Umweltbundesamt
Federal Environment Agency – Austria

MONITORING FOR NATURE CONSERVATION

20-22 June 1996, Vienna

CONFERENCE PAPERS / TAGUNGSBERICHTE
VOL. 22 / BD. 22
CP-022

Vienna / Wien, 1997

Bundesministerium für Umwelt, Jugend und Familie

Federal Ministry for Environment, Youth and Family

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Impressum/*Imprint*

Medieninhaber und Herausgeber: Umweltbundesamt/*Federal Environment Agency*
Published by: Spittelauer Lände 5, A-1090 Wien/*Vienna*, Austria

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Druck/*Printed by:* Riegelnik, 1080 Wien

Gedruckt auf chlorfrei gebleichtem Papier/*Printed on chlorine-free bleached paper*

ISBN 3-85457-360-X

INHALT

PROGRAMME

Seminar on

MONITORING FOR NATURE CONSERVATION

20-22 June 1996, Vienna

Federal Environment Agency
in Co-oporation with
Federal Ministry of Science, Transport and the Arts

Thursday, 20 June 1996

14:00-17:00 **Opening**, welcoming address

The importance of permanent plots for global change research
Georg GRABHERR, University of Vienna, Austria

Aufgaben und Methoden des Vegetationsmonitorings
Dieter MAAS, Technische Universität München, Deutschland

Approaches to monitoring for nature conservation in Scottland
Neil BAYFIELD, Institute of Terrestrial Ecology, UK

Discussion

19:00 ***Evening at a typical Viennese "Heurigen"***

Friday, 21 June 1996

9:00-13:00 **Ansätze für koordinierte Monitoringsysteme im Naturschutz**
Günter WOLF, Bundesamt für Naturschutz, Deutschland

Nature Monitoring Programme in Denmark
Peter WIND, National Environmental Research Institute, Denmark

Applied strategies for monitoring environmental change in Norway:
Vegetation dynamics and plant species persistence
Odd EILERTSEN, Norwegian Institute for Nature Research, Norway

Discussion

14:00-16:30 **Vegetationskundliche Dauerbeobachtung;**
Konzepte und Beispiele aus der Praxis in Niedersachsen
Dietmar ZACHARIAS, Niedersächsisches Landesamt für Ökologie, Deutschland

Requirements of Monitoring Networks for Natura 2000 – Sites
Ole OSTERMANN, European Topic Centre for Nature Conservation, France

Monitoring projects in Austria
Thomas WRBKA, Andreas TRAXLER, University of Vienna, Austria,
Micheal JUNGMAIER, Institut für angewandte Ökologie, Austria

Discussion

Saturday, 22 June 1996

9:00-18:00 ***Excursion*** to monitoring sites at the river March (Ramsar site "March-Auen")
and the Lake Neusiedl (Neusiedler See-Seewinkel, National Park and Ramsar site)

EINLEITUNG

Der Begriff „Monitoring“ ist in den letzten Jahren in Mode gekommen. Tatsächlich aber hat Monitoring eine lange Tradition und ist in vielen Fällen Bestandteil des alltäglichen Lebens. Überall wo Entwicklungen oder Veränderungen über einen bestimmten Zeitraum beobachtet werden, wird Monitoring betrieben. Etwa im Straßenverkehr, im Haushalt oder in Betrieben.

Angewandtes Monitoring im Naturschutz, das Inhalt des vom Umweltbundesamt in Zusammenarbeit mit dem Bundesministerium für Wissenschaft, Verkehr und Kunst veranstalteten Seminars war, repräsentiert einen Teilbereich des Biomonitorings. Biomonitoring wird als Informationsinstrument, das systematische Auskünfte über den Zustand unserer Umwelt gibt, indem gleichsam eine „Kontrollampe“ aufleuchtet, wenn ein geforderter Umweltstandard nicht eingehalten wird, beschrieben (TRAXLER, 1997).

Eine prägnante Definition aus dem englischen Sprachraum formuliert „Monitoring is to record change“ (BAYFIELD, 1996).

Wie immer naturwissenschaftliches Monitoring auch definiert wird, tatsächlich bestehen regelmäßig dokumentierte Dauerbeobachtungsflächen in Österreich bereits seit geraumer Zeit, etwa im Wirtschaftsgrünland oder im Wald. Neu ist hingegen die Vielzahl der Monitoringprojekte, die speziell Naturschutzfragen behandeln. In einer Studie des Umweltbundesamtes zum Thema Vegetationskundliches Monitoring wurden in einer österreichweiten Umfrage über 100 Projekte erfaßt, die insgesamt fast 17.000 Dauerflächen beinhalten. Die Projekte reichen vom Monitoring von Pflegemanagement in Naturschutzgebieten bis zu Monitoring bei der Renaturierung von Mülldeponien oder der Auswirkungen des Treibhauseffektes auf die Vegetation des Alpenraums.

Betrachtet man die internationale Entwicklung, so kann festgestellt werden, daß Monitoring für Lebensräume und Arten in Zukunft ebenfalls an Bedeutung gewinnen wird. Die Verpflichtung Monitoring durchzuführen ist sowohl im Übereinkommen über die biologische Vielfalt als auch in der Fauna-Flora-Habitatrichtlinie der EU festgeschrieben.

Um einen Überblick zu derzeit laufenden Aktivitäten zum Monitoring im Naturschutz in anderen Staaten Europas zu erlangen und dazu Erfahrungen auszutauschen, veranstaltete das Umweltbundesamt das Seminar „Monitoring for Nature Conservation“ in Wien.

Der vorliegende Tagungsband umfaßt die Kurzfassungen der einzelnen Beiträge, die im Rahmen der Tagung von den Referenten aus dem In- und Ausland gehalten wurden.

Das Seminar war Teil eines Projektes des Umweltbundesamtes zum Thema „Vegetationskundliches Monitoring“.

Im Rahmen des Projektes wurden Richtlinien bzw. Mindeststandards zum Vegetationskundlichen Monitoring ausgearbeitet, die derzeit gängigen Monitoringmethoden dargestellt, ein Informationskapitel für potentielle Auftraggeber von Monitoringprojekten erstellt, sowie die derzeit laufenden Monitoringprojekte in einem „Dauerflächenregister“ beschrieben.

INTRODUCTION

Despite its longstanding tradition, it is only in the course of the last years that the term monitoring has become fashionable. Actually, monitoring is part of our day-to-day lives. Wherever developments or changes over a certain period of time are observed, monitoring takes place, be it in road traffic, at home or in enterprises.

In co-operation with the Federal Ministry for Science and Transport, the Federal Environment Agency Austria held a seminar on applied monitoring for nature conservation, which is a part of bio-monitoring. Bio-monitoring is a means of obtaining systematic information on the state of our environment, ringing a warning bell if certain environmental standards are not met (TRAXLER, 1997).

An exact definition was given by BAYFIELD (1996): "Monitoring is to record change".

But whatever the definition of bio-monitoring may be, Austria has a long tradition of monitoring permanent plots, be it grassland or forest sites. What is new, however, is the large number of monitoring projects dealing specifically with aspects of nature conservation. The Federal Environment Agency Austria commissioned a study on vegetation monitoring in the course of which a survey of 100 projects was made covering nearly 17,000 permanent plots. The projects range from the monitoring of management measures in nature reserves to the monitoring of recultivation of waste disposal sites and the impact of global warming on alpine vegetation.

On the international level, the growing importance of monitoring for habitats and species becomes more and more obvious: both the Convention on Biological Diversity and the EU Fauna-Flora-Habitat Directive stipulate an obligation for monitoring.

In holding a seminar on monitoring for nature conservation the Federal Environment Agency Austria pursued a twofold aim: to give an overview of monitoring activities for nature conservation carried out in other European states and to provide a forum for an exchange of experience.

This volume of conference papers contains the abridged versions of the talks given by national and international experts in the course of the seminar.

The seminar was part of the Federal Environment Agency project on vegetation monitoring.

In the course of this project guidelines and minimum standards for vegetation monitoring were established and currently used monitoring methods described. Furthermore information was provided for parties potentially interested in commissioning monitoring projects and, last but not least, ongoing monitoring projects were included in the Austrian Register of Permanent Plots.

MONITORING OF ENVIRONMENTAL CHANGE BY MEANS OF VEGETATION ANALYSIS

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1 ABSTRACT

Vegetation monitoring for the evaluation of the success of nature conservation measures and for general environmental control can be done with same methods. Both purposes require certain minimum standards with respect to the assessment of data, sampling design, data processing and interpretation.

These requirements are defined for different levels of vegetation monitoring, especially repeated vegetation mapping of the same area, detection of changes within a plant community in time, and the reaction of single populations.

Possible sources of errors in data sampling, processing, and interpretation, introduced mainly by observer differences and misinterpretation due to insufficient data availability, are explained, and their influence on the results of long-term monitoring of vegetation is demonstrated using two examples from a monitoring project in Bavaria.

For the two examples, the amount of the possible errors can be quantified which offers a possibility to define threshold values which must be passed before a real vegetation change can be stated.

Nevertheless, this possibility exists only for these two examples. Topics for further research are discussed which should try to elaborate general guidelines for all possible plant communities of interest.

2 INTRODUCTION

Vegetation monitoring can be seen as a form of long-term ecological study (PLACHTER, 1991). It can be distinguished from a specific monitoring (HELLAWELL, 1992; PLACHTER, 1991) which serves to detect the ecological effect which is exerted by a defined anthropogenic influence on a biological or ecological system. A long-term ecological study or an unspecified monitoring is laid out to document changes in ecosystems or communities in a first step. In a second step, the causes for the changes have to be found by interpreting the data. For this purpose, it can be useful to have additional data available which were e. g. acquired with technical detection systems. In an optimal study, the interpreted results should be experimentally verified. In contrast to specific monitoring, also termed biomonitoring (HELLAWELL, 1992), long-term studies are generally seen as a tool for the detection of the quantitative or qualitative influence or a change of any environmentally relevant factor.

Of course, certain restraints in comparison with chemical or physical environmental survey systems must be accepted with respect to the quantitative exactness of the results. The advantage of any kind of biomonitoring lies in the direct assessment of the biological effects of environmental changes (ARNDT et al., 1987; SCHUBERT, 1985). As for all biomonitoring systems, also vegetation monitoring must fulfil certain requirements. These can be given as:

- the results must represent reality with sufficient accuracy.
- the results must not deviate from a predefined threshold of accuracy.
- the results must be able to discriminate between the influences of different factors.
- the results must be spatially and temporally consistent and reproducible.
- the results must be relevant to the questions to be answered.

Vegetation monitoring is accepted as a tool for general environmental monitoring, because the plant community of a given habitat as integrating system is assumed to indicate all environmental factors which act on this area (KLÖTZLI, 1993). Beyond this, it can be assessed with comparably low temporal and technical effort. By representing the producers of an ecosystem, it is also assumed to give at least rough ideas about the habitat conditions for ecosystem-specific animals.

Monitoring for environmental change using plant communities, or with an other expression, vegetation as a whole, differs somewhat from the traditional forms of biomonitoring. The latter is still confined to using single species. Only during the last years the interest of traditional biomonitoring research is directed to the question of using species mixtures. So a slow approximation between two very different branches of monitoring is beginning. This article intends to summarise some principle ideas about the design of long-term ecological monitoring using specific vegetation types, and the processing and interpretation of the data. It is based on the realisation of a complete vegetation monitoring program for general environmental control as an example, which is presently installed in Bavaria.

3 GENERAL PURPOSES AND REQUIREMENTS

Vegetation monitoring as described on the following pages has the task of general environmental monitoring. Besides this, other purposes for which such a system is useful can also be imagined:

documentation of the effects of local impacts affecting abiotic and biotic resources, e. g. in local impact studies control of effectiveness of nature conservation measures assessment of experimental results for research purposes.

Vegetation is a very simple word for a system that can be understood as being organised on different levels. Vegetation monitoring can be applied to all the relevant levels, depending on the questions which are to be answered. The level of observation must be adapted to the specific questions which are addressed to by the investigation. The different levels can be identified as (MAAS & PFADENHAUER, 1994):

- monitoring of changes of the area covered by certain plant communities
- monitoring of changes of species abundance/dominance within a plant community
- monitoring of changes within one or several populations of species forming a plant community.

The next more detailed level of monitoring would be that of the reaction of single individuals belonging to one population within a plant community. By this level, one approaches the methods of traditional biomonitoring very closely, with the difference that here often selected and isolated individuals are used. Observing the reaction of single individuals within a 'natural' plant community is the normal approach in specific passive biomonitoring, e. g. using accumulators for environmental pollutants.

4 DATA SAMPLING

4.1 Arrangement of sample plots

Important parts of effective vegetation monitoring are a reasonable placement of sampling areas, data assessment and data processing and interpretation.

Placement of sampling areas can be based on subjective decisions of the investigator but should preferably be arranged in a way that can be tested for plausibility, that is appropriate for the problem under consideration and should be repeatable by other persons. The placement of sampling areas should be able to render interpretable data with respect to possible environmental changes and be representative for the floristic composition of the type of vegetation that is investigated.

Depending on the specific questions, regular or random placement of sampling areas is preferable. Regular placement is to be preferred when it is necessary to sample the same area several times, since they can more easily be found in the field. A case where this may be necessary is the documentation of changes of the boundaries between different vegetation units. Random placement is a necessary prerequisite for all cases where statistical tests exceeding the power of the explorative techniques usually applied to vegetation data shall be used.

The number of replicates and size of sampling areas should be inquired before a monitoring system is installed. Simple tests for stability of means and variances e. g. of species numbers give the necessary information (WEBER et al., 1995). Generally, there is a relationship between the number of replicates necessary to produce reliable interpretations, and the frequency of data collection in long-term studies: the longer the intervals between sampling dates, the more quadrates are necessary. At the moment, only such a qualitative statement can be given. Further investigations of this problem should be able to render more exact answers.

Whereas random placement gives no problems with the mutual placement of sample plots, regular placement can either be arranged in equally spaced grids or in transect lines. The latter should be preferred, when other purposes, like following the shift of boundaries between different vegetation types, shall also be recorded, or when the expected environmental change will result in an expressed linear gradient (e. g. the groundwater funnel after drinking water extraction). Either arrangement should keep the opportunity to use the sample plots for new questions to be answered, which may be based on other data types than the original ones (e. g. a shift from vegetation relevés to population studies). This restricts the size of the sample plots. They should only be so large, that no difficulty is found to inspect their central parts without artificial disturbance exerted by sampling itself. For forested and unforested vegetation types a size of 10 x 10 m or 4 x 4 m was found to be sufficient to represent app. 95 % of all the species present in a vegetation type adequately (PFADENHAUER et al., 1986). Sample plots of these sizes are used in the example below. They can be arranged in transects of contiguous quadrates with lengths of up to 125 m, in single quadrate lines, or in a combination of four to five neighbouring lines. For other purposes (evaluation of management success), checkerbord arrangements are in use.

Deviations from these principles are often necessary for mapping vegetation when the area covered by distinct vegetation types is under study. Here the general rules can be applied which are used for phytosociological studies (e. g. MUELLER-DOMBOIS & ELLENBERG, 1974; DIERSCHKE, 1994).

5 SAMPLING TECHNIQUES

Several possibilities for the assessment of field data in vegetation monitoring are available. They differ with respect to their exactness, reproducibility, temporal requirements, etc. Generally, the technique used for the assessment of field data should fulfil the following minimum requirements (MAAS & PFADENHAUER, 1994):

Sufficient accuracy to detect changes in the parameters recorded. Robustness against the application by different persons assessment of quantitative or semi-quantitative data independence of the data from the structure of different vegetation types data must be acquired with reasonable temporal effort data should be meaningful with respect to the investigation Very important for long-term studies is the exact definition of the sampling dates. This should preferably be done using phenological states of the investigated vegetation.

Destructive and non-destructive methods which fulfil the above requirements are available. Destructive methods (e. g. dry matter weight) are not always desirable. The separation of dry matter samples into species is very time consuming, but gives data with best ecological interpretability. Non-destructive sampling methods (individual numbers, cover or dry matter, frequency) can either be measured by non-destructive methods, which are generally also time consuming, or can be estimated. Estimation always leads to personal or systematic bias. A compromise between these biases and the requirements stated above is found in the estimation of plant species cover in cover classes. The classes can be defined in a way that reduces systematic and personal bias to a tolerable minimum (PFADENHAUER et al., 1986). Frequency is ecologically more problematic to interpret, and is comparably more time consuming. Whatever data sampling method is used, one should take care that this is done in a way that makes the data adaptable to other sampling systems applied to the same sampling level. The data once acquired can thus be made available to other studies, probably applying different methods. This is generally no problem for cover estimates made with different scales. But e. g. frequency data cannot be transformed to cover scales.

In the examples explained below a cover estimation scale which is based on the traditional Braun-Blanquet scale is applied, which was refined for the low cover classes by subdividing each original class into two, and by only referring to cover without the inclusion of individual numbers (PFADENHAUER et al., 1986). This should be done, because there is no relationship between the dominance of a species and the individual numbers (RICE, 1967), due to the variation in plant size during growth.

If ever possible, besides floristic data other ecological parameters should be recorded for each sampling area (e. g. availability of macro- or micronutrients, pH, groundwater level, etc.). This will result in great improvements of accuracy during the interpretation phase.

Whatever data sampling system is used, the general form which is derived will be that of a matrix where several objects, in this case representing the replicates within the sample data set, are described by several attributes. These attributes are the species presences and quantities.

6 DATA PROCESSING AND INTERPRETATION

Methods for processing vegetation data are in most cases necessary to allow a meaningful interpretation of the data matrix. They are intended to reduce the information content in the data set by extracting meaningful information and suppressing or eliminating redundancy and noise. These methods must fulfil the following requirements (MAAS & PFADENHAUER, 1994):

- they must be appropriate with respect to the aims of the investigation
- the results must be reproducible or at least the way they were produced must be transparent
- the results should be clear.

Depending on the level of observation and the aim of the investigation, different data processing methods are available. These can be separated in descriptive methods, which just serve to reduce the data set and improve its interpretability, and in inferential statistics.

Among the first count all numerical classification methods, ordination, and demographic analysis. Numerical classification and ordination with their multitude of approaches can be applied to more or less any kind of vegetation data set. There are no special requirements with respect to uniformity of means and variances, at least for some of the methods available, and for mere visual interpretation of the results (KERSHAW, 1973; KENT & COKER, 1992). In case additional environmental variables were recorded for each replicate, they can be included in methods of canonical ordination. This gives a better basis for interpretation and places all deductions on a safer ground. The results obtained from canonical ordination can also be tested for their probability of being a chance result by e. g. Monte-Carlo-simulation (JONGMAN et al., 1988). Comparable methods for testing the quality of numerical classifications are also available (WILDI & ORLOCI, 1990). These possibilities for evaluating the result make the distinction between numerical data processing methods and the mere intuitive data processing by hand in form of vegetation tables (DIERSCHKE, 1994), which is often influenced by personal preconceptions how the results should look like (WIEGLEB, 1989).

Demographic data analysis has completely other requirements with respect to the data set. It is only applicable to population data which describe populations structured by grouping individuals of the same species into growth or age stages (BURGMAN et al., 1993). It is thus restricted to the population level of long-term monitoring. Contrasting to the methods applicable to a conventional vegetation data matrix, it allows predictions which proved to be more or less reliable at least for short and medium time steps.

When suitable data are present, it is also possible to subject them to an analysis by inferential statistics. The normal restrictions with respect to the nature of the statistical distribution of the data etc. will in most cases limit its application to cases where abundance or dominance were directly assessed by measurements.

Two examples are displayed which try to an impression how the points outlined above are transformed to reality.

7 EXAMPLES FOR VEGETATION MONITORING

The following examples come from a vegetation monitoring program for general environmental control in Bavaria. This is under supervision of the Bavarian State Office for the Protection of the Environment and is organised and maintained by the Academy for Nature Conservation and Landscape Maintenance in Laufen/Salzach. At the moment this system for environmental control comprises about a dozen of such permanent plots laid out in forests, limestone grasslands, acidic grasslands and mires.

The examples can be used to detect the effects of changes in environmental factors, but also can serve to assess the effectiveness of nature conservation measures for the specific sites. This is no special property of these two examples, but is also true for most of the other permanent plots which were installed up to now.

7.1 Example 1

The first example presents the repeated mapping of a small forest reserve, which has not been used since the early 1950ies and the processing of data from a permanent plot which is placed in this area. The vegetation of this site consist of a mixed *Quercus robur – Carpinus betulus* – forest which is present in several different types (see fig.1). Conventional vegetation relevés using the standard Braun-Blanquet cover-abundance estimation scale (MUELLER-DOMBOIS & ELLENBERG, 1974) were made in 1961 (SEIBERT, 1962) and then again in 1986 (PFADENHAUER & BUCHWALD, 1987). The relevés from the two dates were jointly subject to agglomerate clustering of the herb layer data with the minimum variance method. The data were transformed to presence – absence before. The result of the analysis of vegetation relevés and sites is displayed in form of an arranged differential table in tab. 1. One apparent property of the two data sets is the difference between the pure *Carex montana*-type in the two years.

