belgian and Kenyan researchers studied the biodiversity of an isolated and fragmented forest habitat in south-eastern Kenya. Main objective of the project was to study the existing biodiversity in relation to the relative fragmentation and degradation of a scatter of indigenous forest patches. A number of focal study organisms or groups were selected for ornithological, mammalogical, entomological (including other arthropods) and botanical research. The observed biodiversity is analysed in conjunction with the structure of the landscape and the organism's mobility for some groups. The results obtained are intended as a guideline for a sound management and sustainability plan for the region.

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6.2.27 TISBE: Taxonomic Information System for the BElgian continental shelf

Edward Vanden Berghe, Jan Mees, Jan Seys, Andre Cattrijsse & Bart Bulckaen

Flanders Marine Data and Information Centre, Flanders Marine Institute,

One of the objectives of the Flanders Marine Institute (Vlaams Instituut voor de Zee, VLIZ), and of the Flanders Marine Data- and Information Centre (VMDC), which is part of VLIZ, is to offer data and information to scientists, policy makers and the interested layman. One of the databases under development is a species register for the Belgian coast and adjacent areas (including the Schelde estuary). The database will contain detailed taxonomic information, and information on the distribution within the area of interest. The Marine Species database for Eastern Africa (MASDEA), maintained by VLIZ and hosted on the VLIZ web site, served as a model while developing TISBE. An effort will be made to minimize duplication of other initiatives, both those within the VLIZ (e.g. the North Sea Benthos Survey project in collaboration with ICES), and those from other institutions (e.g. the databases developed at the University of Gent and the Dutch Centre for Estuarine and Coastal Ecology; the European Marine Species Registry). The TISBE database will be integrated in the other databases of VLIZ: literature, databases, experts and institutions will be taken from the Integrated Marine Information System (IMIS), which is already available on the VLIZ web site.
The objective of TISBE is to become a comprehensive list of all records of species from the area. Links with the taxonomic literature and to the original publication of the distribution record will assist in tracing the history of records. By providing a synonymised list of species records, TISBE will be a tool to assess marine biodiversity and to monitor the species composition of the ecological communities along the Belgian coast.
At the time of writing, the structure of the database has been developed, and forms to allow data input are available. All families occurring in the area of interest have been entered. A web interface, again based on earlier experiences with MASDEA, will be available shortly.

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6.2.28 Typologies of natural habitats

Pierre Devillers & Roseline Beudels

Institut Royal des Sciences Naturelles de Belgique - Conservation Biology Section

This programme is a contribution to the identification and elaboration of networks of protected areas, established, in particular, within the framework of European directives and international conventions. The elaboration of catalogues of recognizable natural communities, formed by the fauna and flora in response to the abiotic environment and to each other's influence, is a prerequisite to any attempt at characterizing sites in terms of their importance for nature conservation, of inventorying such sites, of constituting network of protected sites, or of monitoring the evolution of such networks.

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6.3 Theme 2 : species and habitat modelling

6.3.1 BIOMAN: "Biodiversity and human impact in shallow lakes", a EU-project

S. Declerck., L. Brendonck.*, G. Zwart, W. Vyverman, M. Gillis, K. Muylaert, K. Van der Gucht, J.M. Conde Porcuna, E. Jeppesen, M. Søndergaard, T. Lauridsen, K. Schwenk, R. Billiones, J. Janse, W. Ligtvoet, R. Portielje, E. Lammens. & L. De Meester*.*

