Summaries of deliverables of the EuMon Project

The EuMon project attempts to provide a European framework that standardizes, focuses and coordinates existing monitoring programs by comparing and integrating existing methods and monitoring schemes of species and habitats of community interests. The most successful methods in terms of cost effectiveness, regional robustness will be selected and tested for their European wide applicability. EuMon will pay special attention that existing monitoring programs can incorporate these methods and will give recommendations how new and successful monitoring programs can be established.

Special consideration for implementing monitoring programs will be paid by studying the social effects of monitoring regimes, because the relationship between amateurs and professionals are meant to be most important for implementing a successful monitoring regime.

The establishing of the NATURA 2000 network is one of the main actions on a European level to halt biodiversity loss. Therefore it is a prerequisite to evaluate its ability to maintain biodiversity. Additionally EuMon will develop methods to name the responsibility of EU Member states for the species and habitats of Community interests living under their protection.

A comprehensive database on monitoring schemes and recommended methods will be established and made accessible via an Internet portal.
The EuMon consortium combines the expertise of 16 partners from 11 countries. Total project costs are 2.2 Mio Euro, with a requested EU contribution of 1.49 Mio Euro.

In case of interest in further information on the deliverables, please contact Dirk S. Schmeller at monitoring @ ufz.de.

D10: Draft methodology for assessing national responsibilities

This document describes and reviews methods currently used to determine national responsibilities in preserving biological diversity. The analysis of national responsibilities is likely to contribute significantly to fulfilling the objectives of the Convention on Biological Diversity. Beyond providing a review of the conservation status of species using red books and other sources, the analysis of national responsibilities determines the importance of national and regional distributions of species in a global context. Thus, determining the national responsibilities for countries provides a valuable tool for use in legislative and other decision-making processes at both the national and regional level.

We shortly describe the different methods currently used to determine national responsibilities. Even though the document aims to review methods used worldwide, it mostly uses examples from European countries, but also mentions approaches used in Canada and Australia. Approaches in these countries may encounter similar problems regarding state- or province-level responsibilities as the European Union. This paper will be used as a basic document in discussions in Work Package 4 of the EuMon project on the advantages/disadvantages of different methods and potential ways to incorporate the methods or parts of them into a “best practice” method. The potential utilization and application of each method based on currently available data will also be considered.

A special problem in determining national responsibilities is the question of peripheral populations, which will need further attention because a clear definition appears difficult. In addition, the terminology for the different categories of responsibility should be harmonized between the different approaches and should be improved in a unified framework. Currently two main types of approaches exist in Europe for using information about the distribution of species in the focal area relative to their total distribution for setting priorities, the SPEC system and the concept of national responsibilities.

All methods reviewed here lack a clear conceptual structure and mix conservation status and national responsibility. Further, some of the criteria are arbitrary and not intuitively understandable by lay people and policymakers, and therefore will be difficult to apply. We conclude that there is an urgent need to develop a sound method to determine national responsibilities to facilitate the allocation of conservation tasks to geographical entities, like nations and regions.

D11: Draft methodology to analyze whether networks represent adequately habitats and species of Community interests

Conservation area networks are area sets, aiming to protect biodiversity in those areas. The question how to identify areas of conservation interest should be subject to careful conservation planning, to ensure allocating the scarce resources most efficiently. Pressey (1990) presented an intriguing figure, when he studied development of allocated reserve areas and compared this to the total area needed for protection of biodiversity in New South Wales, Australia (Figure 1). It clearly can be seen that the two lines do not approach each other as desired, but merely reflect on opportunistic reserve site allocation, which does not really lead to an implementation of a successful area network. Such data, unfortunately, is not yet analysed for Europe or any of the European nations. However, as the site selection in Europe does not always follow conservation aspects (see D14), it has to be assumed that also in Europe the two lanes will be parallel rather than approaching each other.