The vegetation types were mapped directly in the field, based on the differential species groups indicated in tab. 1. Both maps are shown in fig. 1. It is possible, to calculate the change in the area covered by each of the vegetation types. The differences between the two dates can be found in the legend of fig. 1.

The results of this comparison indicate, that the forest reserve became more enriched in nutrients and the proportion of mesic and moist vegetation types has increased. Taking into consideration the undisturbed succession starting at the beginning of the 1950ies, when forest grazing and leaf litter harvesting ended, these changes can be attributed to the increased establishment of trees and a closing of the canopy with the years. It is not possible, to make atmospheric nutrient deposition alone responsible for the detected changes. Since the groundwater was lowered during the last three centuries, the increasing soil moisture which is represented by the changes in composition of the forest herb layer is due to reduced evapotranspiration under the denser canopy.

In 1986 a permanent plot in form of a transect of five contiguous lines of 25 plots with 10 x 10 m each was established (see fig. 1). The vegetation in each of these quadrates was recorded in 1986 and in 1993 using a refined Braun-Blanquet cover estimation scale (PFADENHAUER et. al., 1986). Some quadrates were surveyed by three observers independently in 1993. This was intended to give an idea about the influence of personal estimation errors.

The data from 1986 and 1993 were subject to minimum variance cluster analysis. The results from this allow to assign each of the 125 quadrates to a distinct vegetation type, as displayed in fig. 2. It is possible to follow for each of the quadrates whether it remains in the same classification unit, or shifts to another one. Also here, as for the map of the whole forest reserve, changes occur regularly towards groups with higher nutrient and water availability, for the reasons discussed above.

The data of all quadrates were also analysed using detrended correspondence analysis. This may be seen as a substitute for a real time series analysis, which is normally not possible with data from vegetation surveys or permanent plot studies, since it requires approximately 50 time steps to render reliable results. This is an unusual high number for vegetation ecology. So, the main reason for applying ordination to this example is not to detect environmental gradients along which the quadrates are placed. This aim can also, with restrictions, be achieved by cluster analysis. Here it is the shift of points representing the same sites in ordination space with time, which is the interesting point. It is not likely, that a point will remain at exactly the same place in ordination space, since there always fluctuations in species abundances within a quadrate from year to year. So the question is, how large must the distance (similarity or dissimilarity) between points representing different observation moments be to allow an unequivocal detection of changes, and how much do personal estimation errors influence the interpretation.

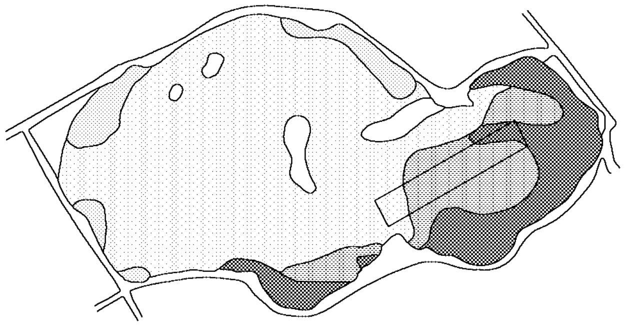
Tab. 1: Differential table and resulting vegetation units for the forest reserve „Echinger Lohe“, arranged according to results from cluster analysis for species and relevés (relevé no 21-30: 1962 – relevé no 1-20: 1986). Not all accompanying species are listed, abbreviations of species names consist of first four letters of genus and species names.

Oak-Carpinus forest
a = Melampyrum pratense-type
b = pure Carex montana-type 1986
c = pure Carex montana-type 1962
d = Arum maculatum-type with Carex montana
e = Arum maculatum-type with Corydalis cava
f = Arum maculatum-type with Corydalis cava and Ranunculus ficaria

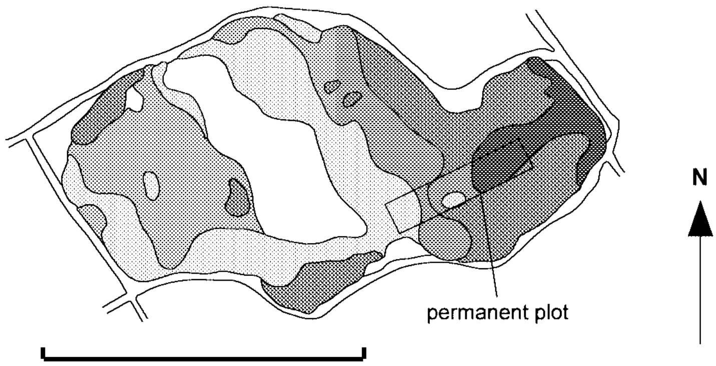
	a	b	c	d	e	f
relevé no	2222	3 1	122		221 21111	111
	1234	32054170	9508	6	962983154	678
Mela prat	1211	....	....	.	....	...
Brom bene	+++.	..+.....	....	.	....	...
Prim veri	.+++	+r.r....	.1..	+	....1....	...
Rubu saxa	++11	11++1+r.	+.1.	+	...+..+..	...
Care mont	2.12	211122..	21..	2	....++...	...
Conv maja	2122	211111+.	221+	1	11.+1r...	...
Apos foet	2+12	1+1+.1..	1.+1	+	.+1++..+.	1..
Lami mont	.11+	+..32123	2+.2	2	222212333	333
Merc pere	33+1	..++.+42	2.11	.	13122.222	.+1
Viol hirt	1112	....+.+.	1221	+	11++2++.+	...
Viol mira	2112	.....+++	1221	1	11112r+.+	...
Camp trac	1111	....	1+1+	.	11+++r.r.	.+.
Lili mart	+12+	..r.....	+++.	.	1+++.+.+.	+1.
Care alba	12..	..1..1..	1...	1	....	...
Tana cory	++11	....	21+.	.	2++.1....	rr.
Chae aure	+.+.	....	2111	1	22.12..1+	211
Arum macu	....	rrr...1+	....	1	122221111	121
Cory cava	....	....	....	.	122.11.11	223
Alli rotu	....	....	....	+	2.2.32+11	21+
Stac sylv	..+.	1	....	.	21..1.1.1	11+
Agro cani	.+++	.....+..	1...	.	22..++..1	+..
Alli cari	.1.+	....	.+..	.	..1.1+.+.	11.
Eurh swar	....	......+1	....	.	.....+211	+13
Lami macu	....	....	....	.	....	.+2
Ranu fica	....	....	....	.	.1..+....	112
Mniu undu	.+..	1	....	.	....	2++
Ranu lanu	....	......r.	....	.	2........	1.2
Brom ramo	1...	...+....	+.++	+	.....+.r.	...
Care sylv	...+	....	..+.	.	..r+..++.	+..
Vinc hiru	..1.	...11...	2.1.	1	.1.......	...

Echinger Lohe – comparison of vegetation maps 1961 and 1985

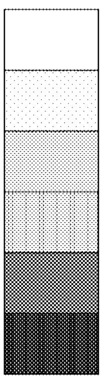
1961 (SEIBERT 1962, modified)



1985 (PFADENHAUER & BUCHWALD 1987)



Classification and area covered by communities in Echinger Lohe (mixed Quercus - Carpinus - forest)



1985	1961
not found 0 m²	Melampyrum pratense - type 7228 m²
pure Carex montana - type 36807 m²	pure type 150068 m²
Arum maculatum - type with Carex montana 59788 m²	not found 0 m²
pure Arum maculatum - type 67951 m²	Arum maculatum - type 43468 m²
Arum maculatum - type with Corydalis cava; Arum maculatum - type withCorydalis cava and Ficaria verna together 70116 m²	Arum maculatum type with Corydalis cava 33808 m²

Fig. 1: Vegetation maps of the nature reserve „Echinger Lohe“ from 1961 and 1986 with size of the area covered by the different vegetation types found in both years.

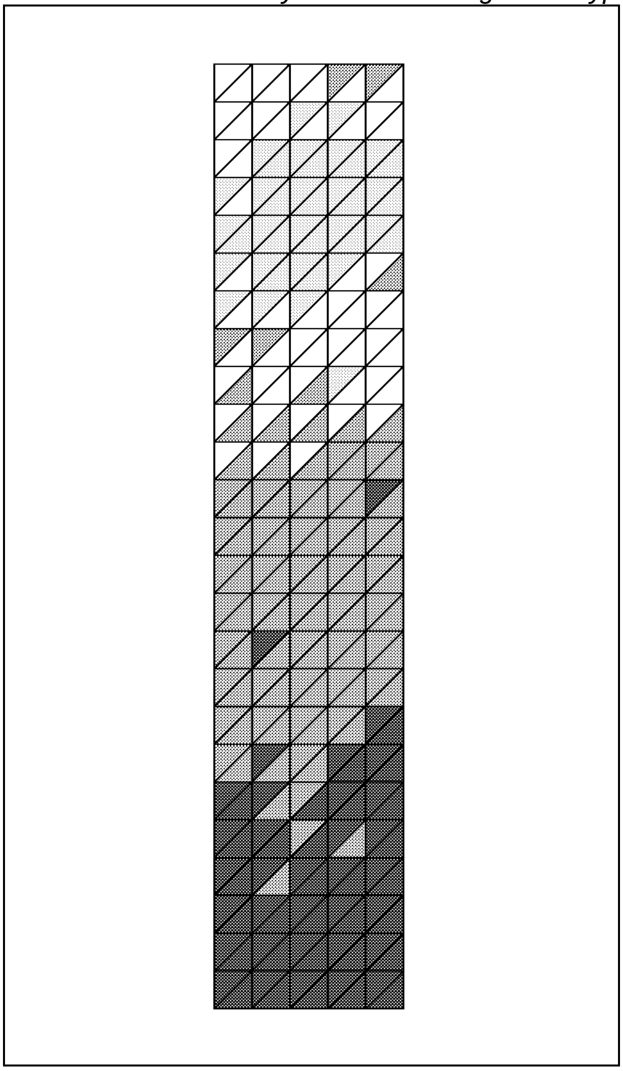


Fig. 2:
Permanent plot for long-term monitoring of vegetation in the nature reserve „Echinger Lohe“. The different grey values indicate the results of a classification of each quadrate into four vegetation types identified within the permanent plot by cluster analysis. The upper left half of each quadrate gives the value for 1987, the lower right half that for 1993. Differences in attribution to a vegetation type can be identified by a change in grey value.

Fig. 3 represents the results of ordination for five of those quadrates which were classified in different units by cluster analysis, and also includes the three replicate estimations made by three independently working investigators. It can be concluded, that except for quadrate 2, the estimates made by these three investigators, have all comparatively large distances from the point in 1986. For quadrate 2 only two of the investigators produced larger distances. So, in general, the method is able to detect vegetation changes, even under the presumption, that different persons will be responsible for the field work at different observation dates. It is thus possible to elaborate minimal values for similarity or dissimilarity between the objects representing the same points at different time steps, which should exceed the similarity/dissimilarity between points resulting from different observers, before one can speak of a change in species dominances.

So ordination is a tool which allows to detect even very slight changes between observation dates. It can thus be difficult to distinguish real changes from cyclic fluctuations between years. This problem cannot be solved by observing only one permanent plot, and not when only two observation moments are available.

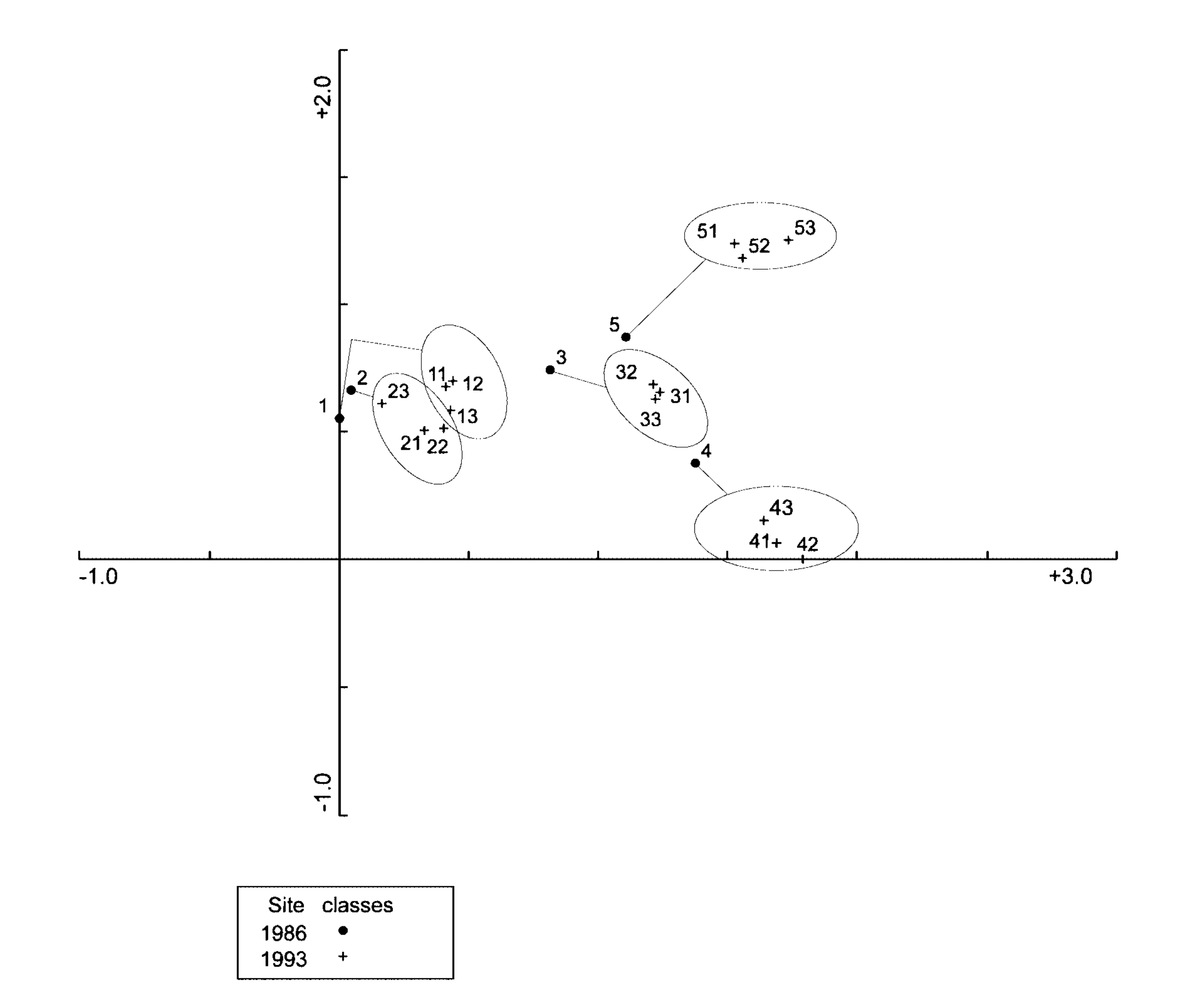


Fig. 3: Ordination diagram for some quadrates in the permanent plot „Echinger Lohe“, derived from detrended correspondence analysis. Single digit numbers (1-5) represent the position in ordination space for samples from 1986, the two digit numbers (11-53) indicate positions for 1993, based on the data of three independently working observes. The three points representing the same quadrate in 1993 are marked by ellipses.

7.2 Example 2

The second example is situated in an extensively grazed grassland, which lies partially on limestone, partially on acidic tertiary sand. This transect has a longitudinal extension of two adjacent rows each with 60 quadrates of size 4 x 4 m. The same procedure as for example 1 was applied here, with the exception, that a small number of randomly chosen quadrates were observed in 1987, 1993 and 1994. This sequence of three years allows to quantify the amount of annual fluctuation in vegetation composition and species dominances and gives an idea how this might influence the result of the interpretation. It would lead too far to repeat all the steps of the procedure already explained in example 1. In the following I will refer only to the effect of annual fluctuation in species composition and dominance.

Fig. 4 presents the results of the DCA applied to a random selection of a small number of quadrates from the two main parts of the transects. Two groups of patterns can be detected:

one group of points changes only in a neglectable way from year to year. They move within a range of 1 to 1.5 units of std. dev. This is a magnitude comparable to the range of observer dependent error in example 1. The second group of quadrates shows a large shift in point position from 1987 to 1993, and then within only one year a second shift back into the direction of the 1987 points. Without discussing this reaction in detail, there are two possible factors which can be given as reason for this shift: annual weather fluctuations (temperature, precipitation etc.) or the management of the site in which this transect is placed. Since the area is used by a migrating sheep herd, it cannot be taken as granted, that the moment of grazing is the same in every year. Also the number of animals fluctuates. This may also be the reason for the shift in floristic composition.

Without a third observation period one could easily conclude an increasing soil acidity for that part of the transect from which the second group of quadrates was selected: this belongs to the section which lies on the base-poor tertiary material, whereas the first group stems from the fringes of the nature reserve which is exposed to fertiliser deposition from adjacent crop fields, and thus may have a higher buffering capacity against acidifying rain water components. Acidification of the soils by industrial emissions is not unlikely, since the next larger industrial complex lies not far away in main wind direction. If data referring to deposition of pollutants or some soil properties, e. g. pH, were available, such misconclusions could easily be rejected.

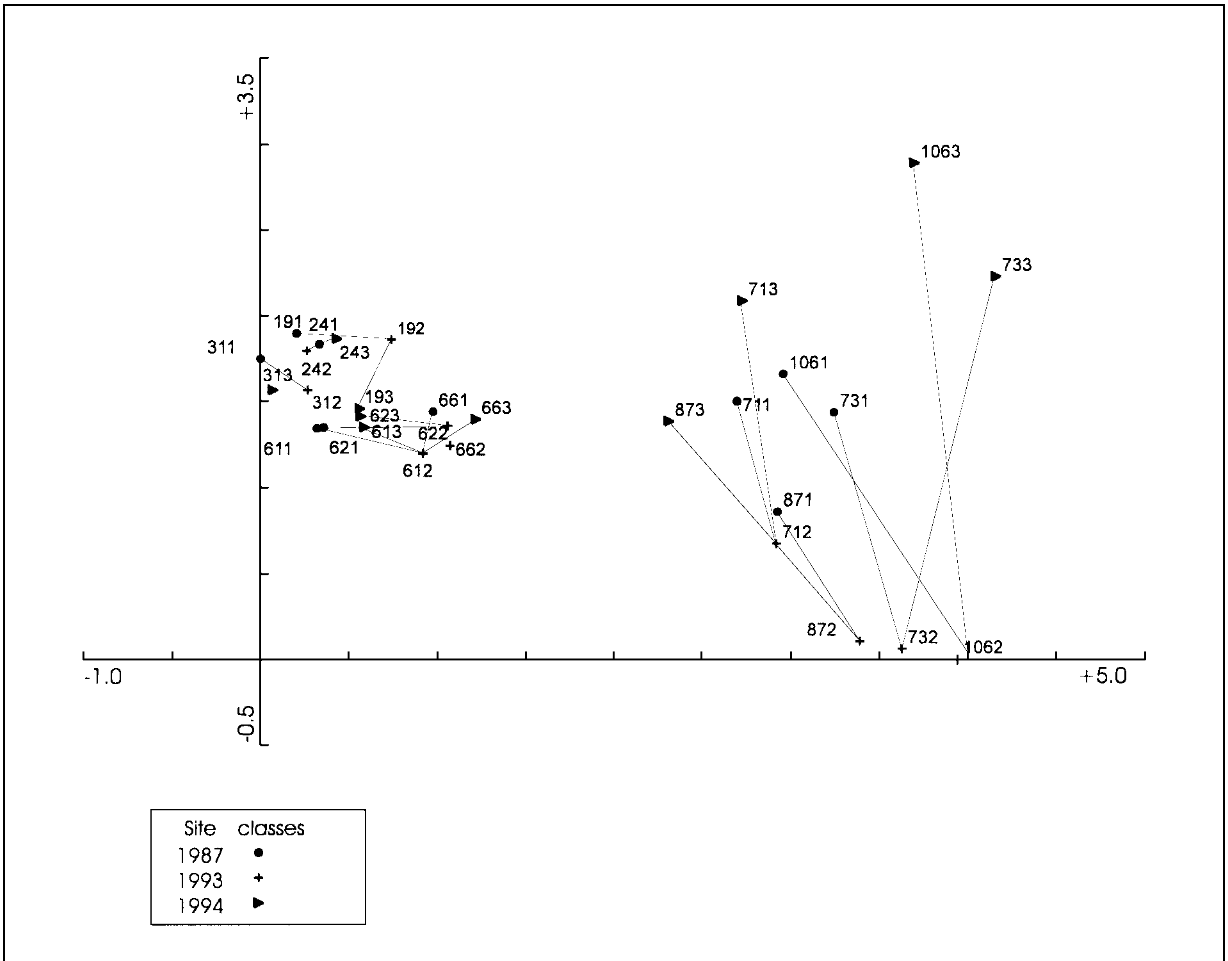


Fig. 4: Ordination diagram for some quadrates in the permanent plot „Sandharlander Heide", derived from detrended correspondence analysis of the same quadrates in 1987 (numbers ending with -1), 1993 (numbers ending with -2) and 1994 (numbers ending with -3). Points belonging to the same quadrate are linked with lines.