**Laboratory of Aquatic Ecology, Katholieke Universiteit Leuven*

"Biodiversity and human impact in shallow lakes" (BIOMAN) is a EU-funded project co-ordinated by the Laboratory of Aquatic Ecology of the Katholieke Universiteit Leuven (Belgium; co-ordinator L. De Meester) that focuses on biodiversity patterns in shallow lakes along a NS gradient in Europe. In three geographic regions of Europe (Denmark, Belgium+The Netherlands, Spain), taxonomic diversity at different trophic levels (bacterioplankton, protozoa, phytoplankton, zooplankton, fish and macrophytes) as well as genetic diversity of key zooplankton taxa is being simultaneously monitored in a total of 96 shallow lakes. The lakes studied differ widely in area, degree of connectivity with other water bodies, nutrient loading (total phosphorus content) and water transparency. In addition to the multitrophic biodiversity survey, we also quantify taxonomic diversity in the zooplankton resting egg bank in an effort to explore the idea to use resting egg banks to obtain reliable and integrated diversity estimates. The major goals of the project are the development of (1) reliable and cost-effective indices for overall ecosystem diversity in shallow European lakes and (2) mathematical tools that allow prediction of the effects of human impact on biodiversity in shallow lakes. The main users of the project are local water managers, policy makers and researchers.

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6.3.2 Black Grouse conservation : as case study in Belgium.

J.C. Ruwet, O. Charlet, S. Houbart, C. Keulen, M. Loneux & P. Poncin

Zoological Museum of University of Liège

Black grouse *Tetrao tetrix* is actually endangered within Central Europe. This emblematic bird of the Belgian National Park « Hautes Fagnes » is lighthouse species of the biodiversity in the whole landscape it uses. The Ethology Laboratory of Liege University is involved since 1966 in Black grouse monitoring and research in the Hautes-Fagnes Nature Reserve. This long time research investment has allowed to model the climate influence on population dynamics, to compare the landscape evolution and to analyse the characteristics of habitat around the leks. Results emphasize ecological requirements of Black Grouse and bring information on actions to be taken by managers to improve the conservation of this species and the associated biodiversity.
Modelling of Climate influence has been enlarged at European level, an international Coordination Committee for the Conservation of Black Cocks (and hens!), the CoCoCoCocks, has been created, and an international Conference on the Fate of Black Grouse has been organized in collaboration with Walloon Region, in Liege, September 2000, were 11 Countries were represented. Exchange of knowledge has led to recommendations for conservation of small populations and to submission of a European research project. At last we have been recently associated to management actions and managers' training in Walloon Region by a Convention with the Country Life and Agriculture Ministry.

Contact: Dr. Michèle Loneux

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6.3.3 Differential colonization causing non-random forest plant species community structure in a fragmented agricultural landscape.

*Jan Butaye *, Hans Jacquemyn & Martin Hermy.*

Lab.Forest, Nature & Landscape Research
University of Leuven

The biotas of fragmented habitats often have been found to exhibit non-random patterns of species composition. An example of such non-random distribution pattern is a nested subset pattern. At both the community and the individual species level we investigated whether a nested community pattern could be found in 84 isolated recent forest fragments. Next the hypothesis that nestedness was generated by isolation and differential colonization was tested. Alternative hypotheses formulated in the past such as nested habitats and patch area dependent species relaxation were verified.
Individual species colonization probabilities were derived with a logistic regression analysis. Species occurrence in suitable target patches was related with the degree of isolation from occupied source patches. Habitat suitability of each target patch was determined with a habitat space model based on the actual species composition.
Albeit the stochastic factor involved in the colonization process, we found at both levels that the observed non-random community structure resulted primarily from different colonization probabilities and isolation. At the individual species level the degree of nestedness is highly correlated with isolation sensitivity.
Based on the results we recommend the use of colonization probabilities to quantify effects of isolation in heterogeneous landscapes. Although migration rates may be superior to study migration within homogeneous forest systems.
The consciousness of the importance of geographic isolation on species composition forces us to change our perception on forest conservation and to integrate landscape planning into conservation efforts.

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6.3.4 Habitat models for forest birds conservation

Laurence Delahaye

Gembloux Agricultural University
Forest Unit

In order to acquire a better knowledge of the ecology and spatial distribution of some bio-indicator birds, we modelized their requirements. The resulting habitat suitability indices are based on the ecology of the birds and on data of a systematic forest survey. The development of habitat suitability indices for three bird species is intended to provide foresters with tools for the ecological monitoring of oak and beech forests in space and time. Thanks the use of data provided by the forest survey, managers will be able to monitor the population trends of the three bird species studied and the other species having the same habitat requirements.