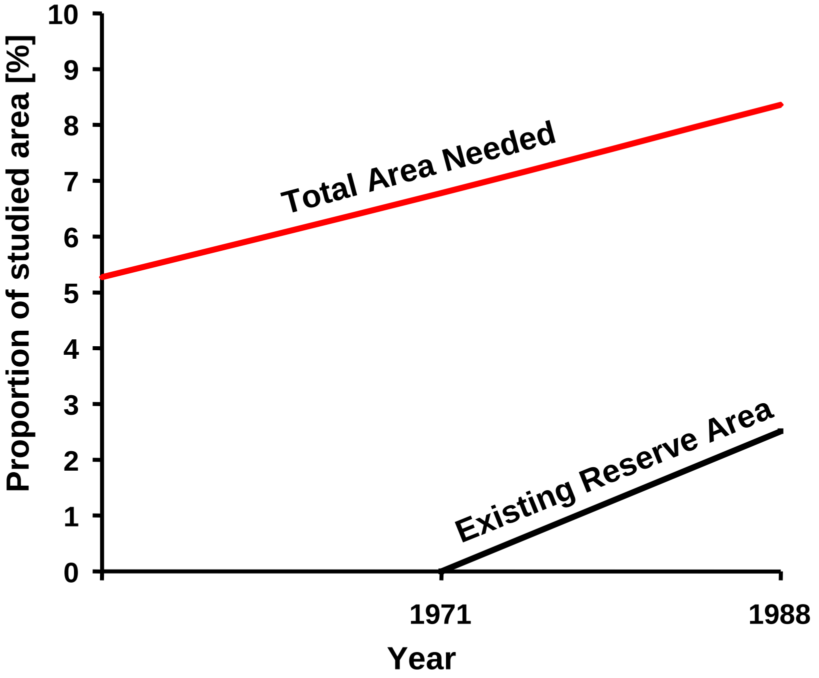

Figure 1 : Accumulation of reserves in north-western New South Wales between 1971 and 1988 (lower line) and the total area needed in 1971 and 1988 to represent all land systems (environmental classes). Re-produced from Pressey (1990).

The NATURA 2000 network aims to fulfil the protection of species and habitats of Community interest on the European scale. To achieve this goal most effectively, it is necessary to follow a scientific sound protocol of area selection, which has been intensively developed in the recent years. This methodological framework for a systematic conservation planning process includes the following steps:

- Delineate manageable, potential priority sites
- Identify the conservation goals of the network
  As it is not possible to cover biodiversity in the whole region more specific goals have to be defined for specific regions (i.e. conservation of rare species, conservation of indicator species, conservation of specific habitat types of processes, assurance of ecosystem services)
- Nominate biodiversity surrogates
  To be able to determine which sites should be protected, knowledge on the state of biodiversity (or the delineated goal of the network) has to be gathered. This cannot be done for complete sets of species/habitat types in all potential areas, therefore surrogates for biodiversity have to be defined (e.g. indicator species/habitats).
- Setting of quantitative representation targets
  To verify the success of the conservation network a clear quantitative representation target has to be defined (i.e. at least three occurrences of each species, 1000 ha of each habitat type)
- Selection of priority sites by a standardize method
  This step includes the determination of principles of site selection. It follows

mathematical algorithms that allow for multiple criteria optimization by evaluating a reserve in regard to its role within the context of many other units. Site selection can be based on different features such as complementarity, rarity, adjacency and vulnerability. The algorithms weigh the different feature and aid in selecting areas from potential sites. Important methods are iterative algorithms, simulated annealing and linear programming.

It is important to note that so fare this unified approach has not been undertaken by the members of the European Community. If they agreed on the already elaborated methods of network sites selection, the streamlining of the reporting process for the NATURA 2000 areas would be much facilitate and would further aid to allocate NATURA 2000 sites more efficiently. The NATURA 2000 network still lacks this sound common framework that would allow for an efficient reserve site selection (see e.g. D14). Nevertheless, the framework can be used to identify specific conservation goals and to check the efficiency of the network by testing whether the conservation goals have been reached. For example, the proportion of the amount of habitat needed to the area for the protection of all habitats of Community interest that is needed should decrease with the allocation of more reserve sites.