This result stresses the fact, that long intervals between the observations of permanent plots can lead to wrong concepts concerning the reasons for vegetation changes, as long as the influence of natural factors like the annual weather, or of the land use or maintenance measures which are applied to an area, cannot be quantified.

Fluctuations in species numbers lead in some way back to the population ecology of the plants forming the vegetation under study. Intrinsic factors can regulate fluctuations in individual numbers, like e. g. the intrinsic population growth rate (RIETMAN, 1993), as well as fluctuations in the carrying capacity of the site. The latter does not only comprise abiotic factors like water supply, but also interactions with biotic factors, like predator or pest pressure and disturbance by grazing animals.

7.3 Conclusions

The examples show that the methods applied are principally suitable to detect changes in vegetation. As for the examples, it can be stated, that observer dependent errors do neither critically influence the result of numeric data processing methods, nor the conclusions from interpretation of the results. This is no warranty, that this principle holds true for other vegetation types, it should be further tested.

Based on the results of the few examples which are available at the moment from the environmental monitoring program, some questions cannot be answered and some improvements can be suggested for the future. This includes a further research with respect to some special problems.

Is it possible to define vegetation units unequivocally, so that errors in their separation are minimised?

The first example demonstrates the problem with syntaxonomic nomenclature: the same vegetation units are named differently by different authors. This may imply a different sight they have for the vegetation to be mapped. The separation of vegetation units may consequently be based on slightly different criteria, which renders a comparison of areas covered by the same type rather difficult and biased. It is also known, that the mapping of boundaries between vegetation units based on floristic criteria has a large variation between different investigators. Maybe that other criteria than floristic ones should be included when defining units for the purpose of environmental control.

Under which conditions can the separation of vegetation units be accomplished using remote sensing data?

One possible method to increase the accuracy of vegetation maps is the interpretation of remote sensing data. Here, structural criteria which are expressed as patterns of differently coloured patches of different sizes, are available as additional information. Another aspect is the temporal effort which may possibly be reduced by using remote sensing data.

If ever possible, additional ecological data for each sampling area should be assessed.

Especially with respect to improved interpretation and exclusion of interpretation errors, it is recommendable that additional data of some possibly relevant environmental factors should be provided. In an optimal case, this would comprise a data set which is available for each quadrate within a permanent plot. Especially in the starting phase of environmental monitoring programs it allows a separation of important and unimportant factors, as far as they are accessible with chemical or physical detectors. This allows, e. g. the application of canonical ordination methods to extract those factors which have the largest impact on species abundances. Later, data assessment can then be restricted to these factors and must not necessarily be acquired from each quadrate.

How long should monitoring intervals be to allow a sure separation of trends from internal cycles or random fluctuations?

The second example stresses the necessity to have short observation intervals (optimally every year), until it is clear how large annual fluctuations of species dominances are in a special vegetation type. If these are known, it will be possible to give threshold values for similarity/ dissimilarity which goes beyond annual fluctuations.

How many replicates are minimally necessary to assess real vegetation changes, and which is the relationship between number of replicates and observation frequency?

Results from statistical tests for species numbers indicate that there is a relation between the length of the interval between observation dates and the number of replicates which is necessary for reliable detection of changes. The same can be assumed for species dominances. Further experience is needed for different vegetation types to answer this question in a satisfying way.

Is it possible to give tested guidelines for different plant communities?

Taking all these suggestions and improvements together, it should be possible to develop guidelines which define reasonable observation frequencies, numbers of replicates, average values for the observer dependent error to be expected, and the average minimum similarity/ dissimilarity which can be interpreted as a real, not error dependent change in species dominance.

Can population ecological data be used as indicators for vegetation changes?

The background of changes in species dominances is in many cases that of changes in the population structure of single species. Changes in size or age classes are summarised in form of cover values. Thus, it is principally possible to detect vegetation changes from changes in population structures. This offers a new field for investigation, which could on one side improve the results of long-term monitoring, and on the other side can probably reduce the temporal effort for observing permanent plots, since only species with high susceptibility to certain environmental factors would have to be observed permanently. Only if these show a marked reaction, it would then be necessary to acquire a complete data set, as in the examples above. This procedure also offers links between traditional biomonitoring and long-term ecological studies.

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9 ACKNOWLEDGEMENTS

The examples were drawn from a project which was financially supported by the Bayerische Landesamt fuer Umweltschutz und Akademie fuer Naturschutz, Laufen/Salzach, who also gave information concerning the present state of the vegetation monitoring program in Bavaria. The author also thanks Franziska Knuesel and Wolfgang Mayer for access to data from their master theses, and the Nature Conservation Authorities of Oberbayern and Niederbayern for the permission to access the natural reserves “Echinger Lohe“ and “Sandharlander Heide“.

APPROACHES TO MONITORING FOR NATURE CONSERVATION IN SCOTLAND

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1 INTRODUCTION

This paper gives examples of national, regional and local monitoring schemes in Scotland. The country has a high proportion of upland and coastal habitats of national and international nature conservation interest. Primarily nature conservation land designations include national Sites of Special Scientific Interest (SSSI) (10 % of Scotland) and international Special Areas of Conservation (SAC) and Special Protection Areas (SPA). Other national environmental designations that have an element of nature conservation importance include Environmentally Sensitive Areas (ESA) (19 % of Scotland) and National Scenic Areas (NSA) (13 % of Scotland). There are also regional and local designations such as the Grampian Region Sites of Interest to the Natural Sciences (SINS) and the Cairngorms Partnership Board Area. Most have some monitoring schemes in operation or planned but there is considerable variation in the methods used, resources available and reasons for monitoring. In some cases monitoring is to comply with EU Directives (mainly national schemes). In others it is to ensure that management or grant aid for nature conservation is effective (national and regional schemes), and in yet other cases it is to check that an individual development does not have unacceptable impacts (mainly local monitoring).

There is no one organisation responsible for monitoring, but the main national statutory organisations involved are Scottish Natural Heritage (SNH) and the Scottish Office Agriculture Environment and Fisheries Department (SOAEFD). At regional level, Local Governments and Area Planning Boards are active. Non-Government Organisations such as the Royal Society for the Protection of Birds (RSPB), World Wildlife Fund (WWF) and the National Trust for Scotland (NTS) operate a number of mainly local schemes. Monitoring is also undertaken by individual developers to meet planning conditions or agreements to protect nature conservation interests.

2 THE RATIONALE OF MONITORING

Monitoring is to record change. The first step in the process is to identify the principal issues and concerns affecting nature conservation resources. The second is to undertake a resource inventory and identify the most appropriate indicators of change. Monitoring can then begin.

There are basically two functional types of monitoring:

- non-regulatory monitoring primarily aimed at providing information about changes in impacts of environmental pressures or the effectiveness of management, without a framework of defined quality standards (although it may lead to definition of standards);
- regulatory monitoring aimed at comparing changes against quality standards in order to trigger a management response when unacceptable change occurs .

The majority of monitoring in Scotland is non-regulatory, mainly because quality standards have not yet been identified for most of the attributes being recorded.

3 NATIONAL MONITORING SCHEMES

3.1 General countryside monitoring

Changes in land use have been monitored in the UK for more than 20 years. Land cover mapping of the whole of Scotland by the Macaulay Land Use Research Institute (MLURI) has been derived from analysis of aerial photographs, ground validation and computer interrogation of digitised data. This serves as a baseline for changes in land cover. (ASPINALL et al., 1991). The main weakness is that the smallest mappable areas are 10 ha for open ground and 2 ha for woodland. GAULD et al. (1991) have used this approach to analyse changes in cover in the Cairngorms Mountains area from historic photographs between 1946 and 1988 . The study showed, for example, that over 42 years heather moorland had declined by 16 %, montane vegetation by 8 % and woodland had increased by 58 %. A larger-scale exercise on sample photographs from across Scotland has also been undertaken by SNH (TUDOR et al., 1994).

A continuing monitoring programme that relies primarily on ground survey is the Institute of Terrestrial Ecology (ITE) Countryside 1990 programme, which has involved detailed inspection of sample kilometer squares throughout the UK (Bunce et al., 1993). The framework for sampling is the ITE land classification of every kilometre square in the UK into 32 types, so that the results can be extrapolated to any subsample of the country. The sampling was first done in 1978, then repeated in 1984 and 1990. It will next be undertaken in 2000.

Information on 1200 plant species and 500 freshwater animal taxa were recorded within each sample square, providing detailed information on species abundance and change. Some of the Scottish changes from 1978-1990 were:

- numbers of woodland species decreased in all landscapes and there was a shift towards more grassy and open woodland;
- hedgerows were reduced in length by 4000 km, but species composition remained unchanged;
- there were species reductions in arable and semi-improved grasslands associated with more intensive management;
- species diversity in road verges decreased in arable landscapes but not elsewhere;
- species numbers decreased along streambanks, particularly in pastoral and upland landscapes.

3.2 Habitats and species monitoring

The EC Habitats and Species and Birds Directives require monitoring of designated species and communities. This has necessitated the identification of key indicators of change, in some cases involving the development of new methods of monitoring. A recently example is the identification of impacts of grazing, burning and disease on habitat condition. This involves recording signs of disturbance specific to individual plant communities (SNH unpublished draft, McDONALD, 1993). This method is intended for large-scale assessment of habitat disturbance. Estimates of condition are typically undertaken in quarter kilometre squares. recording in the Cairngorm Mountains suggests that the method is reliable, and further development work is underway, including the identification of indicators of impacts due to recreation.

A much smaller-scale example is monitoring of rare Scottish diurnal lepidoptera (PEARCE et al., 1996). This has entailed the development of methods of habitat recording that include habitat structure as well as species composition, and the testing of well-tried and alternative methods of recording lepidoptera numbers. This has resulted in a well-documented set of reference sites and comprehensive distribution maps for individual species.

4 MONITORING OF CONSERVATION FUNDING EFFECTIVENESS

Several monitoring schemes have been initiated in Scotland to assess the effectiveness of conservation funding. A recent example by SOAEFD was a study of the effectiveness of the Farm Woodland Premium Scheme (CRABTREE, 1996). The scheme aims to encourage the creation of new woodlands on farms both to enhance the environment and a productive land use (principally timber production). The study found that the scheme was generally meeting its nature conservation, landscape and amenity objectives, although there appeared to be scope to fine-tune some of the details of the scheme to give further benefits. This analysis was after the scheme had been running for three years.

FARM WOODLAND MONITORING

Scale: samples throughout Scotland
Sampling: representative plantings (one per farm) (150 farms)
Frequency: 3 years after planting

Procedure

1. Stratified random selection of farms
2. Farmer interviews
3. Site recording of habitats and site features
4. Site recording of birds
5. Site recording of landscape
6. Computer generation of visual envelopes for sites
7. Calculation of economic, landscape and biodiversity costs and benefits

The Environmentally Sensitive Areas Monitoring Scheme (CUMMINS et al., 1996) is in the third year of a ten year programme to examine the effects of the payment scheme in conserving the ecological, landscape and archaeological value of ESAs, which cover 1.5 million ha of Scotland. The recording involves:

- background monitoring which takes place throughout the ESAs regardless of uptake of the scheme and enables comparisons with national data;
- prescription monitoring, which is targeted solely at land in the scheme.

5 REGULATORY MONITORING

Some monitoring is initiated to check on impacts of a new development, such as the Aonach Mor ski resort, which lies partly in a SSSI. In this case the recording involves an annual audit, in which the values of key attributes of the site are compared against quality standards agreed for the site by a monitoring group (BAYFIELD & McGOWAN, 1995). The monitoring group represent the main interested parties at the site, including the Planning Authority, ski developer, Forestry Commission, SNH and the land owner, British Alcan. The Group also agree the management action that should follow any failure to meet the quality standards. This approach is based on the Limits of Acceptable Change method developed by the American Forest Service for management of wilderness areas (STANKEY et al., 1985). This monitoring has been in operation for six years.

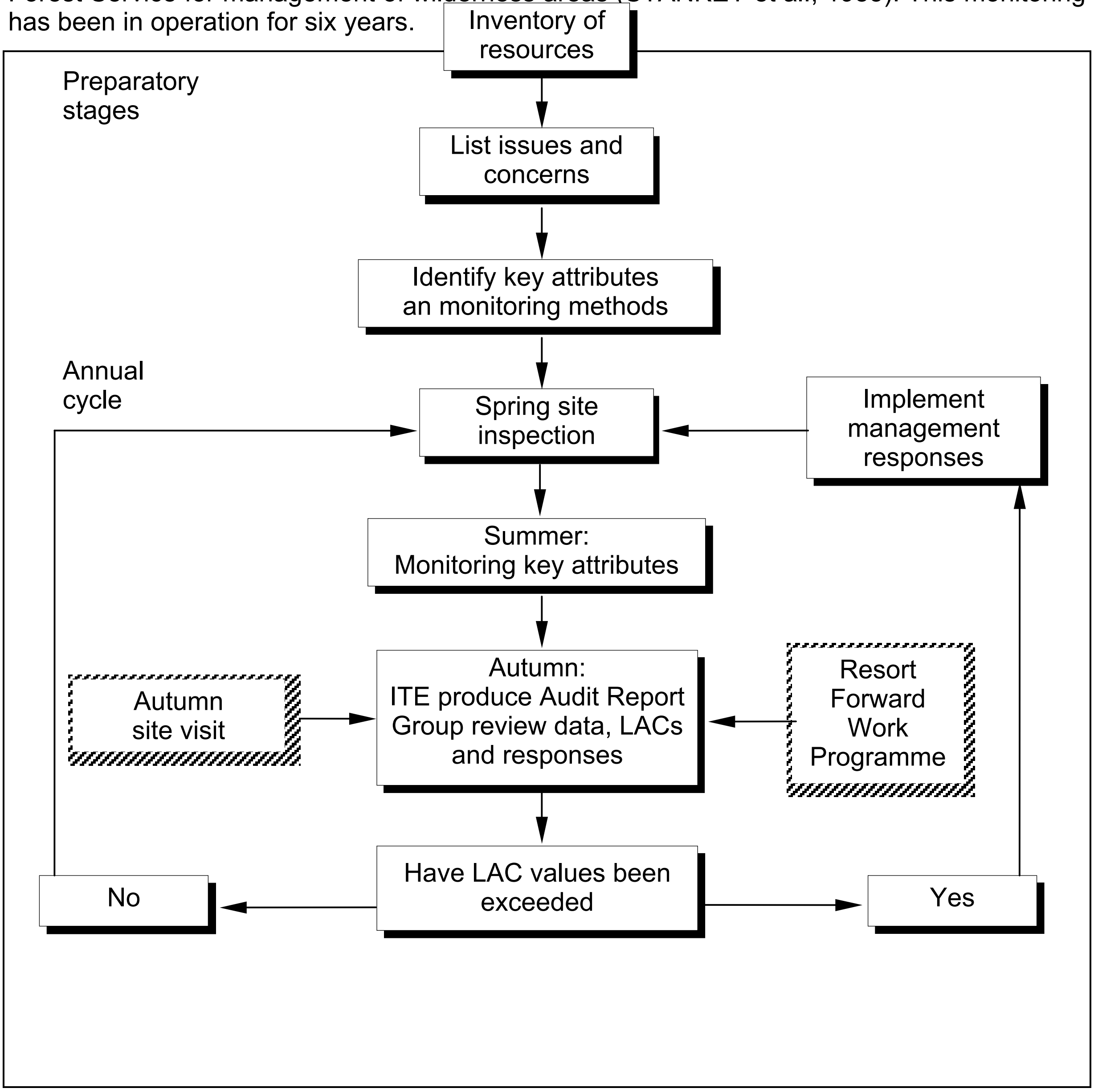

Fig. 1: Stages in setting up and operating a Limits of Acceptable Change (LAC) monitoring and management information system.

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ANSÄTZE FÜR EIN KOORDINIERTES MONITORING IM NATURSCHUTZ IN DEUTSCHLAND

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1 EINLEITUNG

Monitoring im Naturschutz ist die zweckgerichtete, langfristig angelegte und regelmäßig wiederholte Messung und/oder Beobachtung an Pflanzen- und Tierpopulationen, Lebensgemeinschaften und Ökosystemen zur Ermittlung ihrer Veränderungen in Raum und Zeit. Die Folgen der festgestellten Veränderungen für den Naturhaushalt und den Menschen sollen so frühzeitig als möglich aufgezeigt werden ("Frühwarnsystem").

Elemente eines Monitoringsystems für den Naturschutz sind:

- die Populationen wildlebender Pflanzen- und Tierarten
- die einzelnen Biotope/Lebensgemeinschaften/Ökosysteme als Lebensräume
- die Landschaft als Ganzes mit ihren Strukturmerkmalen.

Der Schwerpunkt des Monitorings im Naturschutz liegt bisher auf gutachterlich ausgewählten Naturschutz-Vorrangflächen (z. B. Grünland-Magerrasen, Feuchtwiesen, Heiden, Moore u. a.) in den Bundesländern. Unberücksichtigt bleibt dabei das Geschehen auf den intensiv genutzten Flächen und damit der Einfluß der Land- und Forstwirtschaft auf die Pflanzen und Tiere auf ca. 85 % der Flächen.

1.1 Zweck und Stichprobenkonzepte

In den einzelnen Bundesländern existieren vielfältige Ansätze der naturschutzorientierten Dauerbeobachtung mit unterschiedlichen Zielsetzungen, räumlichen und zeitlichen Bezügen. Eine Zusammenführung der einzelnen Ergebnisse zu einer bundesweiten Beschreibung des Zustandes und der Entwicklung von Natur und Landschaft sowie zur Erfassung und Bewertung der biologischen Vielfalt ist, wegen der zur Anwendung kommenden unterschiedlichen Methoden, kaum möglich.

Eine bundesweite, auch auf die 85 % land- und forstwirtschaftliche Nutzfläche ausgedehnte naturschutzorientierte Umweltbeobachtung ist notwendig und sinnvoll

- zur nachhaltigen Sicherung (Schutz) der natürlichen Ressourcen und der biologischen Vielfalt (Bundesnaturschutzgesetz),
- zur Ermittlung der Wirksamkeit staatlicher Natur- und Umweltschutzmaßnahmen sowie
- zur Erfüllung der nationalen und internationalen Berichtspflichten des Bundes.

Eine bundesweite Erfassung des Naturzustandes und seiner Veränderungen ist nach zwei methodischen Ansätzen zur Stichprobenerhebung möglich:

1. Die Einrichtung eines systematischen Stichprobennetzes (z. B. Waldzustandserfassung, Level I und II), oder die Ziehung einer Zufallsstichprobe aus der geschichteten Grundgesamtheit (z. B. Landnutzung, Naturraum, Standorttyp) zur wiederholten Erfassung des Zustandes von Natur und Umwelt. Sie erlaubt die statistische Auswertung der Beobachtungs-

ergebnisse, ihre Übertragung auf das gesamte Bundesgebiet mit einer sichereren Interpretation der Ergebnisse (z. B. ökologische Flächenstichprobe).

2. Die gutachterliche Auswahl von repräsentativen Beobachtungsgebieten nach definierten Kriterien durch Experten (vgl. Abb. 2) mit erheblichen Unsicherheiten bei der Übertragbarkeit der Ergebnisse auf das Bundesgebiet (z. B. Umweltprobenbank, Buchenwaldmonitoring), aber möglicherweise mit geringerem Untersuchungsaufwand.

Es werden zwei Projekte zur Dauerbeobachtung des Naturzustandes und der biologischen Vielfalt in Deutschland vorgestellt.