Gembloux Agricultural University - Département environnement, territoires, nature et forêts
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6.3.5 Integrating species-specific ecological knowledge into site-oriented conservation policy : Species recovery plans, modelling landscape connectivity and use of multi-species approaches

Hans Van Dyck, Dirk Maes (*), Inge Brichau, Wouter Vanreusel, Frank Adriaensen & Erik Matthysen

Laboratory of Animal Ecology, Department of Biology
University of Antwerp (UIA-UA),
(*) Institute of Nature Conservation

A consistent problem in conservation biology is the difficulty of converting scientific knowledge into conservation practice. Among several other lines of ecological and evolutionary research, our team deals with the scientific foundation of the use of species-specific knowledge for conservation efforts that are mainly site- or landscape-oriented in Flanders (and elsewhere). Biological realism may be lacking in conservation measures when crucial features of target species have not been taken into account (e.g. dispersal). For instance, the completion of ecological networks and corridors may be questionable if no particular species have been used as role models. We present an overview of case studies including species recovery plans for threatened butterflies and the use of landscape-connectivity modelling for vertebrate and invertebrate species. We also make a plea for the use of scientifically sound multi-species approaches in conservation policy and practical management. Although often assumed, a single species (or a single taxonomic group) can never be regarded as a universal bio-indicator and we argue that the development of complementary series of indicator species from different taxonomic groups for a particular habitat or area is a more promising option.

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6.3.6 State and Control of Antarctic Plankton Diversity.

Jean-Henri Hecq [1], Anne Goffart [1] Vincent Demoulin [1] & Alain Norro [2]

[1] *University of Liège,* [2] *UGMM*

In the Antarctic, the diversity of plankton species is reduced relatively to other oceans. However, the multiplicity of habitats generated by abiotic factors (micro-circulation, ice coverage and circumpolar circulation) is responsible of the high diversity of the plankton assemblages and food webs (e.g. herbivorous, microbial, viral) and their spatial and temporal variability in of the Austral Ocean. That diversity of plankton assemblages is essential to assume the diversity of upper trophic levels (including mammals and birds) but also to respond to the changes of the environment. The poster presents various aspects of those assemblages.

A conceptual and numerical model of the Antarctic plankton biotic assemblage have been developed in the context of Belgian Antarctic Programme and describes the dynamics of the principal species of the biota. The model is used to test the stability and the sensibility of the assemblages in reaction to potential stresses of the ecosystem (light, temperature, ice coverage,...) and some results are presented in the poster.

The poster present and discuss the methods to compile data collections and analyses on plankton key species distribution and dynamics in the aim of diversity monitoring.

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6.3.7 The importance of historical museum collections for *in-situ* conservation in Africa

Marc Herremans, Michel Louette & Danny Meirte

Royal Museum for Central Africa

Understanding the principle requirements that determine the distribution range of a species is essential for its conservation management. In Africa, which has several world priority hotspots of biodiversity and endemicity, even the ranges of most endemic vertebrates remain very poorly known. For many species, knowledge is restricted to a handful of specimens in museum collections. For regions with political instability, there is furthermore little hope to obtain additional information from the field, let alone comprehensive distributional data. Modelling of historical ranges can be achieved using geographical and ecological information extracted from specimen labels in museum collections. Because most endemics have specific habitat requirements (e.g. sub-mountain forest), a comparison between the modelled historical range and the currently remaining habitat provides a measure of conservation status and potential threats. The information about ranges and ecological preferences obtained and modelled from ex-situ collections is thus an essential tool for making conservation management decisions in otherwise data-deficient areas:
e.g. to improve the accuracy of priorities for choices like park designation, restoration or degazetting.
In the Albertine Rift context, questions that could be addressed with this research tool are e.g. "which part of Itombwe still contains most optimal habitat and should be included in a new park design" or "what part of Kahuzi-Biega is the least important for endemics and can be degazetted (if such a move were the way to safe more important parts)".