D12: Compilation and illustration of statistical methods for the analysis of state and trends in populations and species level biodiversity

Distribution and population size are the two criteria accepted for the reporting of member states on the status of the Annex species of the Birds and Habitats Directives to the European Commission. Deliverable 12 provides an illustrated compilation of methods to quantify state and trends of the distribution and population size of a species. The suggested methods include the estimation of distribution with presence-absence data and the estimation of population size with relative abundance data for large-scale surveys as well as the estimation of population size with capture-mark-recapture sampling for small-scale ones. All three classes of methods are exemplified by the case studies of the EuMon partners on birds, butterflies, and orchids, described in a uniform format. Special focus is given to dealing with the problems of spatial variation and imperfect detection, which are the key issues in species monitoring. Only few monitoring schemes can apply exhaustive sampling in which all the potential sites where a species may occur are surveyed within the area of interest. In the remaining cases, when a small fraction of the area has to be selected for sampling, a random or systematic selection of sampling sites or their post-stratification during the data analysis is recommended. Similarly, total count, in which all individuals are detected, is hardly ever possible. The recorded value of a parameter monitored (distribution or population size) is typically the product of its true value and the detection probability. Thus unless imperfect detection is accounted for, any changes in the recorded value may not necessarily reflect the true changes in the parameter that monitoring scheme is intended to document, but instead they may be due to variation in detection probability.

D16: Framework for integration of different species monitoring schemes

Many biodiversity monitoring schemes exist. While some are part of an international network but most of them are run independently, with a local scope and small geographical coverage. Biodiversity monitoring would thus benefit from integrating monitoring schemes/data into broader monitoring programmes (i.e. unifying existing monitoring schemes) and broader monitoring goals (i.e. combining monitoring schemes with complementary monitoring goals) to monitor biodiversity changes more effectively and more representatively. An output of integration should also be to increase visibility and legitimacy of integrated monitoring schemes compared to ‘disconnected’ schemes. They would thus get a higher profile in the scientific community and would be of higher value for biodiversity policy.

This deliverable mainly develops the different avenues for integration that could be followed, as well as the methods that can be used to achieve this integration. Avenues for integration were mainly determined from questions in the DaEuMon questionnaire (Deliverable 8). These questions were designed so that they allow a thorough description of monitoring targets, methods, designs, efforts and biological scopes. In the text hereafter, we refer to questions by their number in the questionnaire (legends in Deliverable 8; e.g., S26 for question 26 in Species questionnaire, namely Taxonomic group).

According to spatial scale, we restrict suggestions of integration to two administrative scales: national and Europe. If not mentioned otherwise, integration is focusing at the European level. For all following criteria, if integration is sought at the national level, just add ‘same country’ criterion. We did not address integration at a smaller scale than the national level because region identity is not available in DaEuMon (but, on the medium-term, that could be changed) and because biodiversity evaluations for environmental policy issues are most frequently undertaken at national scales.

Integration should be thought in two general ways, with complementary benefits:

- Combine schemes with similar characteristics. The resulting network of schemes would promote exchanges and integration of data or estimates. Main benefits would be:
    - increase geographical coverage per taxonomic group. If geographical scales differ among schemes to be integrated (e.g. mix of local and national schemes), then one may use post-stratification with weights in statistical analysis to compensate for these differences;
    - increased precision of estimates of states and trends, e.g. by increasing sample sizes (cf. number of sites);
    - increased representativity of results.
- Combine schemes with different characteristics. In this case, the main benefits come from complementarity among schemes. Benefits would be:
    - increase biological coverage (complementarity across species and across taxonomic groups), thus allowing characterisation of biodiversity changes with different taxonomic group rather than the one available at hand in each separate schemes;
    - increase geographical coverage;
    - increase temporal coverage;
    - increase coherence of monitoring activities with EU Directives by identifying which schemes need to be combined so that ‘state and trends of species and their habitats’ are monitored for all species listed in the Directives in all countries.

From a practical point of view, the goal of work presented in this Deliverable is to design a tool that identifies which schemes could be integrated.

To imagine this ‘tool to promote integration across schemes’, one may think of an interface that basically works as a filtering tool. You may think of it as a filter in Excel: the more you define constraints of similarity (or dissimilarity) for different questions, the easier it will be to integrate schemes since they will be similar in many points. Then you may relax some constraints, increasing the list of schemes that could be combined, but also increasing difficulties to combine information since schemes will be less and less similar. However, their complementarity will increase.