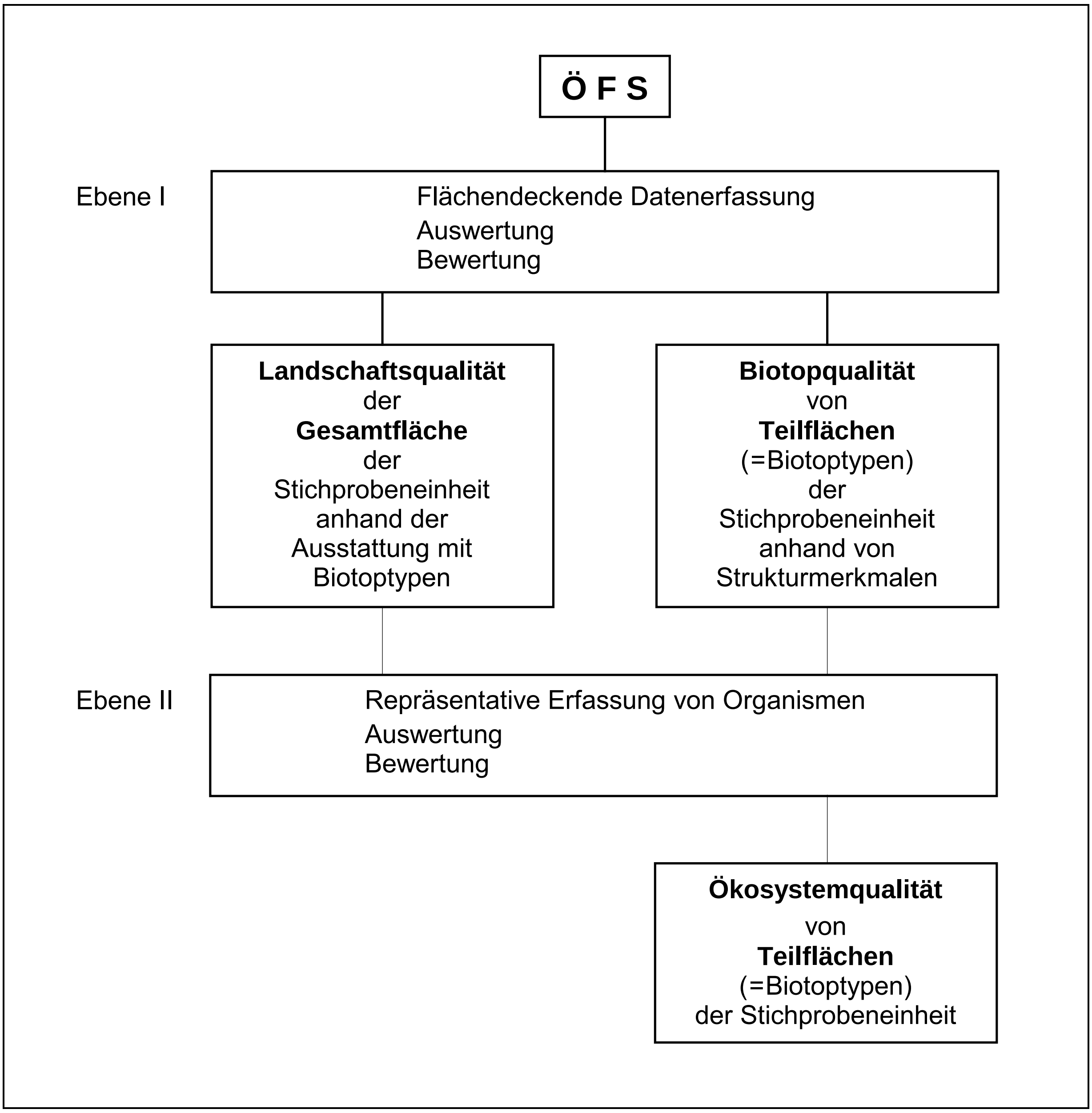

Abb. 1: Diagramm zu Gesamtkonzept und Ablauf der "Ökologischen Flächenstichprobe" (ÖFS) (nach BACK et al., 1996).

GRUNDSÄTZLICHE AUSWAHLKRITERIEN
■ Hauptbaumart: Buche ■ Flächengröße: ≤ 20 ha ■ Bestandsalter: mehr als 50 % des Bestandes 80 jährig (oder älter)
WEITERGEHENDE AUSWAHLKRITERIEN
■ Vegetationsgebiet: jedes Vegetationsgebiet (nach TRAUTMANN, 1978) mit zonalen Buchenwaldgesellschaften (in Anlehnung an BOHN & SCHRÖDER, 1985, unveröff., OBERDORFER, 1992, POTT, 1992) ist durch mindestens eine Monitoringfläche zu repräsentieren ■ Relief: das Reservat soll mindestens zur Hälfte eben bis mäßig geneigt sein (Neigung 0°-10°)
PRIORITÄTEN BEI MEHREREN IN FRAGE KOMMENDEN FLÄCHEN
■ Lage in Forschungs- und Beobachtungsgebieten ■ Kombination mit Maßnahmen der Umweltüberwachung ■ außerhalb des Einflußbereichs spezieller Emittenten ■ räumliche Homogenität (ein hohe Heterogenität führt zwangsläufig zu einer Vergrößerung des Gesamtflächenbedarfs) ■ hoher Informationsstand: Bestandesgeschichtliche Kenntnisse, Forschungsarbeit

Abb. 2: Auswahlkriterium für ein bundesweites Netz von Dauerbeobachtungsflächen in naturnahen Wäldern (nach THOMAS et al., 1995).

1.2 Die ökologische Flächenstichprobe (ÖFS)

Mit Hilfe der "Ökologischen Flächenstichprobe" (ÖFS) des Statistischen Bundesamtes (HOFFMANN-KROLL et al., 1995) sollen die Voraussetzungen dafür geschaffen werden, daß systematisch, periodisch und bundesweit Daten für den Bereich "Natur" mit einem vertretbaren Aufwand auf Dauerbeobachtungsflächen erhoben werden können. Bundesweit heißt in diesem Fall, daß die Aussagen repräsentativ für ganz Deutschland sein sollen, ohne aber jede Parzelle des Landes erfassen zu müssen. Das Projekt ist eingebettet in den größeren Zusammenhang des Forschungsvorhabens "Entwicklung eines Indikatorensystems für den Zustand der Umwelt in der Bundesrepublik Deutschland mit Praxistest für ausgewählte Indikatoren und Bezugsräume" (finanziert als Forschungs- und Entwicklungsvorhaben durch das Bundesministerium für Bildung, Wissenschaft, Forschung und Technologie). Die Ergebnisse sollen die Grundlage der Darstellung des Themenbereichs Umweltzustand innerhalb der Umweltökonomischen Gesamtrechnung bilden.

Über das Gesamtgebiet der Bundesrepublik sollen Zufalls-Stichprobenflächen von 1 km^2 verteilt werden, in denen Informationen über die Veränderung von Natur und Landschaft gewonnen werden (Trendermittlung). Die Erfassung und Bewertung erfolgt auf der Grundlage einer luftbildgestützten flächendeckenden Geländeaufnahme der Biotoptypen, die zu einer Bewertung der Landschafts- u. Biotopqualität führt. In einem zweiten Schritt sollen auf Dauerbeobachtungsflächen in ausgewählten Biotoptypen Pflanzen- und Tiergruppen erfaßt und nach Vorkommen und Indikatoreigenschaften bewertet werden (Abb. 1). Eine Pilotstudie wird zurzeit in Brandenburg und Thüringen auf landwirtschaftlichen Nutzflächen durchgeführt. Vorbild für die periodische Erfassung von Struktur- und Qualitätsmerkmalen ist die in Großbritannien 1978 und 1990 durchgeführte "Countryside Survey" (BARR et al., 1990).

2 DAS BIOMONITORING IN NATURNAHEN BUCHENWÄLDERN (THOMAS ET AL., 1995)

ist ein stärker forschungsbezogener Ansatz mit dem Bemühen um Verknüpfung des Monitorings mit anderen Aktivitäten der Umweltbeobachtung u. -forschung. In 25-35 gutachterlich ausgewählten, nicht mehr bewirtschafteten naturnahen Buchenwäldern (vorwiegend Naturwaldreservate, Abb. 3) soll festgestellt werden, wie in den Buchenwaldgesellschaften Lebens- und Entwicklungsprozesse (Wachstum, Alterung, Regeneration) ablaufen und welche Auswirkungen Schadstoffe und mögliche klimatische Änderungen auf den Wald haben. Die Buchenwald-Monitoringflächen dienen als Null-Flächen (Referenz-) für eine naturgerechte Waldbewirtschaftung und für den Naturschutz als Grundlage zur Beurteilung von "Natürlichkeit" in dem die Lebensabläufe mit ihren Populationsschwankungen des beteiligten Artenspektrums zugelassen und geschützt sind.

Insgesamt werden aus der Sicht des Naturschutzes sowohl flächendeckende als auch themenbezogene Monitoringsysteme mit regionalem Schwerpunkt benötigt. Aus bundesweiter Sicht sind flächendeckende Biomonitoringsysteme vorrangig, weil dadurch am ehesten die Veränderungen in Natur und Landschaft des Bundesgebietes aggregiert und beschrieben werden können. Eine weitestgehende frühe Abstimmung mit anderen sektoralen Monitoringverfahren muß angestrebt werden. Die Erhebungs- und Auswertungsmethoden müssen/sollten über die Ländergrenzen hinweg für bundesweite Aussagen angeglichen werden.

3 LITERATUR

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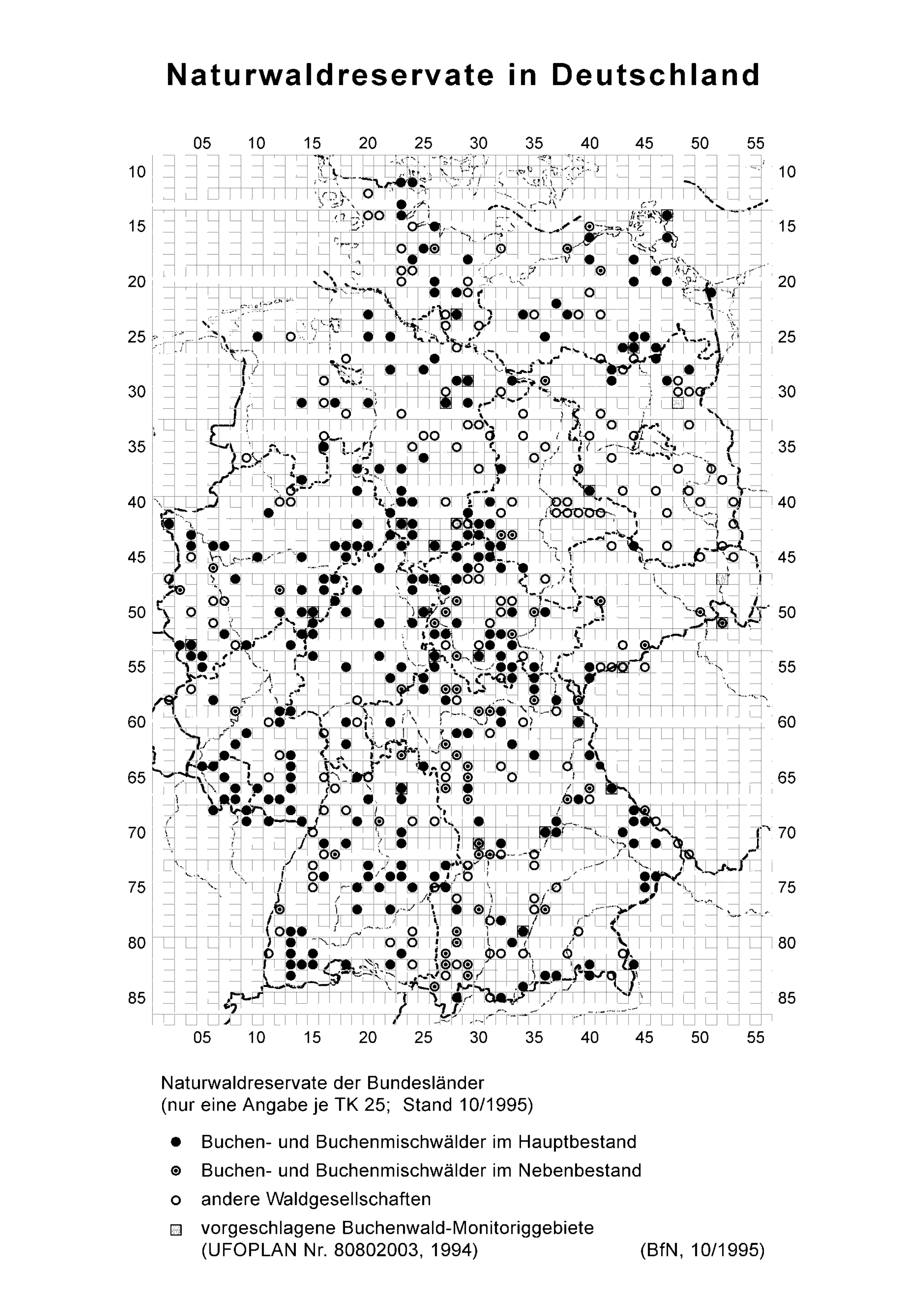

Abb. 3: Naturwaldreservate in Deutschland mit ausgewählten Buchenwald-Monitoringgebieten (nach BfN, 1995).

NATURE MONITORING IN DENMARK

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1 INTRODUCTION

This contribution will focus upon the terrestrial monitoring in Denmark, as the overall national monitoring also include separate monitoring programmes for marine communities, non-marine waters and forests. The latter programmes are run by other institutions under the Ministry of Environment and Energy or by other ministries.

When the Protection of Nature Act (Act No. 9 of 3 January 1992) came into force a provision was introduced in § 62 of the Act which committed the Minister of Environment and Energy to monitor the state of nature in Denmark. This obligation has been introduced to improve nature monitoring as a crucial basis for an effective nature policy and to ensure regular gathering and analysis of data to elucidate state and trends in nature. Besides, the current nature monitoring is used as a tool to reflect state and trends in the natural conditions of the protected and designated areas of national and international importance which Denmark due to international conventions is committed to perform.

2 GEOGRAPHY

The terrestrial area in Denmark comprises 43.000 km^2 of which the arable land constitute the major part (65 %) while the rest is shared between three other land classes of nearly the same extension (Figure 1). Regarding the 12 % natural and semi-natural areas the largest part is covered by dunes while heathland, lakes and streams, mires, meadows and salt marshes cover between a sixth and a tenth of the total area each leaving only a minor part for dry grassland (Figure 2). The total area of the natural and semi-natural nature types has decreased rapidly especially during the last 100 years because of modification into arable land. Nowadays normally small and often fragmented ‘islands’ are to some degree left unaffected in the intensively used farmland (Figure 3).

The fragmentation of the landscape reduces the possibilities of the indigenous plants and animals to settle in suitable habitats, to disperse freely, and avoid a free exchange of genetic material – a characteristic feature of the arable land which is common for most of the lowland areas in the European countries.

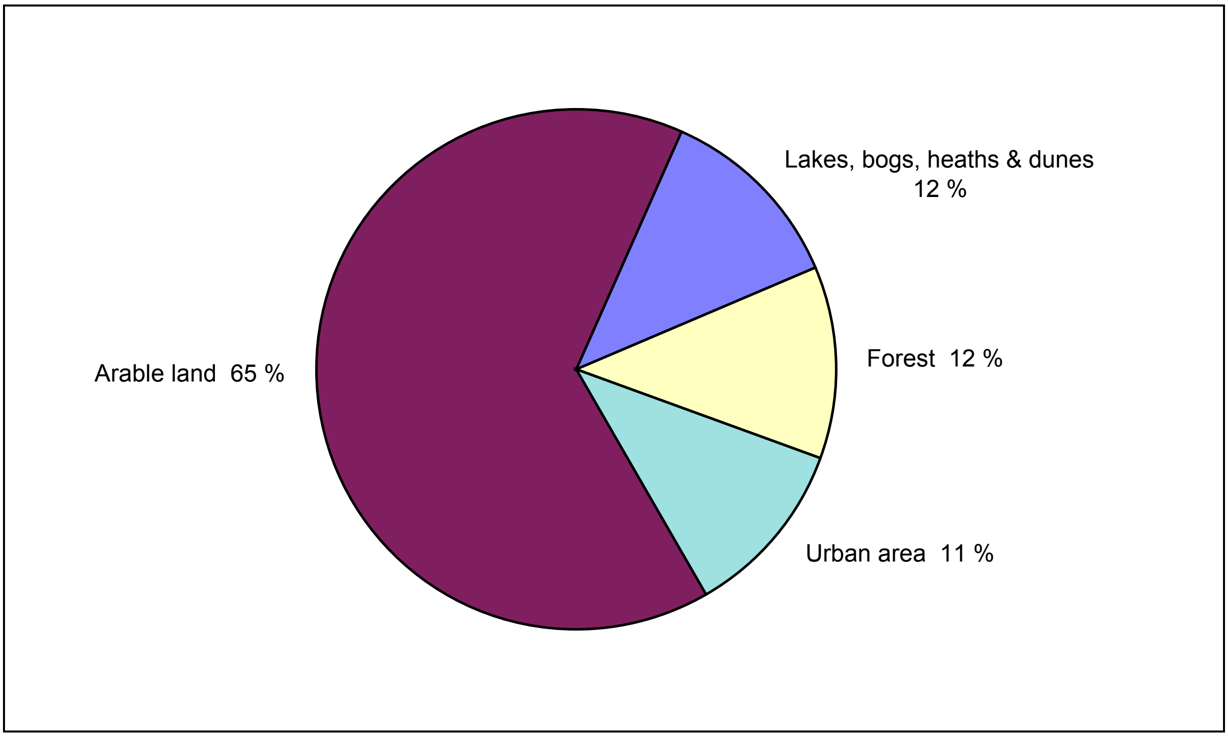

Fig. 1: Land use in Denmark.

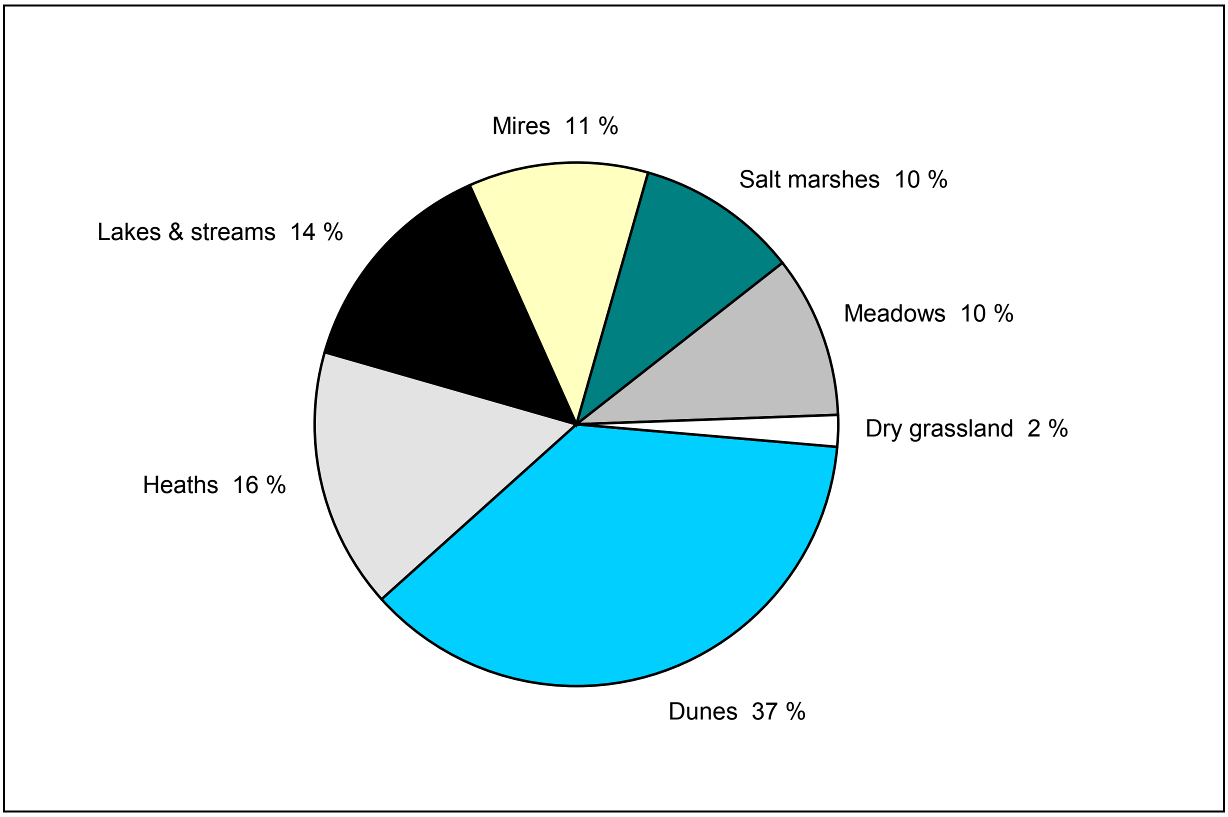

Fig. 2: Nature area in Denmark.