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6.4 Theme 3: experimental approaches and habitat restoration

6.4.1 Benthos and sustainable management of marine ecosystems

Prof. Dr. A. Vanreusel, Prof. Dr. M. Vincx & collaborators

Gent University, Biology Department, Marine Biology Section,

Benthic communities are high biodiversity spots in marine ecosystems; they are considered as good bio-indicators for sustainable management.
Bottom communities have to be adapted to the influences of processes occurring in the overlaying water and the most sensitive species will disappear, which will effect the structure and the functioning of the communities. Information about the structural and functional biodiversity (number of species, biomass-spectra, food-web linkages,...) is required in order to understand the functioning and sustainability of an ecosystem. Through experimental approaches the functional relationships are investigated in order to understand the maintenance of biodiversity patterns, while monitoring programmes allow to survey the condition of the marine habitats.
The relationships between biodiversity and functioning of an ecosystem (with emphasis for developing scientific tools for conservation) will be illustrated from coastal systems (North Sea and adjacent estuaries) as well as from extreme marine environments (e.g. deep sea, Antarctic sediments, ..).

Contact: Dr Magda Vincx
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6.4.2 Conservation of estuarine ecosystems

Patrick Meire[1], Erica Van den Bergh [2] & Tom Ysebaert [3]

[1]*University of Antwerp*
[2]*Institute of nature conservation*
[3]*Netherlands Institute of Ecology*

Estuaries belong to the most productive ecosystems of the world and hold a very diverse and rich biodiversity. However these areas are also under heavy pressure from many human activities such us fisheries, land reclamation, dredging etc. In these systems conservation of biodiversity is only possible by adopting an ecosystem approach. In this paper we will present an ecosystem management plan for the Schelde estuary. Overall ecosystem goals (both structural and functional) are defined and the different management options or explored. Management options include habitat restoration, changes in the hydraulics, water quality and -quantity management.

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6.4.3 Experimental management of a limestone grassland in the Viroin Valley

Louis-Marie Delescaille

Centre de Recherche de la Nature, des Forêts et du Bois
La Maison du Parc

Since 1989, the effects of an experimental management by mowing at different periods of the year have been followed in a limestone grassland of the « Abannets » plateau (Nismes - province de Namur). The evolution in 6 managed and 2 unmanaged quadrats (each of 100 m^2) has been compared, using the number of flowers/inflorescences produced, the diversity of plant species/m^2 and the dynamic of orchid populations as indicators.
The results showed a positive response for most of the species between 1989 and 1995. Since 1995, the contrasted responses observed could be due to the development of a dense, close herb layer and the regression of the gaps in the canopy (regeneration niches).
The results have been used to adapt the management plans of the nature reserves in Wallony.

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6.4.4 Illé – Restoration of a multi-purpose wetland

Debbaut, Rosillon & Vander Borght

Fondation Universitaire Luxembourgeoise

An old 17th-century pond in Belgian Lorraine gradually filled in, then was drained and planted with fir trees.
In 1996 the municipality of Etalle bought part of the site (50 ha) with the help of the Walloon Region to turn the site back into a natural area.
The preparation of and work on this site were organised as part of the Semois river contract. The aims of the restoration work are several and complementary and contribute to the valley's overall management (self-treatment of domestic effluents, flood control, enrichment of the flora and fauna, and development of the landscape's natural beauty).
The first results seem fairly promising, for we are indeed witnessing a 'boom' in the site's biodiversity (birds, fish, insects, marsh plants, etc.). A water quality monitoring programme has been instituted to evaluate the processes that govern this aquatic ecosystem's functioning and periodic electrofishing has enabled us to monitor the development of the fish species that have moved in.
One of the long-term stakes will be to design a balanced management programme for the area.