For instance, imagine that an EU-wide programme that monitors population sizes of bats is to be set up. Highly similar, easily combined schemes would be identified by filtering schemes monitoring ‘at least bats’ (field S26 - Taxonomic group contains ‘bat’), at ‘national or international or EU’ levels (field ‘geographical scope’), collecting ‘counts of individuals’ (field S2 - Data type), with a representative sampling design (field S6 - Choice of sites equals ‘random choice’ or ‘systematic choice’ or ‘exhaustive’). This filtering would yield a limited list of schemes, and that would be the basis for building an EU-network, with schemes rather easy to combine. Actually that yields a list of six schemes from three countries (Estonia, France, Hungary; DaEuMon database, 16/10/2006).

Then, some constraints maybe relaxed to find more schemes, less straightforward to be integrated, but that still would benefit from each other. For instance, the constraint on data type could be relaxed to increase the biological coverage of the monitoring, although data type will then be a mixture of presence/absence, counts of individuals, capture-mark-recapture, age-structure and phenology data. In the case of European bats monitoring, that adds two more schemes from two countries (Slovakia, Switzerland). These schemes document presence/absence only. On the whole, state and trends in distribution for bats could be integrated across five countries, with trends of population size being documented with good (counts) precision in three countries, and lower precision (presence/absence) in two countries.

Another example would be the identification of schemes running in other European countries than the one of interest. That would correspond to filtering on question ‘Country’, constraining that schemes ‘do not contain’ the name of the country of interest.

These suggestions for the design of the ‘integration tool’ are rather simple, and will be improved by WP5-WP6 to design and produce a user-friendly browser of DaEuMon, while allowing advanced filtering criteria.

D17: Recommendations for the coherence, scientific quality, and cost-effectiveness of species monitoring schemes

The general aim of this deliverable is to help in identifying suitable approaches for the establishment of newly initiated schemes, for the improvement of existing schemes, and to contribute to moving towards higher coherence among monitoring schemes in Europe. The direct objectives are to provide a detailed list of criteria for judging and quantifying the scientific quality of species monitoring schemes, to outline ways for establishing coherence within and among schemes, and to estimate the time- and cost-effectiveness of schemes. All criteria proposed can be qualitatively characterised or quantified from data entered in the DaEuMon database available at http://eumon.ckff.si/monitoring.

Scientific quality of monitoring schemes (chapter 2) is proposed to be characterised by the following measures:

- spatial and statistical representativity of data collected,

- statistical power: ability of monitoring schemes to detect trends,
- measurement precision of monitoring schemes: reliability of data from monitoring,
- degree of refinement of the sampling design,
- scientific knowledge requirements for data collection, and
- use of state-of-the-art field and statistical methods.

Coherence (chapter 3) can be defined in several ways. The DaEuMon database can be used to characterise criteria related to:

- the internal consistency of individual monitoring schemes,
- compatibility among monitoring schemes, and
- coverage of Natura 2000 species and sites and of species for which countries have medium to very high responsibility by the monitoring schemes.

Time and cost-effectiveness (chapter 4) is proposed to be measured as the ratio of (i) the level of information obtained by the scheme and (ii) the effort necessary to conduct the scheme. The level of information encompasses the quantity and quality of information provided by the scheme and can be measured by:

- the areal coverage,
- taxonomical and ecological extent and
- scientific quality of monitoring schemes.
- Effort required to run the schemes can be of two kinds.
- Time requirements, measured by manpower, including both professionals and volunteers.
- Financial costs are composed of
- personnel costs, that can be estimated by manpower plus arbitrary salaries (not in DaEuMon), and
- costs of materials and equipment.

We do not evaluate schemes or develop overall ranks for all schemes. Rather, we provide these guidelines to filter out schemes that can be recommended as examples of “best practice” schemes given the trade-offs described or schemes that are particularly suitable for integration into broader (geographically or taxonomically) monitoring schemes. This should allow coordinators of monitoring schemes to identify scopes for improvements of their schemes given their specific constraints. A full evaluation should involve the simultaneous evaluation of scientific quality, coherence, and time and cost-effectiveness for monitoring schemes. Because monitoring schemes differ largely in geographic scope, taxonomical extent, time and cost requirements, we argue that full evaluations should be carried out on smaller sets of similar schemes. Guidelines for a synthesis approach using composite measures of quality for such smaller sets are given in chapter 5 of this document.