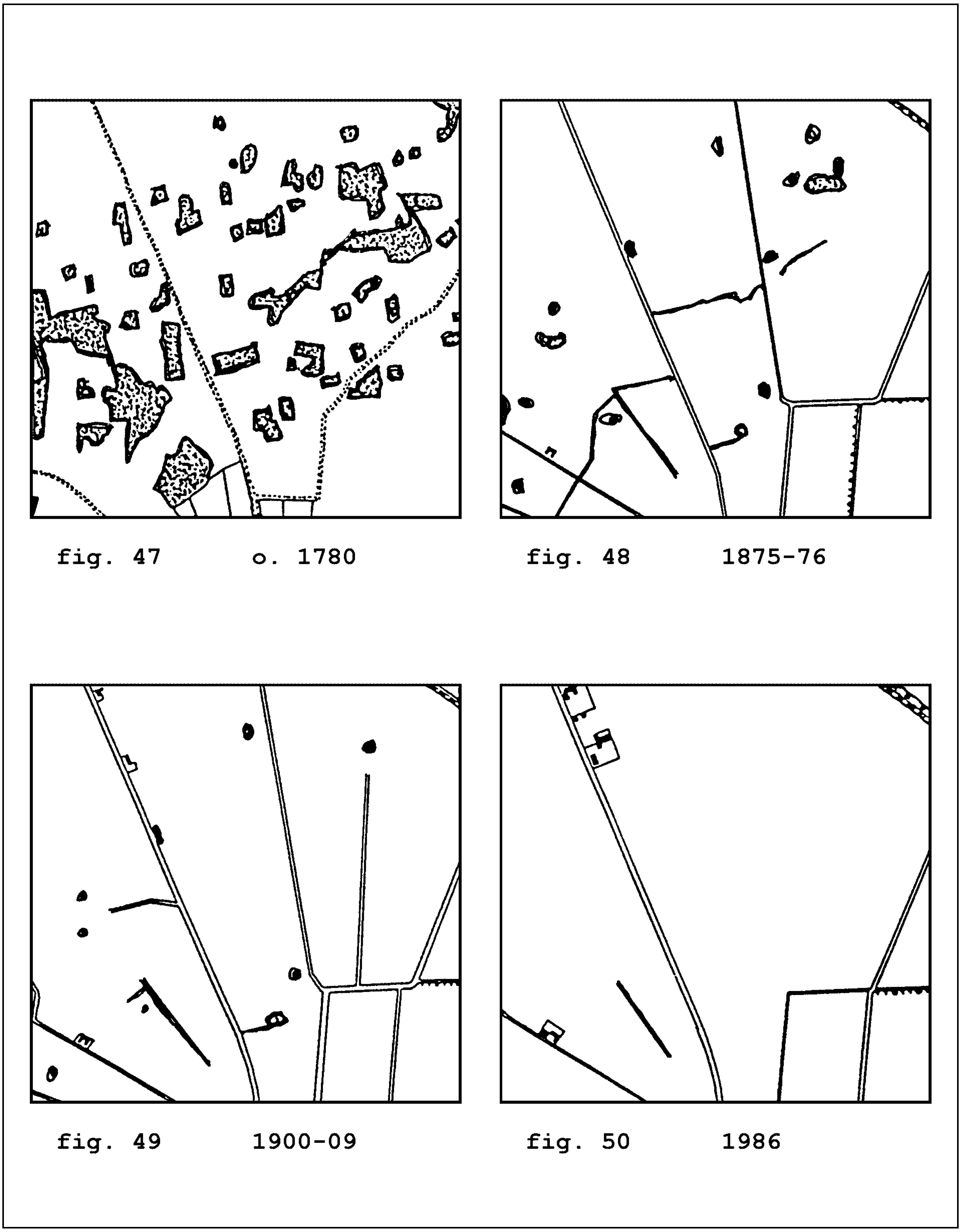

Fig. 3: Reduction during 200 years in the area of the small biotops in the arable land based on four maps sketches.

2.1 Nature monitoring programme

One of the ways for the administration to follow state and trends in the ecosystems and the natural conditions of plant and animal species is nature monitoring.

2.1.1 Organisation

The governmental nature monitoring in Denmark is practised by the nature monitoring unit at the Department of Coastal Zone Ecology under the Ministry of Environment and Energy. The staff in total amounts 13 man-year of which the core monitoring team consists of five persons – two biologists, one technician who manage the six field stations, one ½ time database administrator and one ½ time secretary. One technician is responsible for the monitoring of the Danish Wadden Sea and the adjacent dammed salt marshes on the main land. The six field stations are permanently staffed by technicians.

Most of the field work which in basic for the various activities of the monitoring programme is performed by consultants.

2.1.2 Origin of the current nature monitoring programme

In October 1986 the Forest and Nature Agency held a symposium on nature monitoring. The participants representing official bodies, universities, natural history museums, and NGOs presented their specific subjects, discussed the applied methods and the co-ordination of a future programme on nature monitoring in Denmark.

Based on the discussions and the conclusions of the symposium the Forest and Nature Agency formed a nature monitoring programme which came into force the preceding year. Besides, experience on nature monitoring methodology was gathered and proven, and applicable sites for monitoring were considered and designated.

2.1.3 The 1995 programme

The subjects of the Danish nature monitoring programme comprise habitats, plant and animal species, and designated nature areas in accordance with the international conventions which Denmark has ratified.

An overview of the activities accomplished in 1995, the frequency of performance, the year of onset of the activity and the applied methods is listed in table 1 to present the diversity of the Danish nature monitoring programme. Some of the preliminary results is in brief discussed below.

1. The six field stations are mainly responsible for counts of breeding and migratory birds, especially waders, ducks, geese and gulls on which valuable data has been collected since the end of the 70'ies. As an example, the Avocet (*Recurvirostra avocetta*) has been monitored since 1978. In spite of fluctuations between the years it is obvious that the population has stabilised (Figure 4).
2. The raised bogs has been monitored for the first time in 1987-89 using various methods for analysis (Table 1). for instance, the vegetation composition has been analysed for every half meter in 0,1 m^2 plots (Raunkiær-circles) along a 100 m transect and the relative height of the bog surface has been estimated to appoint the distribution between the hummocks and the hollows (figure 5). The analysis on the same sites has been repeated in 1995 for half of the bogs and is planed repeated on the rest in 1996.

3. The monitoring programme on dry grass land was initiated in 1995. The vegetation was analysed on nine sites containing six plots throughout the country. On each plot ten Raunkiær circles maid after a strict pattern (Figure 6). The analysis is planned to be repeated in 1996 in order to settle a baseline for the vegetation composition.
4. Approx. 135 populations of orchids are monitored regularly. The programme started in 1987 with 42 populations which have been monitored regularly since. The number of monitored populations has increased since which has resulted that nearly every species in Denmark are being monitored and that a number of sites countrywide of the more common orchid species are being monitored.
   The total number of flowering ramets of the Pyramidal Orchid (*Anacamptis pyramidalis*) has increased during the monitoring period (Figure 7). The increment in the number of orchids in the population is caused by a successful management plan worked out by the state forest authorities. The plan comprises subdivision of the site by fencing, regulated grazing, mowing and cutting of scrubs and trees.
5. The monitoring of the Common Seal (*Phoca vitulina*) in the Wadden Sea which is one the Danish contributions to the trilateral co-operation between Denmark, Germany and Holland has shown that the total number of animals in the population has increased during the monitoring period. Besides, it has been verified that the population has been able to recover after the virus disease in 1988 (Figure 8).
6. Counts of breeding birds has been performed on ten sites in 1995 as a part of the 'Joint Monitoring Programme for Breeding Birds in the Wadden Sea' (Figure 9). The aim of the monitoring programme is to follow the fluctuations in the breeding waterfowl in the entire Wadden Sea for a number of years.
7. In the beginning of the 80'ies the Cormorant *(Phalacrocorax carbo sinensis)* was totally protected by law. Ever since the total number of both breeding couples and colonies has increased until the middle of the 90'ies where the increment seems to have reached a maximum (Figure 10 & 11). In 1995 the Minister of Environment and Energy allowed minor regulations of the population, i. e. shooting of single birds at fishing tools and destruction of new established colonies.
8. In April and May 1995 egg masses of the Common Frog (*Rana arvalis*), the Moor Frog (*R. temporaria*) and the Agile Frog (*R. dalmatina*) have been counted for the first time in ponds in 32 selected quadrates of 2 x 2 km in the arable land (Figure 12). The Common Frog and the Moor Frog are evenly distributed all over the country while the Agile Frog was only found in three quadrates.
9. In order to follow the oscillations of the populations point counts of the common bird species in forests, meadows and towns has been performed since 1976. For instance, during the monitoring period the decline of the Lapwing (*Vanellus vanellus*) has been constant. The regression can not be related to climatic conditions, e. g. the strength of the winter period (Figure 13). The decline is merely a result of the ongoing intensification of farming.
10. The bottom vegetation of vascular plants has been monitored in 8 different years during the last 10 years on shallow water in Ringkøbing Fjord. The results have shown great oscillations in biomass and species distribution (Figure 14) of the vegetation, but hitherto, non fluctuations can not be related to improvements of the state eutrification.

Besides, the Danish Red Data Book has been revised in 1995. the revision has been done in co-operation with the NGOs. The first edition was issued in 1991. It is planned to revise the Red Data Book every fifth year.

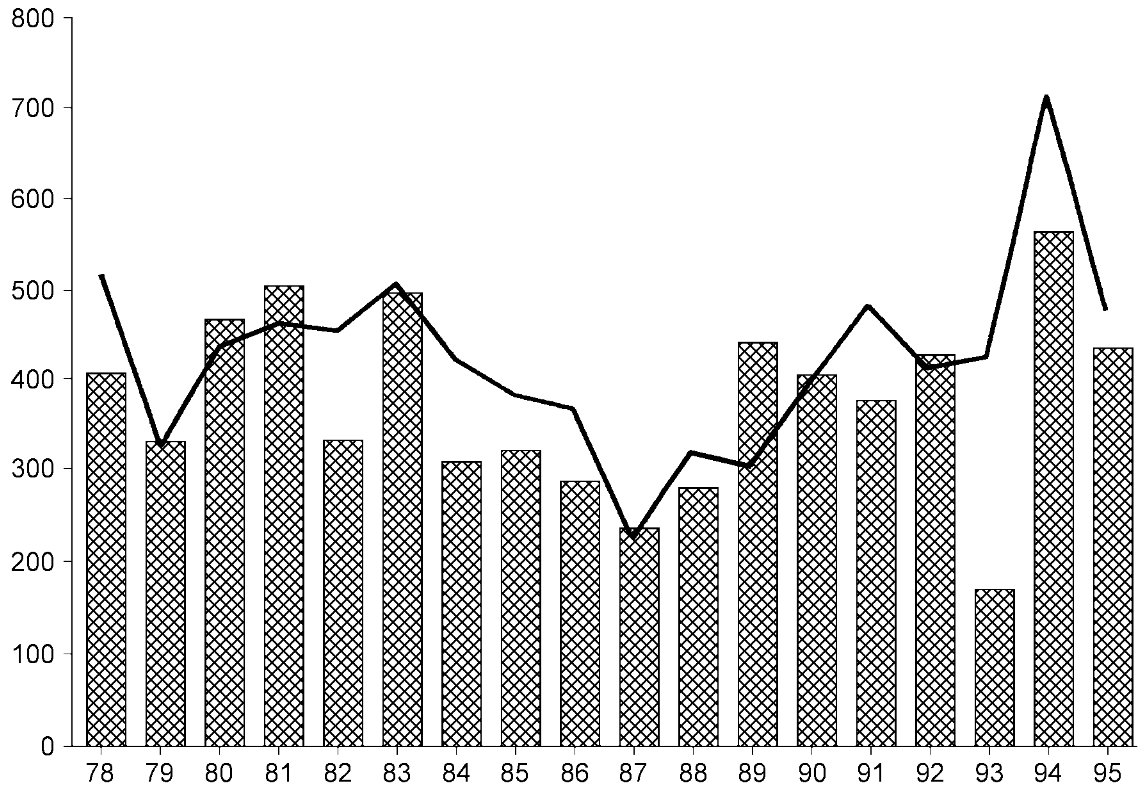

Fig. 4: Recurvirostra avocetta. Population estimation and maximum counts 1978-95.
Columns = number of couples,
solid line = maximum counts at the beginning of the breeding season.

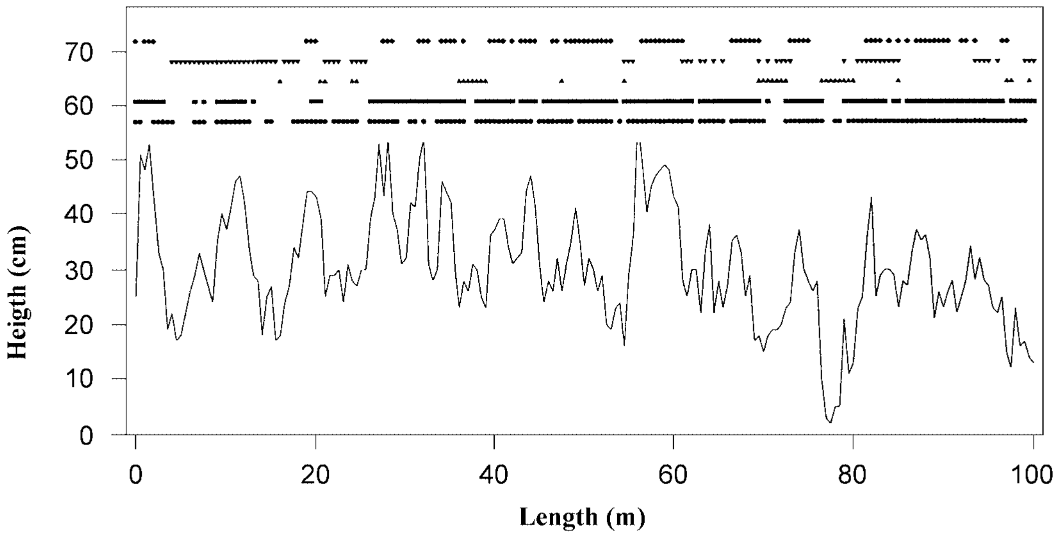

Fig. 5: Outline of the surface in a raised bog along a 100 m line where vegetation analysis has been performed. The distribution of five selected species is shown:
◆ Hypnum cupressiforme, ♊ Sphagnum magellanicum, ♉ Sphagnum cuspidatum,
■ Empetrum nigrum and ✐ Calluna vulgaris.

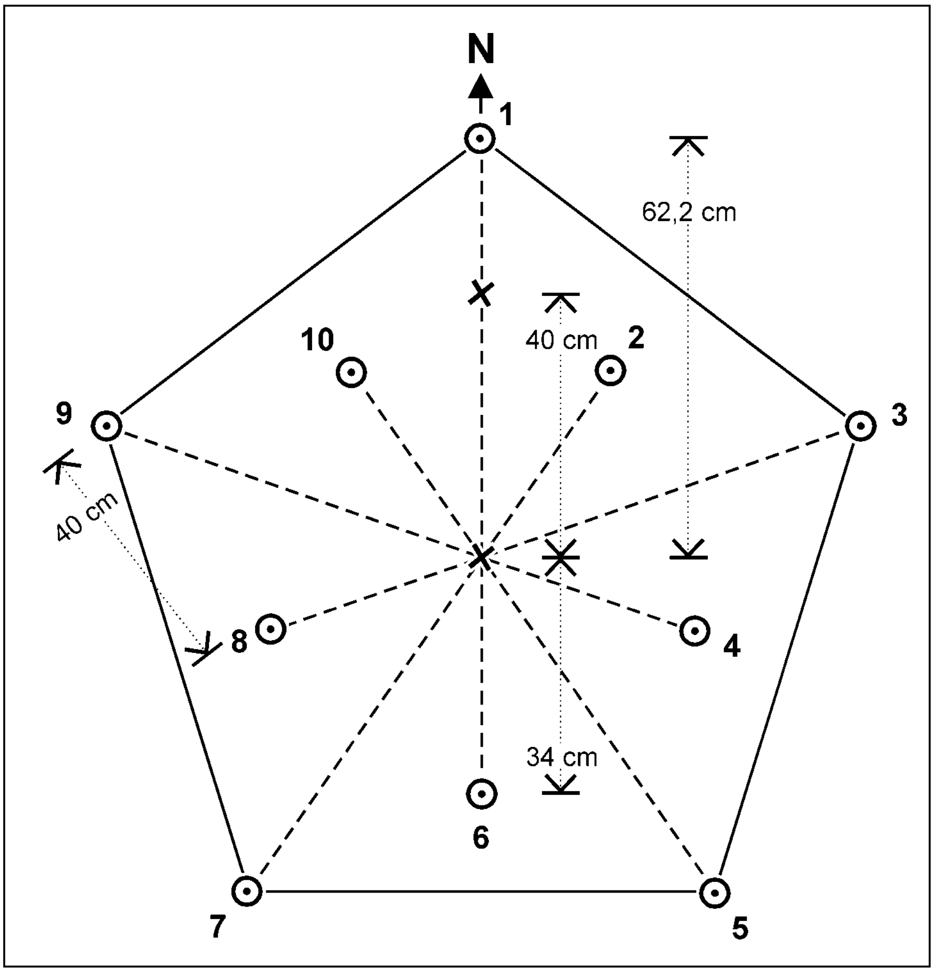

Fig. 6:
Plots with centres for the Raunkiær-circles (no. 1-10) covering of 0,1 m^2 each for vegetation analysis on dry grassland.

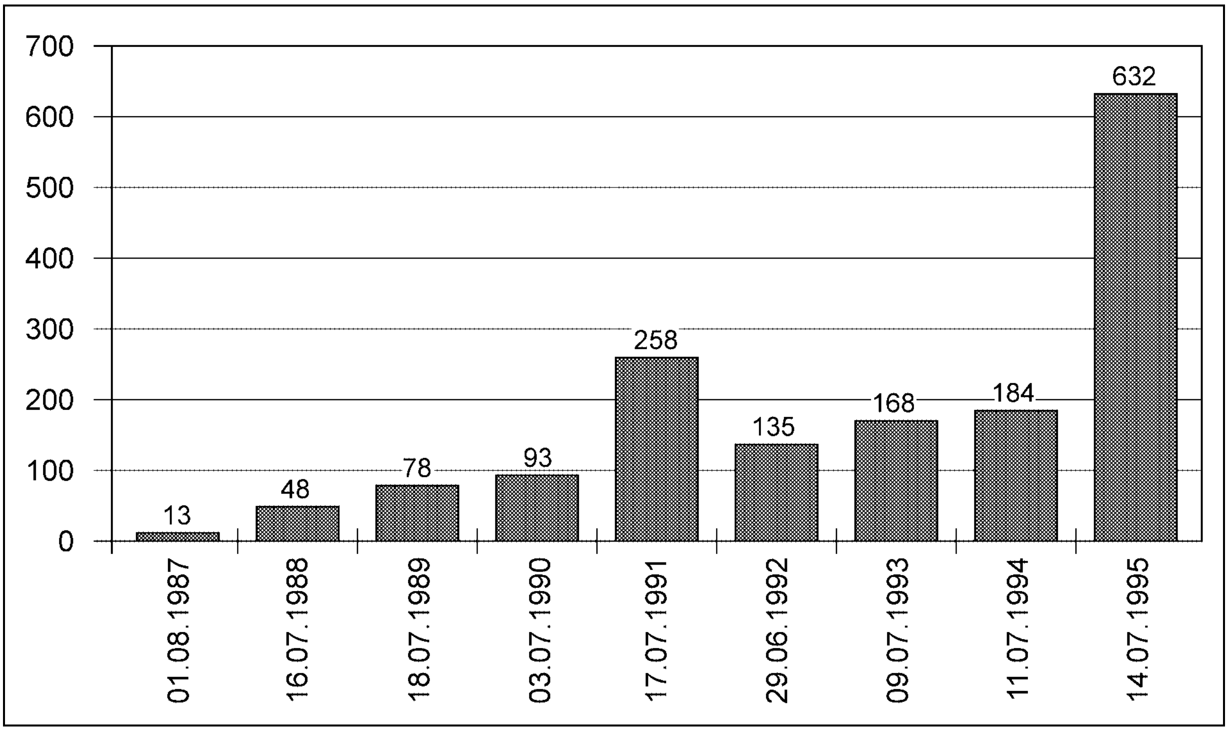

Fig. 7: Anacamptis pyramidalis. Counts of flowering ramets 1987-95.