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6.4.5 Maintaining the biodiversity in rivers submitted to high economic contraints, a case study : the gravel-pit of Lanaye (Belgium)

C. Keulen, P. Poncin, M. Loneux & J-CL. Ruwet

Laboratory of Ethology - University of Liège

For seventy years, the Lanaye area, at the Belgian-Dutch border, has undergone large hydraulic works like the creation of the Albert Canal and the rectification of the river Meuse, that isolated some meanders. One of them, called « Vieille Meuse » (the "Old Meuse") at Lanaye (4 ha of stretch of water bordered by about 3 ha of lands), became, year after year, a site of high biological interest. Due to actual economic priorities, this site is threatened today, entirely or partially, by the expansion of the neighbouring locks. In order to preserve the ecosystems present in this part of the Meuse Valley, the Walloon Ministry of public works (M.E.T.) burrowed in 1986 a substitution site located some 500 meters upstream to the « Vielle Meuse », named the « Nouvelle gravière de Lanaye » (the "New gravel-pit of Lanaye"). In 1993, the M.E.T. asked the Ethology Department of the University of Liege to compare the biological diversity of both sites, and to establish a management plan for the new gravel-pit. Accordingly we have clearly described and characterised the main birds' habitats and the main spawning sites of fishes in the « Old Meuse ». In comparison with the undeniable biodiversity on the site « Vieille Meuse »and its higher spawning interest, the new gravel pit is not so developed but the characteristics of the various habitats are quite similar.

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6.4.6 Mowing impact on butterflies in ardenne's humid grasslands and implications for habitat management

Philippe Goffart.

Unité d'Écologie et de Biogéographie, Centre de recherches sur la Biodiversité, Université Catholique de Louvain

In a four-year experiment, I attempted to measure separately the impacts of different cutting regimes on pre-imaginal stages and on imagos. The first aspect has been assessed indirectly by trapping emerging adults in cages set up above vegetation of managed and control plots. Cutting had a great and significant negative impact on butterfly (and moth) first stadia. This impact varied according to species (in relation to their life cycles and life-history) and period of management. Treatments had also contrasted effects on imagos as attractivity of treated plots was either enhanced or reduced (if not unchanged) according to species. For conservation of local butterfly populations, results of these experiments highlight the need: (1) to maintain refuge surfaces every year, introducing a rotational management plan, (2) to diversify periods of cutting in space (but not in time), (3) to maintain long-term neglected surfaces required by some species.

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6.4.7 Seed bank studies for restoration of heath ecosystems : a case study.

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In the context of ecological network, and particularly NATURA 2000, habitat restoration will likely play a key role in restoring and maintaining connexion between plant populations of semi natural non-forested communities (heath, chalk grassland, meadows). In order to restore ecosystems, it is vital to consider the accessibility of the site to target species by the way of spatial dispersion from neighbouring sites or by the way of germination from a persistent seed bank. Monitoring seed dispersion and seed bank in high priority habitats is thus a crucial preliminary step for plant diversity management at the local and landscape level.
We studied the composition and spatial heterogeneity of seed bank and seed rain in relation to vegetation in two *Calluna* heath sites in High Ardenne (Belgium). Out of the 21 species present in the vegetation, only six occurred in the seed bank. In particular, *Vaccinium* spp, were lacking indicating that, for these species, seed bank is not useful for the recolonisation of restored sites. The seed bank was dominated by *Calluna vulgaris*, *Erica tetralix* and *Juncus* spp. The species exhibited different vertical and horizontal profiles of seed bank distribution that will influence the outcome of management action. The relationships between cover in the vegetation and patterns in the seed rain and the seed bank suggest strong limitation to spatial seed dispersal. Decoupling between *C. vulgaris* soil seed bank and *C. vulgaris* cover in the aboveground vegetation show that the outcome of management action

can not be fully predicted from the current pattern of the species in the vegetation. Similar patterns were observed in an another study concerned by the effects of top-peat removal for restoring degraded wet heaths overgrown by *Molinia caerulea*: few species had a permanent but heterogeneous seed bank.

Contact: Gregory MAHY
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6.4.8 Survey and Health Status of a *Posidonia oceanica* meadow since 1975: Perfecting of a method for the meadow rehabilitation and restoration

Sylvie Gobert[1], Denis Vangeluwe[1], Gilles Lepoint[1], Peter van Treeck[2], Michael Eisinger[2], Markus Paster[2], Helmut Schuhmacher[2] & Jean-Marie Bouquegneau[1].