D18: Compilation and illustration of recommended methods for analysis of combined data from different monitoring schemes

Combining data from different schemes improves representativity, precision, and robustness of conclusions derived from monitoring data on biodiversity changes. Benefits, limits, and available methods for combining data from different schemes were compiled in D16. Here we illustrate recommended methods for data combination with reference to case studies. Raw data combination is recommended when data were collected with similar field methods and correspond to the same data type (i.e., data document the same biological process and have the same theoretical distribution). When estimates are to be combined, geometrical mean, and meta-analysis methods are recommended. Despite of its great potential to assess general patterns, the meta-analysis approach remains very poorly used for biodiversity trend assessment with species or habitat monitoring data. In all cases, whether data or estimates are combined, weights to account for differences in sampling design and sampling effort across schemes need to be included in computations of means and statistical analyses. Finally, different monitoring schemes may produce complementary information; e.g., combining estimates from count survey and capture-mark-recapture survey allows linking population trends to demographic processes.

D19: Framework for the integration of different habitat monitoring schemes

The aim of this document is to reveal the conditions, explore the possibilities, and develop criteria for the integration of habitat monitoring schemes in order to improve the ability to detect trends in biodiversity loss in Europe. Habitat monitoring activities encompass a wide range of activities and can be classified into several distinct categories. Therefore, it is essential that a unified framework for the integration of habitat monitoring schemes is established. Such a framework will obviously be an important step in the process, hopefully leading towards a more integrated monitoring of the habitats of Europe.

Habitat monitoring schemes evaluate the conservation status of habitats or habitat types by estimating the following sets of habitat attributes: extent, biotic composition, biological structure, and physical structure. Habitat monitoring schemes can be classified into those with and without a spatial aspect. Both can monitor one, few, most or all specific habitat types within a country, region, or landscape. The schemes that monitor all habitat types within an area hereafter will be termed as belonging to a holistic approach. Schemes that monitor one or a few habitat types of interest will be referred to as representatives of a targeted approach. An important difference among habitat monitoring schemes further lies in whether they use remote-sensing or field-mapping as their primary source of data. Question H4 in DaEuMon (‘Spatial variations in habitats are documented by:’) provides the basis for classification, where only two answers are possible: ‘remote sensing’ and ‘field mapping’.

The potential combinations of the main aspects of habitat monitoring schemes results in several types of habitat monitoring schemes. Whereas some combinations are highly unlikely (e.g., holistic, remote sensing-based, non-spatial), some are frequent (e.g., field mapping-based, targeted, spatial). Scheme integration is easier to carry out for schemes of similar type. Integration will be more difficult for schemes belonging to opposite approaches, e.g., integrating remote sensing-based schemes with field-based schemes. However, the integration of different schemes can give highly valuable insight that within-class integrations cannot provide.

Remote sensing-based monitoring schemes belonging to the holistic approach, i.e. schemes that monitor all habitats within an area, are highly appropriate for integration.

These schemes have a common “language” in the form of a geo-referenced spatial information basis. Due to their inherent common interface, holistic remote sensing-based schemes have the best chances to become part of a pan-European integrated monitoring scheme. However, an ideal solution for a pan-European habitat monitoring system would incorporate the best of both the remote sensing approaches (large spatial scales, relatively easy integration etc.) and the field mapping-based approaches (small scales, high sensitivity, detailed etc.).

An ideal pan-European habitat monitoring system should include at least the following aspects. An integrated monitoring should have a remote sensing-basis, assuring the manageability of large spatial scales (cf. entire EU27) and providing an opportunity to detect changes in spatial properties of habitat types. Although a holistic approach would be ideal, an integrated scheme does not have to be holistic, perhaps only encompassing those SCI areas that have been specifically designated for HD Annex I habitat types. Ideally, the integrated monitoring scheme should also include SPAs for establishing a connection point to the most frequently used species monitoring schemes. An integrated scheme should be suitable for extension to possible future pSCI (or SPA) areas. Finally, an integrated monitoring needs to be complemented with field-mapping in habitat types of Community importance because remote sensing alone is not suitable to detect small-scale but relevant changes. Considering the overwhelming scope of the task, it appears inevitable that indicators will need to be used instead of direct measurements to assess achievement of the 2010 target.