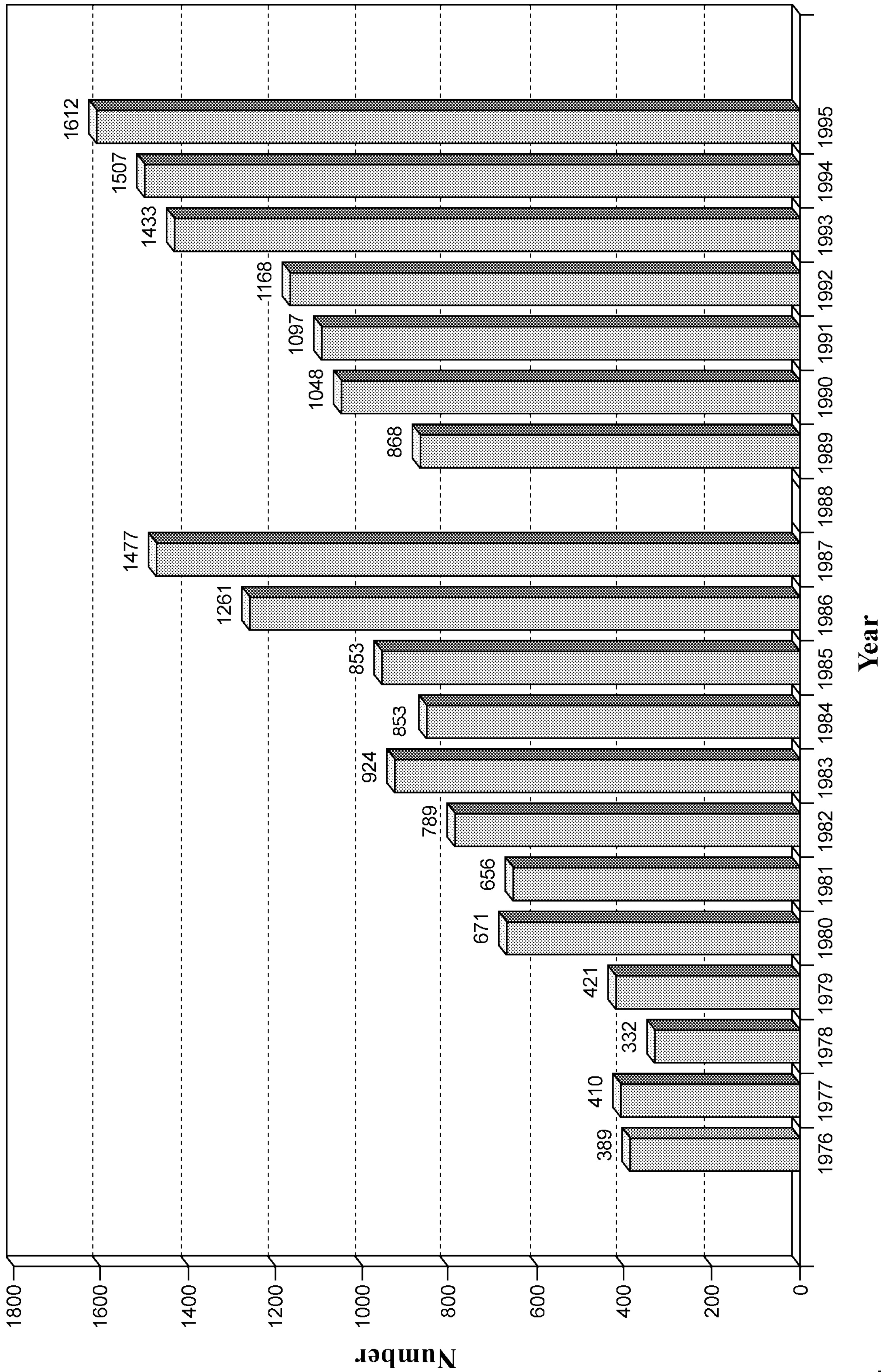

Fig. 8: Aeroplane survey of Phoca vitulina *in the Danish Wadden Sea 1976-1995.*

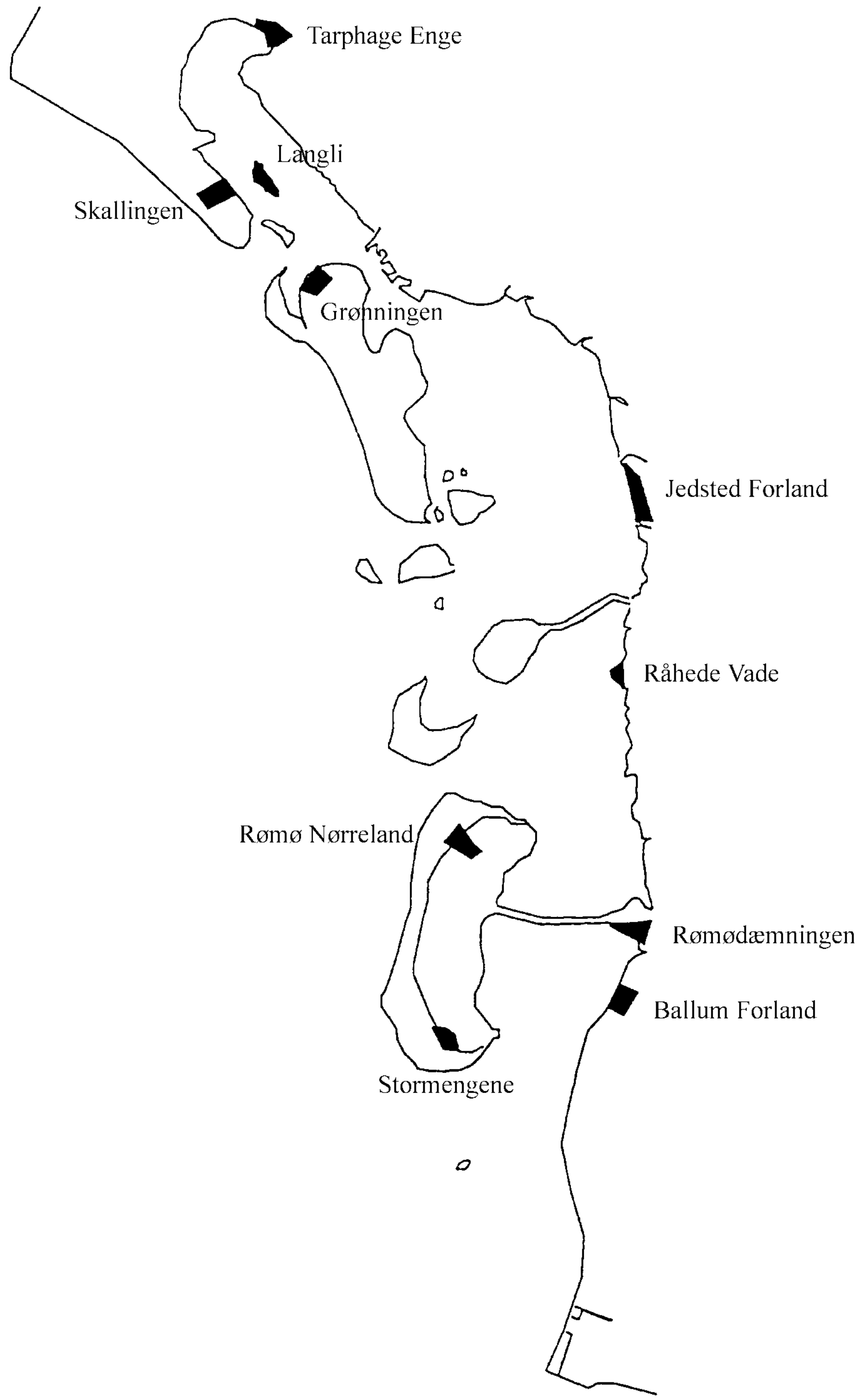

Fig. 9: The location of 10 sites for breeding birds in the Danish Wadden Sea.

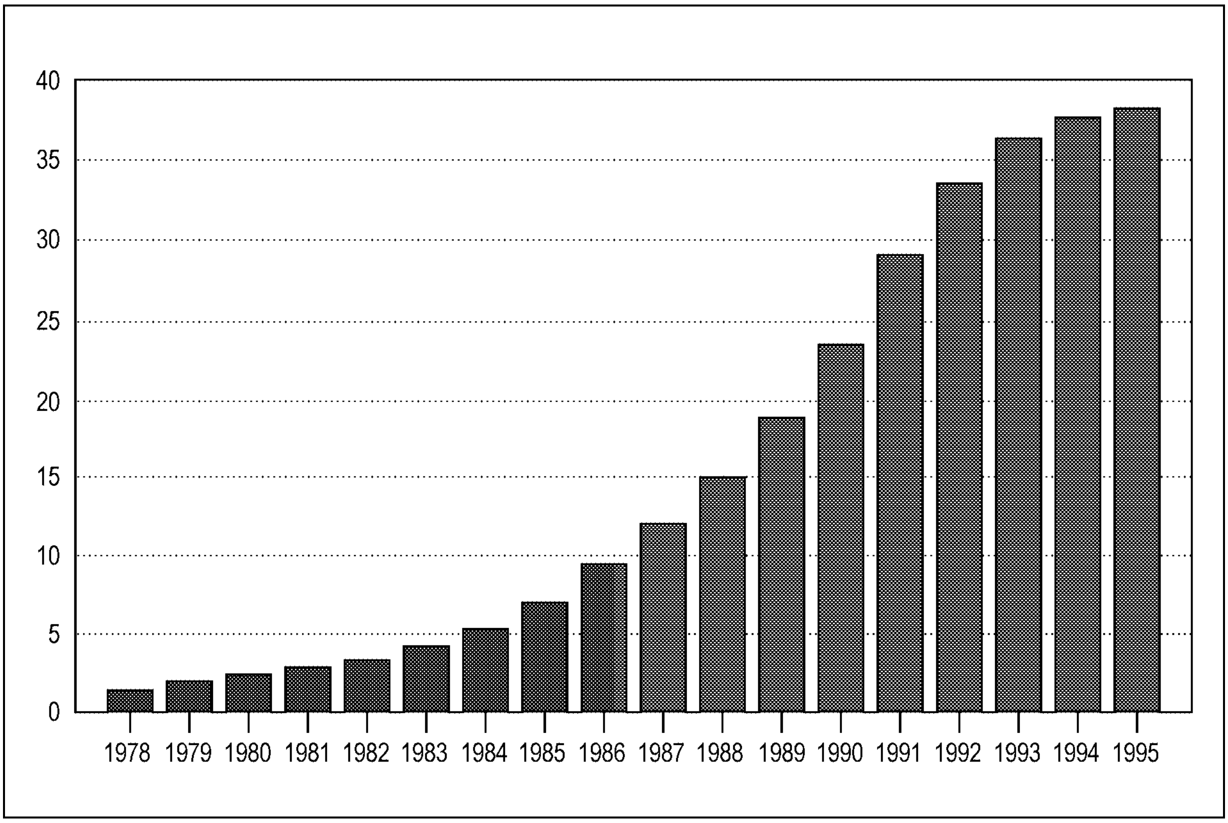

Fig. 10: Phalacrororax carbo sinensis. Number of breeding couples (1000) in Denmark 1978-1995.

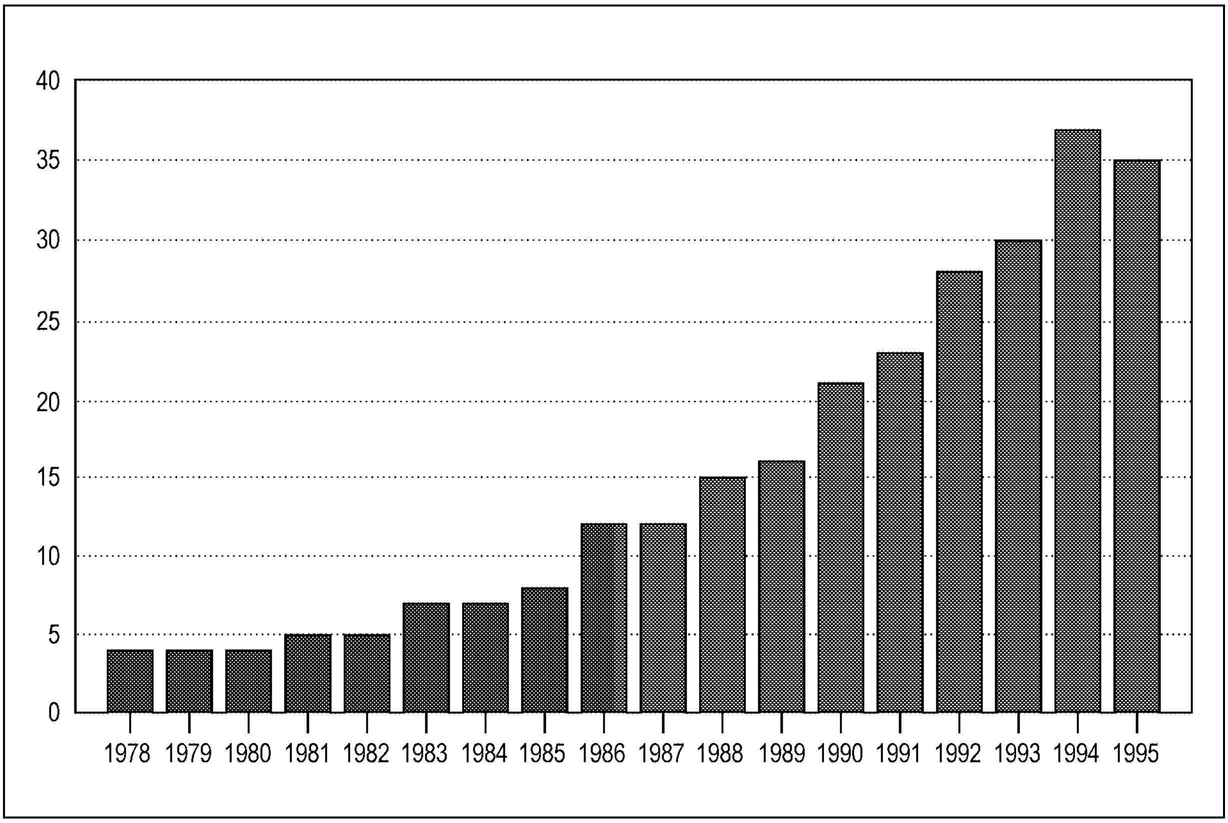

Fig. 11: Phalacrororax carbo sinensis. Number of colonies in Denmark 1978-1995.

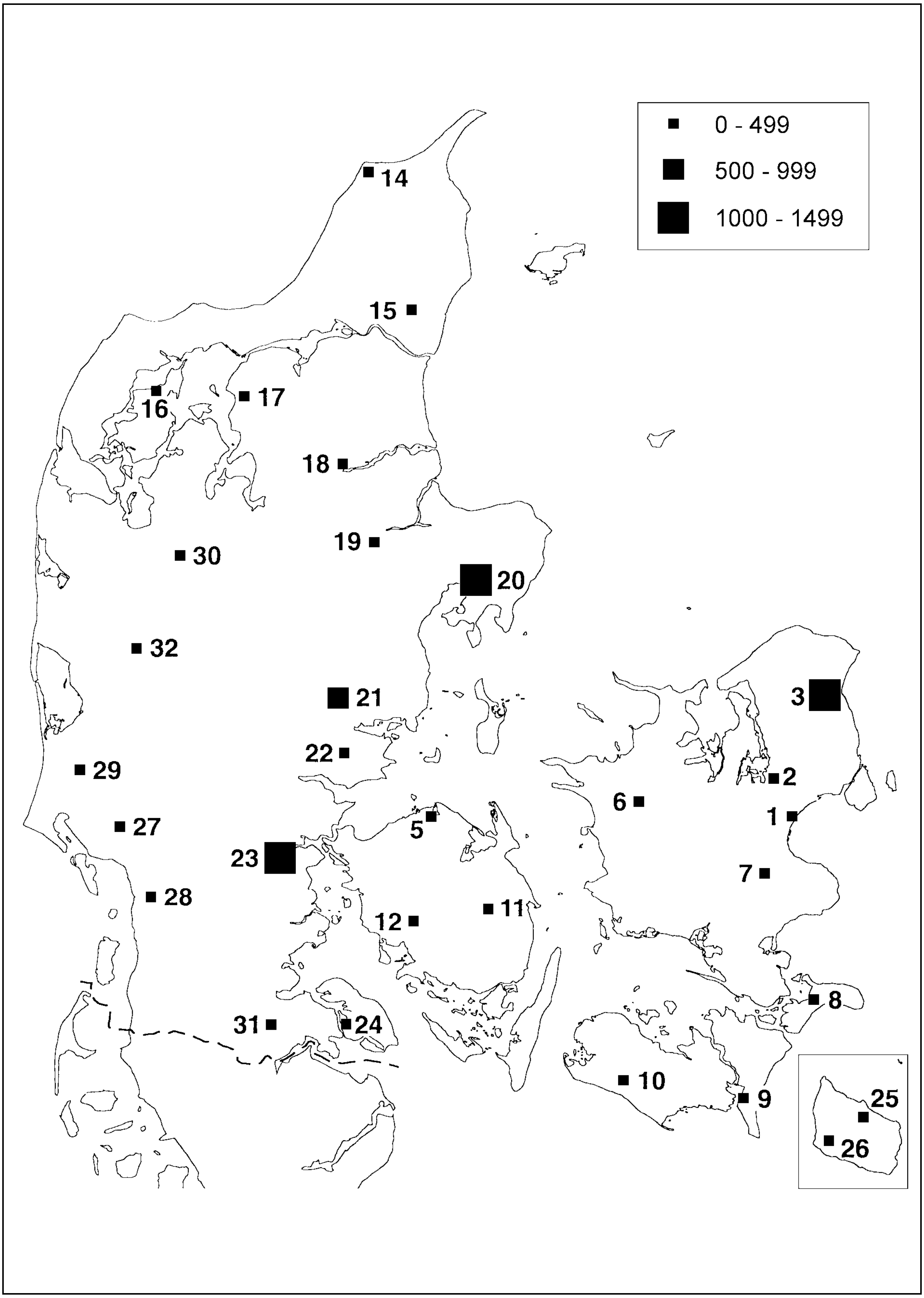
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Fig. 12: The number of registered ægg masses of Rana arvalis, R. temporaria and R. dalmatina in 32 2 km x 2 km quadrants in 1995. The indicated numbers are the total counts of all three species.

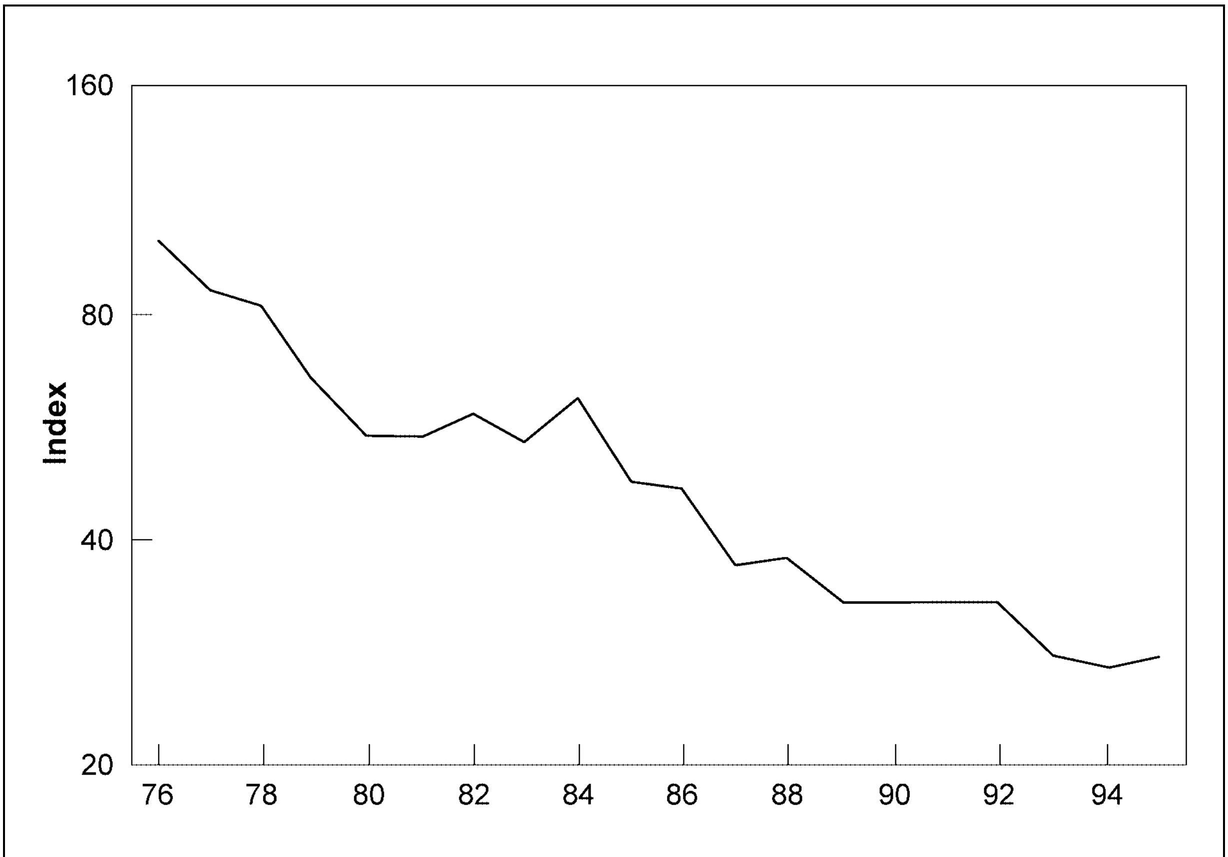

Fig. 13: The index for Vanellus vanellus 1976-95.