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A long-term survey of the *P. oceanica* meadow has been in progress since 1975 in the Revallata Bay (Corsica, France) (*e.g.* Bay, 1984). Actually, since 1991, biometric parameters of the meadow have been monitored regularly (Gobert *et al.*, 1995). The seasonal, interannual and long term changes of these *Posidonia* characteristics are analysed regarding meteorological (*e.g.* sun, rain, temperature..) and anthropologic events such as tourism and nutrient enriched effluents in the area. Our results have pointed out the good health status of the meadow in spite of some ecological modifications linked to the increasing water temperature (Gobert *et al.*, in press). Recent aerial photos have shown a modification of the covering surface of the meadow. An accurate study of causes of the distribution modifications is beginning. Using our long term background data on the meadow, we are developing a transplantation technique of *P. oceanica* shoots using semi-artificial substrates (EAT: electrochemical accretion technology) (Van Treeck and Schuhmacher, 1998) with the aim of providing a guideline-report based on model case studies representative for many threatened Mediterranean areas.

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6.5 Theme 4 : conservation genetics

6.5.1 Conservation genetics and bio-indicators in changing environments

Prof. dr. Ludwig Triest

Free University of Brussels (VUB)

Fragmentation, isolation and degradation of habitats are among the relevant causes for the loss of genetic diversity in natural vegetations. Wetland plants, forest herbs, forest trees and mangroves are investigated for their genetic diversity in relation to habitat characteristics and dynamics. Evolutionary important phenomena such as hybridisation and introgression of species provide a better insight in the dynamics of hybrid contact zones within a landscape context. The research is always based on original fieldwork, a wide array of molecular tools for screening and software packages for high standard statistical treatment and will contribute to the concept of genetic zone management.
Biological indicators of degradation as well as improvement of aquatic habitats, especially macrophyte and diatom species are monitored to assess also the ecological quality of running waters. Conceptual improvement of bio-indicator systems and the development of reference images will lead to a better understanding of the species dynamics in changing environments.

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6.5.2 Conservation genetics of the Galápagos Giant Tortoise

Patrick Mardulyn & Michel Milinkovitch

Unit of Evolutionary Genetics, Institute of Molecular Biology and Medecine (IBMM)
Free University of Brussels (ULB)

The Galápagos Giant Tortoise (*Geochelone nigra*) is a seriously endangered species. Eleven sub-species survive on six islands, the largest island displaying 5 sub-species isolated from each other on different volcano slopes. Most of these populations are small, and even the largest populations are in danger of extinction due to human activity. We have isolated >300 *G. nigra* microsatellite loci of which a subset will be used to assess the genetic diversity of the various populations of the Galápagos archipelago. In particular, these data will allow us to assist an ongoing captive breeding program for the population from the Espanola Island. We will determine parentage of individuals born in captivity in order to objectively determine the crosses to be favoured for maximizing the genetic diversity of this population.

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6.5.3 Conservation strategies for the endangered bullhead (Cottus gobio L., 1758) in Flanders by integrating ecological, physiological and genetic research methods.

Dries Knapen[1,3], Wouter Meeus[1], Liesbet Bruyndoncx[2], Guy Knaepkens[2,3], Lieven Bervoets[1], Marcel Eens[2], Erik Verheyen[3] & Ronny Blust[1].

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[2] University of Antwerp – UIA, Antwerp,
[3] Royal Belgian Institute of Natural Sciences, Brussels

As a result of water pollution and river management practices, most Flemish bullhead populations are nowadays both small and isolated. Consequently, due to the loss of genetic variation associated with this, several populations are threatened with extinction. In order to evaluate the impact of human activities on these populations, and to develop appropriate conservation strategies, different approaches, considering different processes and endpoints, were combined. We determined conservation units using both highly variable microsatellite markers and mitochondrial DNA sequences. These data were also used to assess genetic variation and population differentiation. A series of challenge tests was used to investigate the populations' physiological condition. Furthermore, population characteristics such as population size, age distribution, condition factor and mobility were determined. The results of these different studies allowed us to evaluate the severity of the problem and to formulate conservation strategies for this species.