D20: Recommendations for the coherence, scientific quality, and time and cost-effectiveness of habitat monitoring schemes

The general aim of this deliverable is to help in identifying suitable approaches for the establishment of new habitat monitoring schemes, for the improvement of existing schemes, and for moving towards higher coherence among schemes in Europe. The direct objectives are to provide a detailed list of criteria for judging and quantifying the scientific quality of habitat monitoring schemes, to outline ways for establishing coherence within and among schemes, and to estimate the time- and cost-effectiveness of schemes. All criteria proposed can be qualitatively characterized or quantified from data entered in the DaEuMon database available at http://eumon.ckff.si/monitoring.

- Coherence (chapter 2) can be defined in several ways. The DaEuMon database can be used to characterize schemes using criteria related to:
- the internal consistency of individual monitoring schemes,
- compatibility among monitoring schemes, and
- coverage of Natura 2000 habitat types for which countries have medium to very high responsibility by the monitoring schemes.

Scientific quality of monitoring schemes (chapter 3) is characterised by the following measures:

- spatial and statistical representativity of data collected,
- biodiversity representativity
- statistical power: ability of monitoring schemes to detect trends,
- measurement precision of monitoring schemes: reliability of data from monitoring,

- the extent to which habitat quality can be monitored,
- scientific knowledge requirements for data collection, and
- use of state-of-the-art field and statistical methods.

Time and cost-effectiveness (chapter 4) is proposed to be measured as the ratio of (i) the level of information obtained by the scheme and (ii) the effort necessary to conduct the scheme. The level of information encompasses the quantity and quality of information provided by the scheme and can be measured by:

- the areal coverage of habitat monitoring,
- ecological and taxonomical extent, and
- scientific quality of monitoring schemes.
- Effort required to run the schemes can be of two kinds:
- Time requirements, measured by manpower, including both professionals and volunteers and
- financial costs, which are composed of
- personnel costs, which can be estimated by manpower plus salaries (not in DaEuMon), and
- costs of materials and equipment.

We provide these guidelines to filter out schemes that can be recommended as examples of “best practice” schemes given the trade-offs described or schemes that are particularly suitable for integration into broader (geographically or taxonomically) monitoring schemes. This should allow coordinators of monitoring schemes to identify scopes for improvements of their schemes given their specific constraints. A full evaluation should involve the simultaneous evaluation of scientific quality, coherence, and time and cost-effectiveness for monitoring schemes. Because monitoring schemes differ largely in geographic scope, extent of habitat types or quality assessed, and time and cost requirements, we argue that full evaluations should be carried out on smaller sets of similar schemes. Guidelines for a synthesis approach using composite measures of quality for such smaller sets are given in chapter 5 of this document.

In chapter 6 we illustrate the evaluations in two case studies from the EuMon database. In one of the case studies, we assess all habitat monitoring schemes in the database and in the second one, we evaluate schemes from Greece, Spain, and the UK.

D21: Revised and tested methodology - for the assessment of national responsibilities for species and habitats of Community interest

The major aim of this deliverable of WP4 was the development of a method for the determination of national responsibilities and conservation priorities for species and habitats of Community interest. Generally, national responsibility can be thought of as a measurement directly correlated with the effect of the loss of a population in the area of a political entity on the species’ global survival. The availability of such a method allows conservation decisions to be based not only on the conservation status of a species (Red Lists) but also on the responsibility of a geographic or administrative entity for the survival of a species. The method is supposed to support EU-policy and nature conservation. In D10, WP4 has reviewed currently existing methods, which were found unsuitable for application on a European scale. In most existing methods, threat status and international importance have been hardly separated and a scaling of results has not been implemented in a practical way for larger scales. EuMon has developed a new method, basing on the distribution pattern and distribution range, has tested the method and assessed it giving a list of criteria. Most importantly, the method clearly distinguished between the national responsibilities of countries and the conservation priority given by the combination of national responsibilities and threat status. The latter is introduced in the method by using the nature directive annexes, the IUCN red list and national red lists.