2.1.4 The costs

The costs in 1995 were:

Salary costs for the core team
and the six manned field stations .... 2,8 mill DKK
Consumable.. 1,3 mill DKK
Consultancy.. 1,0 mill DKK
Total.. 5,1 mill DKK.

2.1.5 The difficulties and problems

The monitoring of the nature in Denmark is insufficient to a high degree mainly due to the following reasons:

1. The economical resources are low.
2. Monitoring of some objects is scant or even missing like that of the flora and fauna in the agricultural and forestry land and that of endangered species.
3. The establishment of linkages between data collection from different sectors is inadequate.

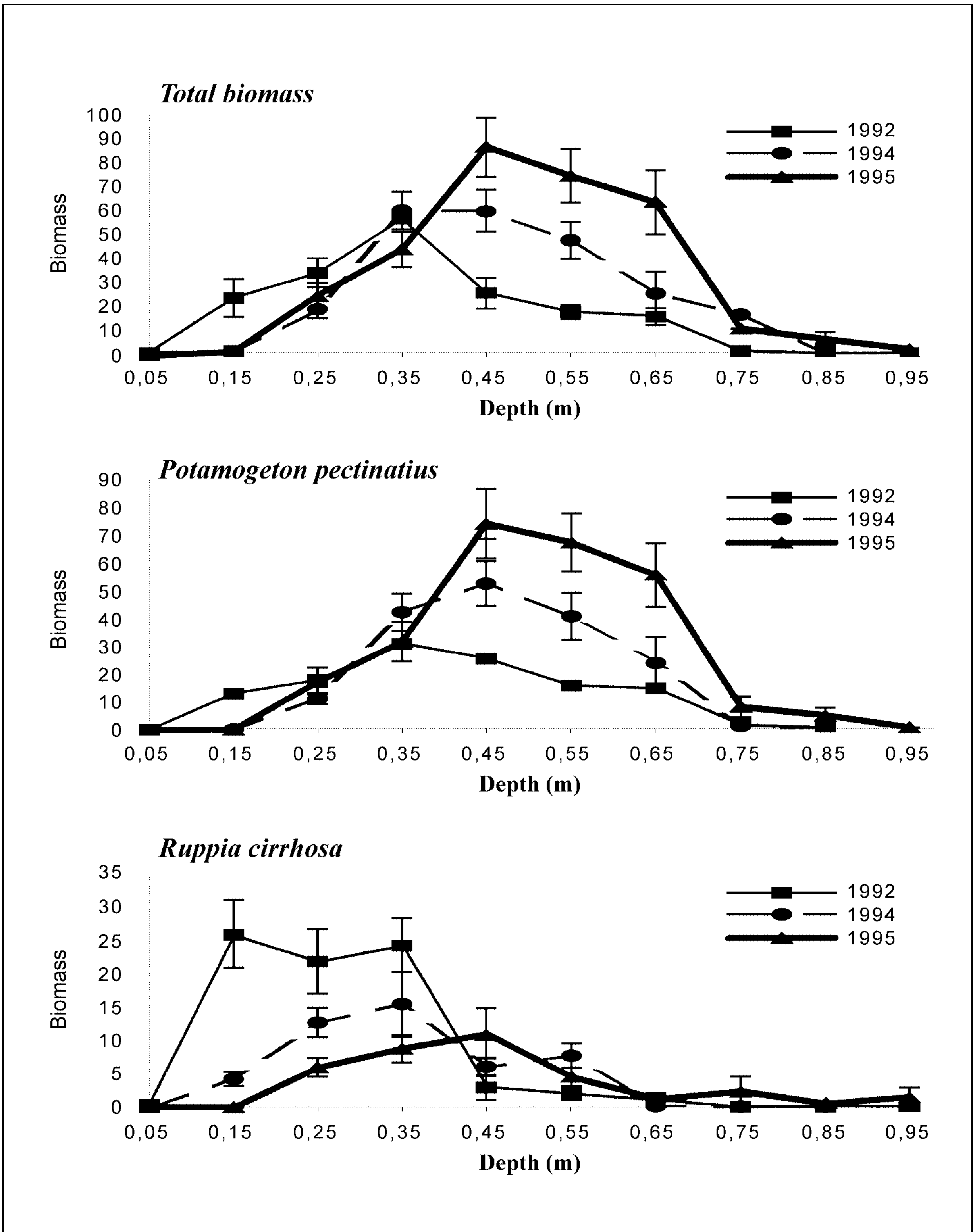

Fig. 14: The distribution of the vegetation on shallow water in Ringkøbing Fjord in 1992, 1994 and 1995 expressed as biomass (g dry weight/m^2).

2.2 The future

The present programme was originally planned to last until the end of 1996 but due to co-ordination with the ongoing programmes for monitoring fresh and marine waters and to the amount of the governmental grants, the existing nature monitoring programme will continue in 1997 and in 1998. A revised and improved nature monitoring programme with a high degree of integration with monitoring programmes from other sectors is planned to start in 1999, albeit, some activities might commence in 1998, already.

2.3 Recommendations

1. Design a nature monitoring programme which can be fulfilled easily.
2. Develop and use methods which are easy to use and to reproduce.
3. Select monitoring objects which can yield results that are easy to understand for the public and for the politicians.

Tab. 1: Activities in 1995 included in the Danish nature monitoring programme.

Activity	Frequency	Year of onset	Methodology
Reports from field stations	Annually	1987	Point counts
Raised bogs	Approx every 7 year	1987	Point analysis Transect analysis Vegetation description Photo registration Collection of samples of water and Sphagnum
Dry grass land	Annually during 3 yrs	1995	Vegetation analysis by circling
Orchids	Annually	1987	Count of flowering and vegetative ramets
Seals	Annually	1976	Aeroplane survey Photo registration
Breeding and migrating birds	Annually	1978	Counts of numbers of birds
Cormorant	Annually	1978	Counts of nests
Amphibians	First year	1995	Counts of egg masses
Breeding birds	Annually	1976	Point counts
Shallow water vegetation	1-3 yrs	1978	Vegetation analysis

VEGETATION MONITORING: CONCEPTS AND EXAMPLES OF THE PRACTICAL WORK OF NATURE CONSERVATION IN LOWER SAXONY, A STATE OF THE FEDERAL REPUBLIC OF GERMANY

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1 ABSTRACT

A monitoring concept for nature conservation in Lower Saxony (Germany) is prepared by the State Authority for Ecological Affairs of Lower Saxony. Investigations are planned on the level of habitat types, plant communities, flora and fauna. This paper only deals with plant communities and flora. The aim of our monitoring is to provide us with information on the status and trend in nature and landscape based on our questions of nature protection and conservation. We focus on nature reserves and in a first step on grasslands.

On the level of vegetation the investigation of permanent plots and repeated mapping, using floristically defined units, is planned in a selection of nature reserves. The investigation methods are defined: the permanent plots in grasslands should be representative for the type of vegetation which is investigated (regular placement). The size of the plots should be 25 square meters. For estimation of plant covering we use a modified LONDO-scale (Table 1). Every two years a repetition plot should be done. The results will we directly comparable. Good marking of the plots is very important. We use permanent magnets, which are put into the soil thus marking the four edges of each plot. They can be found using a magnetic locator. Additionally the exact location of the plots has to be mapped measuring the distance to different points (e. g. old trees, ditches, buildings). The repeated vegetation mapping should be done every ten years in selected nature reserves only. There are many former vegetation maps of parts of Lower Saxony, which are an important basis for comparison with the status quo.

Nowadays monitoring for nature conservation purposes initiated by governmental authorities uses the investigation methods defined by the new concept. Former permanent plots were installed dealing with different projects and using different methods. The department of nature protection of the above mentioned authority 380 permanent plots investigated up to now (Table 2). The results show the changes of indicator species within plant communities for special sampling areas. Recent management plans for nature protection benefit of this, as there are investigations on the effectivity of regeneration of peat-bogs or on grassland management. A program for installing and investigating a system of permanent plots in Lower Saxony does not exist yet. There is only a concept.

Monitoring in Lower Saxony does not focus only on permanent plots or on vegetation mapping. The level of plant species and of populations is also of importance to us. In nature reserves the occurrence of all species of vascular plants should be recorded every ten years. The group of endangered vascular plants has to be mapped even more detailed. The location and the population size of every population should be recorded in intervals of five years. Cryptogamic plants should be taken into consideration in some special nature reserves. Methods and collection of the data and the interpretation of the results are defined by the Lower Saxony plant species field survey program of the State Authority for Ecological Affairs of Lower Saxony. In this program plant species are recorded at the whole area of Lower Saxony, not only in nature reserves.

1.1 Zusammenfassung

Für das Bundesland Niedersachsen erarbeitet derzeit das Niedersächsische Landesamt für Ökologie (NLÖ) ein Monitoringkonzept für den Naturschutz, das Erfassungen auf den Ebenen des Biotoptyps, der Vegetation der Fauna und Flora vorsieht. Die Ausführungen in dem Beitrag beziehen sich ausschließlich auf die Ebenen der Vegetation und der Flora. Ziel ist es, anhand von Daueruntersuchungen, Aussagen über den Zustand von Natur und Landschaft und deren Änderungen treffen zu können, die an Fragestellungen und Zielen des Naturschutzes orientiert sind. Der räumliche Schwerpunkt liegt in den Naturschutzgebieten und aus pragmatischen Gründen hier zunächst im Bereich des Grünlandes. In bezug auf die Vegetation sind die Anlage von vegetationskundlichen Dauerflächen sowie Vegetationskartierungen in ausgewählten Teilräumen vorgesehen. Hierzu werden Vorgaben zur Auswahl und zur Methode der Markierung sowie der Aufnahme entwickelt, die eine zusammenfassende Auswertung auf Länderebene ermöglichen.

Während bei der Neuanlage von Dauerflächen durch Naturschutzbehörden die methodischen Vorgaben bereits Berücksichtigung findet, wurden die vorher bestehenden Dauerflächen im Rahmen sehr unterschiedlicher Projekte mit differierenden methodischen Ansätzen untersucht. Dennoch lassen sich bereits aus diesen gebietsbezogen für die Naturschutzpraxis Aussagen über die Entwicklung der Bestände ableiten, und es erfolgt eine Rückkopplung mit Naturschutzplanungen.

Zusätzlich zu den vegetationskundlichen Untersuchungen sollen nach dem niedersächsischen Konzept die Wuchsorte und Populationsgrößen gefährdeter Arten sowie qualitativ der Bestand an Pflanzenarten bestimmter Teilräume in regelmäßigen Zeitabständen erfaßt werden. Die Methode, Datensammlung und -auswertung sind durch das NLÖ im Rahmen den Durchführung des Niedersächsischen Pflanzenarten-Erfassungsprogramms bei dem die gesamte Landesfläche erfaßt wird, bereits konzipiert und vorgegeben.

1.2 Einleitung

Niedersachsen ist ein deutsches Bundesland mit ca. 51.000 km² Fläche. Es erstreckt sich vom Nordwestrand der deutschen Mittelgebirge durch die nordwestdeutsche Tiefebene bis zur Nordseeküste mit den Ostfriesischen Inseln.

Das Niedersächsische Landesamt für Ökologie (NLÖ) ist eine Behörde des Landes Niedersachsen, zu dessen Aufgabenbereich die Sammlung, Aufbereitung und Bewertung von Umweltdaten gehört. Auf deren Basis berät das NLÖ andere Behörden und verschiedene Institutionen in Fragen des Natur- und Umweltschutzes und entwickelt Fachkonzepte für angewandte Fragestellungen aus diesem Bereich. Die Abteilung Naturschutz des NLÖ konzentriert sich hierbei vorrangig auf Arten und Biotope.

Die Erfassung des Landschaftszustandes und von den Elementen der Landschaft wird in unterschiedlicher Form seit sehr langer Zeit betrieben. In bezug auf den botanischen Anteil sind hier neben floristischen Bestandsaufnahmen vor allem Vegetationskartierungen zu nennen.

Ein Monitoring im umfassenderen Sinne wird in Niedersachsen bisher nicht durchgeführt. Derzeit erarbeitet das NLÖ (Fachbehörde für Naturschutz) erstmalig ein Monitoringkonzept für Naturschutz bezogen auf Niedersachsen. Zunächst möchte ich kurz die Definition vorstellen, die Basis für dieses Konzept ist.

Monitoring für Naturschutz bedeutet:
Kontinuierliche und systematische Messungen und Beobachtungen an Elementen der Biozönose und des Biotops in Raum-Zeitserien, die geeignet sind, an den Zielen von Naturschutz und Landschaftspflege orientierte Aussagen über den Zustand von Natur und Landschaft und deren Änderungen zu treffen.

Wichtig ist uns hierbei die Zielorientiertheit des Monitoring. Es muß geeignet sein, um Fragen nach der Bestandesgröße und deren Veränderung von Arten oder Pflanzengesellschaften oder des Effektes von bestimmten Maßnahmen beantworten zu können.

Der Schwerpunkt des Konzeptes liegt in bezug auf die verschiedenen Biotope zunächst bei den Grünlandgebieten in Naturschutzgebieten (NSG).

Im folgenden werden zunächst die floristisch-vegetationskundlichen Inhalte dieses Konzeptes dargestellt und anschließend dem aktuellen Stand des vegetationskundlichen Monitoring in Niedersachsen gegenübergestellt. Die Diskrepanz zwischen Anspruch und Realität wird aufgezeigt.

1.3 Anforderungen an ein landesweites Naturschutzmonitoring

Naturschutzmonitoring wird in Niedersachsen bereits seit längerem betrieben. Zu nennen sind an dieser Stelle z. B. das Pflanzenarten-Erfassungsprogramm der Fachbehörde für Naturschutz (HAEUPLER & GARVE, 1983), laufende Untersuchungen der Naturschutzstationen sowie Erhebungen im Zusammenhang mit der Erstellung von Pflege- und Entwicklungsplänen für Naturschutzgebiete. Besonders lange Tradition haben vegetationskundliche Kartierungen zur Dokumentation des Zustandes und der Veränderung von einzelnen Gebieten (TÜXEN & HENTSCHEL, 1955; s. a. GANZERT & PFADENHAUER, 1988).

Aus Gründen der Vergleichbarkeit ist anzustreben, das Monitoring in Zukunft nach landesweit einheitlichen Vorgaben durchzuführen. Viele Untersuchungsergebnisse lassen sich umfassender im überregionalen Bezug interpretieren. Das nun zu initiierende landesweite Naturschutzmonitoringprogramm soll die derzeit durchgeführten Untersuchungen nicht ersetzen. Ziel ist vielmehr, durch Ergänzung und Systematisierung der Untersuchungen und Zusammenführung der Ergebnisse bei optimalem Einsatz der finanziellen Mittel eine größtmögliche Effektivität der Naturschutzarbeit zu erreichen.

Die Programmbestandteile werden in **drei Erfassungsebenen** (**Grund-**, **Aufbau-** und **Zusatzprogramm**) aufgeteilt. Diese sollen im Bezugsraum wie folgt angewandt werden:

- Die Absolvierung des **Grundprogramms** (1. Ebene) ist in *allen* als Naturschutzgebiet oder Nationalpark ausgewiesenen Grünlandgebieten unverzichtbar.
- Die Durchführung des **Aufbauprogramms** (2. Ebene) soll in *zahlreichen* ausgewählten Grünlandgebieten, die als Naturschutzgebiet oder Nationalpark ausgewiesen sind, vorgenommen werden.
- Die Berücksichtigung von Bestandteilen des **Zusatzprogramms** (3. Ebene) wird nur in *einzelnen* als Naturschutzgebiet oder Nationalpark ausgewiesenen Grünlandgebieten erforderlich sein.

Mit Stand Ende 1995 gab es in Niedersachsen 672 Naturschutzgebieten und 2 Nationalparke, die zusammen etwa 3.800 km² (7,5 % der Landesfläche) ausmachen. Etwa in einem Drittel dieser Gebiete sind wertvolle Grünlandflächen vorhanden, die nach grober Schätzung etwa 300 km² bedecken.

Im folgenden wird eine Übersicht über das angestrebte botanische Untersuchungsprogramm wiedergegeben. Nicht eingehen werde ich auf die geplante flächendeckende Biotoptypenkartierung, auch wenn diese in Niedersachsen stark vegetationskundlich ausgerichtet ist. Ich konzentriere mich auf die vegetationskundliche Daueruntersuchung, möchte den Anteil des von uns vorgesehenen floristischen Monitorings jedoch ebenfalls kurz ansprechen, das für unsere Arbeit einen hohen Stellenwert einnimmt. Hierfür liegen im Rahmen des niedersächsischen Pflanzenarten-Erfassungsprogrammes standardisierte Erfassungsbögen vor (vgl. HAEUPLER & GARVE, 1983, die Erfassungsbögen wurden zwischenzeitlich überarbeitet).

1.4 Monitoring Flora

Methodische Grundlage für die Kartierung der verschiedenen taxonomischen Gruppen ist das Pflanzenarten-Erfassungsprogramm der Fachbehörde für Naturschutz.

1.4.1 Farn- und Blütenpflanzen *(Grundprogramm)*

1.4.1.1 Wuchsortkartierung der gefährdeten Gefäßpflanzenarten

Wuchsortkartierung der in Niedersachsen gefährdeten Arten (GARVE, 1993) im Maßstab 1 : 10.000, besser (insbesondere in reich strukturierten Gebieten) im Maßstab 1 : 5.000 mit Angabe der Populationsgrößen in einer achtteiligen Skala (vgl. GARVE, 1994).

Erfassungsrhythmus: Erstinventarisierung, fortlaufende Ergänzung und Wiederholungsuntersuchung in 5jährigem Turnus.

1.4.1.2 Erfassung des Artenbestandes an Gefäßpflanzen

Erstellung einer möglichst vollständigen Artenliste der Gefäßpflanzen des Untersuchungsgebietes getrennt nach Quadranten der topographischen Karten 1 : 25.000 in Verbindung mit der Wuchsortkartierung der gefährdeten Arten.

Erfassungsrhythmus: Erstinventarisierung, fortlaufende Ergänzung und Wiederholungsuntersuchung in 10jährigem Turnus.

Kryptogamen (Armleuchteralgen, Moose, Flechten, Großpilze) ***(Zusatzprogramm)****.*

1.4.1.3 Wuchsortkartierung der gefährdeten Großpilz-, Flechten-, Moos- und Armleuchteralgenarten

Wuchsortkartierung der in Niedersachsen gefährdeten Arten (VAHLE, 1990; KOPERSKI, 1991; HAUCK, 1992; WÖLDECKE, 1995) mindestens im Maßstab 1 : 10.000 mit Angaben zur Populationsgröße.

1.4.1.4 Erfassung des Artenbestandes an Großpilzen, Flechten und Moosen

Erstellung einer möglichst vollständigen Artenliste der genannten Gruppen des jeweiligen Untersuchungsgebietes für jede Kryptogamengruppe getrennt nach Meßtischblatt-Quadranten

Erfassungsrhythmus: Erstinventarisierung, fortlaufende Ergänzung und Wiederholungsuntersuchung etwa alle 10 Jahre.

1.5 Monitoring Vegetation *(Aufbauprogramm)*

1.5.1 Vegetationskartierung in ausgewählten Teilräumen

Flächendeckende Vegetationskartierung ausgewählter, botanisch wertvoller Teilräume im Maßstab 1 : 5.000 (bzw. 1 : 10.000). Deren Anteil dürfte in vielen Naturschutzgebieten etwa 20-50(-80) % der Fläche betragen. Die Kartierung erfolgt nach pflanzensoziologischen Standardmethoden, wobei die zu erfassenden Einheiten entsprechend der realen Verhältnisse definiert und dokumentiert werden müssen, d.h. daß auch alle ranglosen Gesellschaften und Ausbildungen zu belegen und zu differenzieren sind. Liegen bereits aus Teilbereichen ältere Vegetationskartierungen vor, sollte auf diese methodisch und räumlich aufgebaut werden (z. B. GANZERT & PFADENHAUER, 1988).