Contact: Dries Knapen
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6.5.4 Genetic biodiversity : from diagnosis to conservation. A case study related to the threatened European mink, Mustela lutreola

Johan Michaux, Roland Libois
Unité de recherches zoogéographiques, Institut de Zoologie

René Rosoux
Museum d'Histoire Naturelle (La Rochelle)

Recently, different studies have revealed the existence of a phylogeographical structure of the genetic variability in some mammals, insects, fish, trees… throughout Europe. In species of great conservation concern, namely those surviving in fragmented distribution areas, special attention must therefore be paid to the origin of the animals to be restocked or reintroduced should so a programme be decided. Presently, the European mink lives in two well separated blocks of populations, an eastern one in Bielorussia and Ukraine and a western one in northern Spain and south-western France. A comparison has been made between minks belonging to both blocks. The mtDNA D-loop has been completely sequenced in more than 20 minks and comparisons made using different phylogenetic methods (neighbour-joining, maximum likelihood and maximum parsimony). Among the French minks, the genetic variability is amazingly low whereas they differ quite a lot from the eastern individuals so far tested: the difference between them being the same as between *Mustela eversmanni* and the eastern populations of *M. lutreola*. The implications of these results are discussed in relation to the restocking programme, which is foreseen in a restoration plan, approved by the French Ministry of Environment.

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6.5.5 Genetic consequences of population turnover in a tree metapopulation

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We investigated the population genetic consequences of man-driven population turnover in a metapopulation of *Sorbus aucuparia* (Rosaceae). Using both isozymes and chloroplast DNA markers, we have shown that population turnover associated with *P. abies* cultivation practices leads to a decrease of genetic variation maintained within young populations, as well as an increase in genetic differentiation among young populations, as compared to old populations. The latter are mostly located in nature reserves and probably play a role in buffering the effects of population turnover, notably as reservoirs of genetic diversity. From a conservation point of view, we have shown that (1) human activities, i.e. clearings in *P. abies* plantations, have an impact on the genetic diversity maintained within and among *S. aucuparia* populations; (2) in species characterised by a metapopulation dynamics, such a dynamics has to be taken into account when establishing conservation programmes, in order to maximize the genetic diversity to be maintained.

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6.5.6 Impact of stocking on population of brown trout in the Scheldt and Meuse basin : a genetic perspective

P.V. Baret[1], J. Pinceel[3], J. Van Houdt[3] , M.-C. Flamand[1], P. Gérard[2], E.Dupont[2], M.-C. Eloy[1], M. Briquet[1], J & F.A. Volckaert[3]

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Genetic conservation is commonly associated with small populations.
Nevertheless, for some populations, such as brown trout, the main threat is not the risk of extinction but the genetic contamination by non-native individuals. Moreover, the genetic structure of brown trout (*Salmo trutta fario* L.) is complex due to the combined action of large-scale factors (such as glaciations and drainage patterns) and local recent events (barriers to natural migrations of the fishes, habitat degradation and restocking). To understand the impact of both long term and short term factors, two kinds of markers were used on in total 322 fishes: a mt DNA sequence of 110 bp (D-loop) and 27 RAPD markers. Trout were sampled at 10 rivers and 3 hatcheries (8 to 48 fish per location) across Belgium. Phylogenetic and correspondence analyses based on RAPD markers put in evidence three groups of populations : hatchery, main populations in rivers and isolated inbred populations. Despite the absence of a clear diagnostic marker, the distribution of mt DNA haplotypes confirms the phylogenetic analysis: one haplotype is more frequent in hatcheries and another is more frequent in the upstream populations. It seems that populations of brown trout sampled upstream are less affected by restocking than the downstream ones. These upstream populations represent an important source for the restoration of natural trout populations in a conservation perspective. Further development will consider the use of microsatellite markers in order to specifically identify restocking fishes within wild populations.

6.5.7 Integrating genetic and phenotypic variability as bio-monitoring tool

Erik Matthysen, Luc Lens, Stefan Van Dongen & Peter Galbusera

Universiteit Antwerpen-RUCA - Department of Biology

Human impact on natural populations may affect the quality of the habitat as well as the structure and dynamics of the populations inhabiting these habitats. These effects can be measured by analysing phenotypic (fluctuating asymmetry, size, condition), demographic (fecundity, survival) and genotypic (heterozygosity, allele diversity, effect population size) data. In this poster we illustrate the integration of these approaches through case studies on terrestrial vertebrates in temperate and tropical habitats.

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6.5.8 The importance of intraspecific variation for designing conservation strategies in plants: *Centaurea jacea* as a study case

Sonia Vanderhoeven, Claude Lefèbvre, Olivier Hardy, Xavier Vekemans & Pierre Meerts

Laboratoire de Génétique et d'Ecologie végétales
Université Libre de Bruxelles

In plants, polyploid complexes pose specific problems to design conservation strategies.
We will use knapweeds (*Centaurea jacea*, a widespread plant with diploid and tetraploid cytotypes in Belgium) as a study case. Based on complementary approaches (morphometrics, molecular markers and ploidy level assessment), we argue that populations represent valuable targets of conservation in that complex.

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7 Declaration

Recommendations of the participants of the European platform for biodiversity research strategy held under the Belgian presidency of the EU in Brussels, Belgium

2nd - 4th December 2001

concerning
"Scientific tools for biodiversity conservation: monitoring, modelling and experiments"

Considering European legal commitments in the field of conservation of biological diversity, including the CBD, CCD, Ramsar, FCCC, other international multilateral agreements and appropriate EU and national legislation,

The participants of this meeting agree that the management of ecosystems as a contribution to conservation policy must be based on sound scientific understanding of:

- the needs, values and goals of human society, whether local, national or European, and especially those of stakeholders in managed areas;
- how humans influence and are influenced by ecological processes in managed areas;
- how the agencies and individuals with responsibility for the managed areas interact, work and take decisions;
- how the structure and methods of organisations can be adapted to become more effective in ecosystem management.

The participants further agree that this social and institutional understanding must be complemented by understanding of:

- ecological units and boundaries;
- the interaction between genetic, species and ecosystem biodiversity, and the interaction of these across landscapes and within contiguous marine volumes.

The participants agree that the proper approach to ecosystem management depends on:

- agreement between stakeholders about the objectives of any ecosystem management;
- observations, experiments, modelling and long term monitoring;
- designing experiments at appropriate scales and in such a way that the results may be transferred and applied at relevant scales;
- applying scientific techniques to predict and monitor the effect of management actions;
- acting to protect the components of biodiversity and the processes and interactions between them;
- collecting, compiling, analysing, organising, archiving, and providing access to, appropriate scientific data, continuously and over the long term, in such a way as to make data and knowledge widely available;
- adapting management responses in the light of regular assessment of ecological and social goals and progress towards these goals.

The participants decided that the following key issues and action points have high priority for European research:

- amend, improve or if necessary develop methods and techniques to integrate social, economic and ecological research;

- actively involve the managers who might implement the results in the design and execution of research that has implications for conservation management;
- derive specialised and generalised indicators, suites of indicators and other biodiversity assessment tools, that are soundly based on scientific knowledge, tested and accepted, and that will be simple to use, cost effective, and of direct practical use to managers and policy-makers;
- improve monitoring, modelling and experimental methodology to detect progress towards ecological and social objectives and to detect early any significant deviation from the desired trajectory; and to predict and evaluate the ecological and socio-economic risks and impacts of management regimes and methods, and to recommend changes;
- develop multi-disciplinary scientific support for appropriate policy on conservation management, and legislation, public awareness and information;
- seek better understanding of the functions, goods, services, exchange of genes, and connections between components of biodiversity within ecosystems and the functional links between ecosystems;
- communicate effectively and appropriately the aims and results of scientific projects to stakeholders, policy makers and the public.

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Proceedings of the 5th meeting of the
European Platform for Biodiversity Research Strategy

2-4 December 2001 – Brussels

SCIENTIFIC TOOLS FOR BIODIVERSITY CONSERVATION: MONITORING, MODELLING AND EXPERIMENTS

Meeting under the Belgian EU Presidency

Editors: H. Segers, E. Branquart, A. Caudron, J. Tack
Belgian Biodiversity Platform
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