Erfassungsrhythmus: Erstinventarisierung und Wiederholungsuntersuchung in 10jährigem Turnus.

1.5.2 Vegetationskartierung auf Dauerbeobachtungsflächen

Die Vegetationskartierung auf Dauerbeobachtungsflächen ist neben der Wuchsortkartierung der gefährdeten Arten das wichtigste Instrument der Effizienzkontrolle, da bereits Trends von Veränderungen erfaßt werden, bevor sich die Pflanzengesellschaften bzw. Biotoptypen deutlich verändern.

Die Anlage der Dauerbeobachtungsflächen ist bevorzugt in Bereichen vorzusehen,

- die von besonders schutzwürdigen Pflanzengesellschaften eingenommen werden (insbesondere stark gefährdete und seltene Grünlandtypen),
- die Nutzungsänderungen unterliegen (bei Grünland besonders relevant),
- in denen spezielle Fragen des Pflege- und Nutzungsmanagements zu untersuchen sind,
- die als Kontrollflächen ("Null-Flächen") dienen können.

Jede Dauerbeobachtungsfläche ist an den vier Eckpunkten mit einem versenkten Dauermagneten zu markieren. Diese können auch auf landwirtschaftlichen Flächen (z. B. 60 cm tief unter Acker) verwandt werden, auf denen eine Bodenbearbeitung stattfindet. Zusätzlich können für das leichtere Wiederauffinden ebenerdig an jedem Eckpunkt Kunststoff- oder Metallmeßpunkte eingeschlagen werden. Die Dauerbeobachtungsflächen sind unter Verwendung auffälliger Geländepunkte genau einzumessen. Ihre Lage ist in Detailkarten genau wiederzugeben, da ein Auffinden der Dauermagneten mit Hilfe eines Magnetsuchgerätes nur über Distanzen von wenigen Metern möglich ist.

Im Bereich der Grünlandgesellschaften sind in sich standörtlich und floristisch möglichst homogene, rechteckige Flächen von jeweils 25 m² Größe aufzunehmen. Es werden bewußt relativ große Flächen ausgewählt, um repräsentative Ausschnitte aus den Beständen über die Zeit zu verfolgen. Für spezielle Untersuchungen ist die Anlage eines Transektes sinnvoll. Hierbei wird die 1 m breite, rechteckige Gesamtfläche in 1 m²-Flächen unterteilt, deren Vegetation jeweils wie oben beschrieben aufgenommen wird.

Erfassungsmethodik: Für jede Dauerbeobachtungsfläche ist eine Liste der Pflanzenarten zu erstellen und im einzelnen die Artmächtigkeit nach der modifizierten Londo-Skala (Tabelle 1) zu erfassen. Entsprechende Skalen werden vor allem bei Untersuchungen im Grünland verwandt (z. B. ROSENTHAL, 1992). Eine Übertragung der von uns verwandten Skala in die ebenfalls gebräuchliche, in weniger Klassen eingeteilte BRAUN-BLANQUET-Skala ist zu Vergleichszwecken möglich (vgl. DIERSCHKE, 1995).

Erfassungsrhythmus: 2jähriger Turnus.

Tab. 1: Modifizierte LONDO-Skala zur Schätzung der Artmächtigkeiten der einzelnen Arten in den Dauerflächen.

Wert	Deckung/Artmächtigkeit			
r	<1 %	Deckung	1	Individuum (Rametum)
+	<1 %	- " -	2-5	Individuen
0.1	<1 %	- " -	6-50	Individuen
0.1 m	<1 %	- " -	> 50	Individuen
0.2	1-3 %	- " -		
0.2 m	1-3 %	- " -	> 50	Individuen
0.4	>3-5 %	- " -		
0.4 m	>3-5 %	- " -	> 50	Individuen
1a	>5-10 %	- " -		
1b	>10-15 %	- " -		
2	>15-25 %	- " -		
3	>25-35 %	- " -		
4	>35-45 %	- " -		
5a	>45-50 %	- " -		
5b	>50-55 %	- " -		
6	>55-65 %	- " -		
7	>65-75 %	- " -		
8	>75-85 %	- " -		
9	>85-95 %	- " -		
10	>95-100 %	- " -		

1.6 Laufende vegetationskundliche Monitoringprojekte in Niedersachsen

Bei der Fachbehörde für Naturschutz werden Vegetationskarten aus Niedersachsen, soweit vorhanden ergänzt durch pflanzensoziologische Vegetationsaufnahmen, gesammelt und verzeichnet. Die ältesten Unterlagen gehen bis in die 30er Jahre zurück. Sie bieten die Grundlage für vergleichende flächige Wiederholungskartierungen. So wurde z. B. der gravierende Landschaftswandel am Dümmer, einem großen See, der von ausgedehntem Feuchtgrünland umgeben ist, von 1946 bis 1987 (aktualisiert 1995) dokumentiert (GANZERT & PFADENHAUER, 1988). Aufbauend hierauf wurden Naturschutzplanungen zur Sicherung und Entwicklung des Gebietes erarbeitet.

Entsprechende Wiederholungskartierungen werden derzeit nur in Einzelfällen durchgeführt. Zunehmend werden heute Dauerflächen zur Beobachtung der Vegetationsentwicklung eingerichtet.

Durch die Fachbehörde für Naturschutz wurden bisher insgesamt 380 vegetationskundliche Dauerflächen und zwei Transekte angelegt. Diese gehen jedoch nicht auf das oben dargestellte Konzept, bei dem es sich um einen aktuellen Entwurf aus 1996 handelt, zurück. Vielmehr wurden sie aufgrund unterschiedlicher Fragestellungen im Rahmen von Einzelprojekten eingerichtet: Monitoring bzw. Effizienzkontrollen im Zusammenhang mit Naturschutzprojekten (Entwicklung in Mooren, Effizienzkontrolle historischer Waldnutzungsformen oder im Grünland etc.), Beweissicherungsverfahren z. B. bei Grundwasserentnahmen, das landesweite Bodendaueruntersuchungsprojekt (Tabelle 2).

Tab. 2: Übersicht über die vegetationskundlichen Dauerflächen in Niedersachsen, die durch das NLÖ (Fachbehörde für Naturschutz) bzw. in dessen Auftrag eingerichtet wurden.

Anzahl	Vegetationstyp	Lage	Projekt	seit	Aufnahm-rythmus
	Projekt Bodendauerflächen				
50	Acker Grünland (überwiegend intensiv genutzt)	repräsentativ über Niedersachsen verteilt	Niedersächsische Bodendauerflächen	1992/ 1993	2-3 Jahre
1	Kriechweiden-gebüsch	Insel Baltrum	Niedersächsische Bodendauerflächen	1994	2-3 Jahre
	Beweissicherungsverfahren				
29*	Feuchtwald, Grünland	Drömling, Lkr. Gifhorn	Beweissicherung Grundwasserentnahme	1981	1-2 Jahre
43*	Feuchtwald, Grünland	Wehnsen, Plockhorst, Lkr. Peine	Beweissicherung Grundwasserentnahme	1992	3 Jahre
20	Wald, Heide etc.	Lopautal, Lkr. Soltau-Fallingbostel	Beweissicherung Anlage Schießbahn	1984/ 1988	ca. 5 Jahre
	Monitoring/Effizienzkontrolle im Zusammenhang mit Naturschutzprojekten				
34	Hochmoor- und Degenerationsstadien	NSG Bissendorfer Moor, Lkr. Hannover	Hochmoorregeneration im NSG	1977	ca. 5 Jahre
45	Grünland	Neustädter Moor, Lkr. Diepholz	Entwicklung im NSG Pflege	1992	unbestimmt
51	Grünland	Stollhammerwisch, Lkr. Wesermarsch	Effizienzkontrolle Feuchtgrünland-schutzprogramm	1993/ 1994	2 Jahre
52	Fichtenwälder	Oberharz, Lkr. Goslar	Monitoring (incl. Moose und Flechten)	1991	unbestimmt
8**	Binnensalzstellen jährlich	NSG Seckertift, NSG Barnstorf; Lkr. Helmstedt, Lkr. Wolfenbüttel	Monitoring im NSG, Effizienz Management	1993/ 1994	
6	Pfeifengraswiesen	NSG Hahnenkamp, Lkr. Hannover	Monitoring im NSG, Effizienz Management	1992	jährlich
18	Gehölzbestände, Röhrichte, Staudenflur	Oberaller im Lkr. Gifhorn	Entwicklung einer naturnahen Uferbepflanzung	1993	unbestimmt
16	Eichen-Hainbuchen-Mittelwälder und Rot-buchen-Hochwälder	Salzgitter-Höhenzug bei Liebenburg, Lkr. Goslar	Auswirkungen der Wiederaufnahme historischer Wald-nutzungsformen auf Flora und Vegetation	1994	zunächst jährlich

*380 Dauerflächen und: *... 1 Transekt; **... 2 Transekte*
Wiederholungsaufnahmen werden im Auftrag Dritter durchgeführt.

Eine systematische Einrichtung von Dauerflächen auf repräsentativen Flächen aller naturschutzrelevanten Pflanzengesellschaften, wie sie langfristig geplant ist (s. o.), erfolgte bisher somit nicht.

Die ältesten Flächen existieren seit 1977, die überwiegende Anzahl wurde jedoch nach 1990 eingerichtet. Flächengröße und Aufnahmeskala variieren bei den älteren z. T. stark, so daß eine Standardisierung auch bei Wiederholungsaufnahmen nur eingeschränkt möglich ist. Bei den nach 1994 eingerichteten Flächen wird weitgehend nach den o. g. Vorgaben gearbeitet. Die größten Probleme bei Wiederholungsaufnahmen ergeben sich bei dem Wiederauffinden der Flächen. Daher wird für die Zukunft großer Wert auf gute dauerhafte Markierungen und genaue Lageskizzen der Dauerflächen gelegt. Das Problem stellt sich vor allem bei dem Wechsel der Bearbeiter. Trotz gewisser Probleme haben auch die älteren Probeflächen, auf denen überwiegend bereits Wiederholungsuntersuchungen erfolgt sind, einen hohen Wert für angewandte Naturschutzuntersuchungen.

Im folgenden werden einige der in Tabelle 2 aufgeführten Beispiele kurz erläutert. Im Rahmen der landesweiten Bodendaueruntersuchung werden bis zum Jahr 2000 unter Federführung des Niedersächsischen Landesamtes für Bodenforschung insgesamt 90 Dauerflächen eingerichtet. Neben 20 Flächen unter Wald werden 70 auf überwiegend konventionell bewirtschafteten Acker- und Grünlandstandorten angelegt und bodenkundlich bonitiert (NLfB, 1997). Die Flächen sollen repräsentativ für die gesamte Landschaft sein und sind daher nicht auf Schutzgebiete beschränkt. Die Fachbehörde für Naturschutz führt in einem Projektteil ein floristisch-vegetationskundliches Monitoring auf den Bodendauerflächen in Anlehnung an das o. g. Konzept durch. Eine Darstellung der Methoden und erste Ergebnisse werden in den "Arbeitsheften Boden" (NLfB, 1997) veröffentlicht.

Die übrigen in Tabelle 2 aufgelisteten Monitoringprojekte haben einen Schwerpunkt im Bereich von ausgewiesenen Vorrangflächen für den Naturschutz. Im NSG Bissendorfer Moor (Lkr. Hannover) wird seit 1977 die Entwicklung der Vegetation im weitgehend intakten Hochmoorkern sowie in den abgetorften Randbereichen, begleitet durch Wasserstandsmessungen, beobachtet. Es zeigte sich, daß durch Rückbau aller früheren Entwässerungsgräben in Verbindung mit dem Offenhalten der zentralen Moorfläche das Wachstum der hochmoortypischen Vegetation gefördert werden konnte und nachfolgend das Auftreten von Gehölzanflug in diesen Bereichen deutlich rückläufig war.

Im NSG Grünland am Westrand des Neustädter Moores (Lkr. Diepholz) war trotz Wiedervernässungs- und anderer Pflegemaßnahmen ein leichter Rückgang von Zielarten aus der Gruppe der Zeiger nährstoffarmer Standorte festzustellen. Der Vergleich mit der Entwicklung auf Dauerflächen außerhalb des NSG machte jedoch deutlich, daß hier die genannte Artengruppe in wesentlich höherem Maße zurückging. Durch das Monitoring wurde zum einen ein relativer Erfolg der bisherigen Maßnahmen, zum anderen aber auch ein weiterer Handlungsbedarf deutlich.

Beim Monitoring in Eichen-Hainbuchen-Mittelwäldern (Lkr. Goslar), die seit einigen Jahren wieder in traditioneller Weise genutzt werden, liegt besonderes Augenmerk auf der Beobachtung der Populationsentwicklung jener Arten, die im Gebiet eine Präferenz für entsprechende Waldformen haben (ZACHARIAS, 1996).

Neben den vegetationskundlichen Dauerflächen, die durch die Fachbehörde für Naturschutz eingerichtet wurden, gibt es in Niedersachsen ein Vielfaches an Probeflächen, die von anderen Institutionen angelegt wurden und werden. Zum einen gehen diese auf andere Naturschutzbehörden, zum anderen auf Forschungseinrichtungen aber auch auf Privatpersonen zurück. Allein die Oberen Naturschutzbehörden in den Bezirksregierungen haben in zunehmendem Maße Dauerflächen in Naturschutzgebieten mit Schwerpunkt im Grünland einrichten lassen, die mittlerweile die Anzahl von 800 übersteigen dürften. In Zukunft sollen sich zumindest alle Dauerflächen, die von Naturschutzbehörden eingerichtet werden, methodisch an den landesweiten Vorgaben orientieren. Nur so wird für die Zukunft eine einheitliche Auswertung größeren Datenmaterials möglich sein.

Aktuell gibt es keine zentrale Stelle, die die landesweit erhobenen Informationen auf vegetationskundlichen Dauerflächen sammelt und auswertet. Personell und finanziell ist dies derzeit auch durch die Fachbehörde für Naturschutz, die hierfür die geeignete Institution wäre, nicht möglich. Im Bereich der Artenerfassungen ist die Situation günstiger, da bereits bei der überwiegenden Anzahl der Kartierungen und Untersuchungen die Informationen zumindest auch nach den standardisierten Vorgaben des Pflanzenarten-Erfassungsprogrammes der Fachbehörde für Naturschutz erfolgen und an diese gemeldet werden. Hier erfolgt eine Auswertung und Bewertung. So ist für die gefährdeten Arten die aktuelle Populationsgröße in Niedersachsen weitgehend bekannt (GARVE, 1994).

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REQUIREMENTS FOR THE MONITORING OF NATURA 2000 SITES

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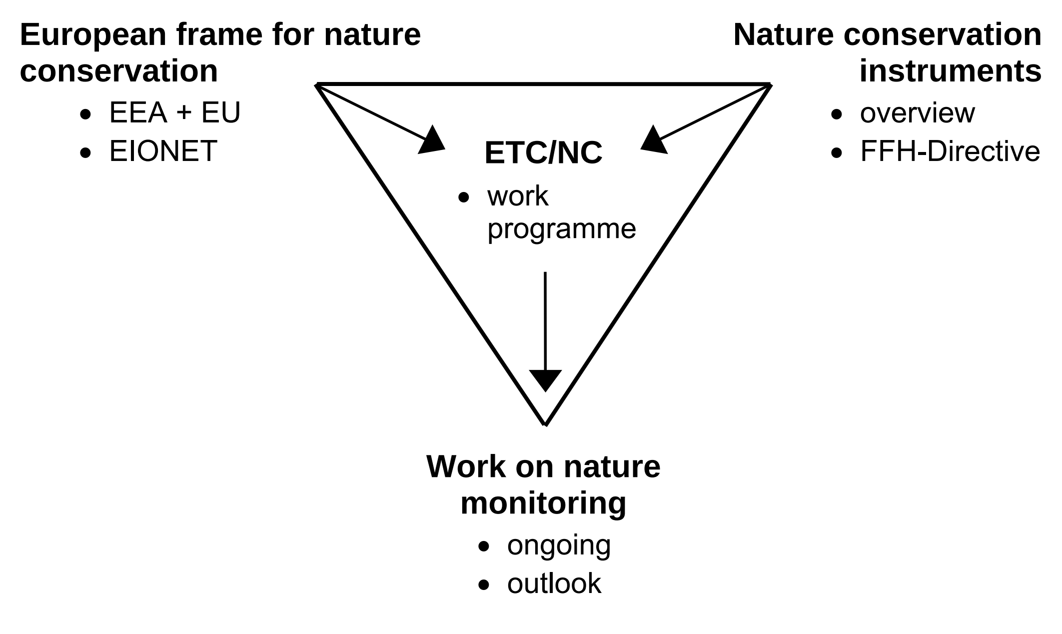


ETC/NC, June 1996

Fig. 1: Requirements for Monitoring for the Natura 2000 Network.

2 THE EUROPEAN FRAME FOR NATURE CONSERVATION

2.1 EEA and EU

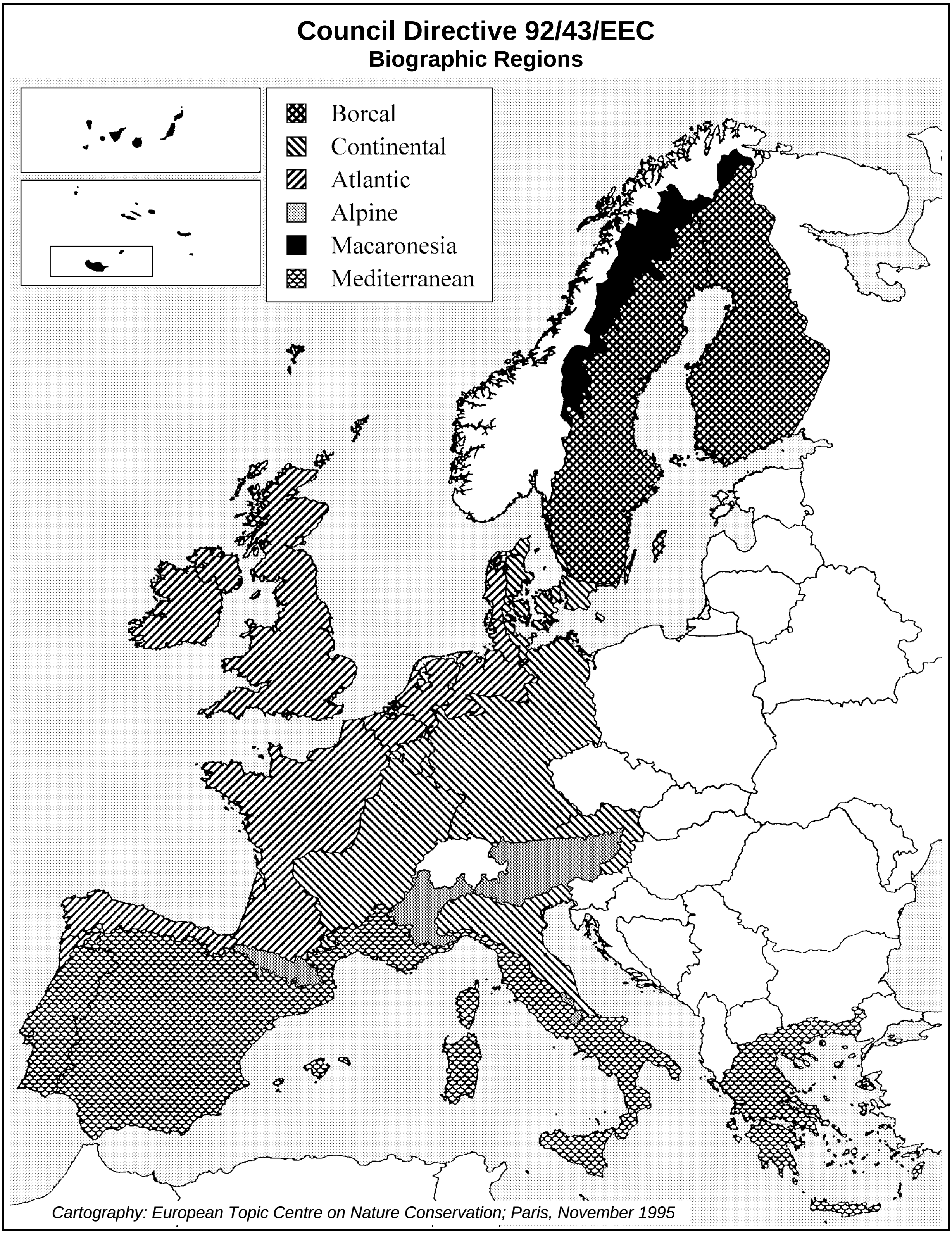


Fig. 2: European Union area (15 countries) and FFH-Directive's biogeographic regions.

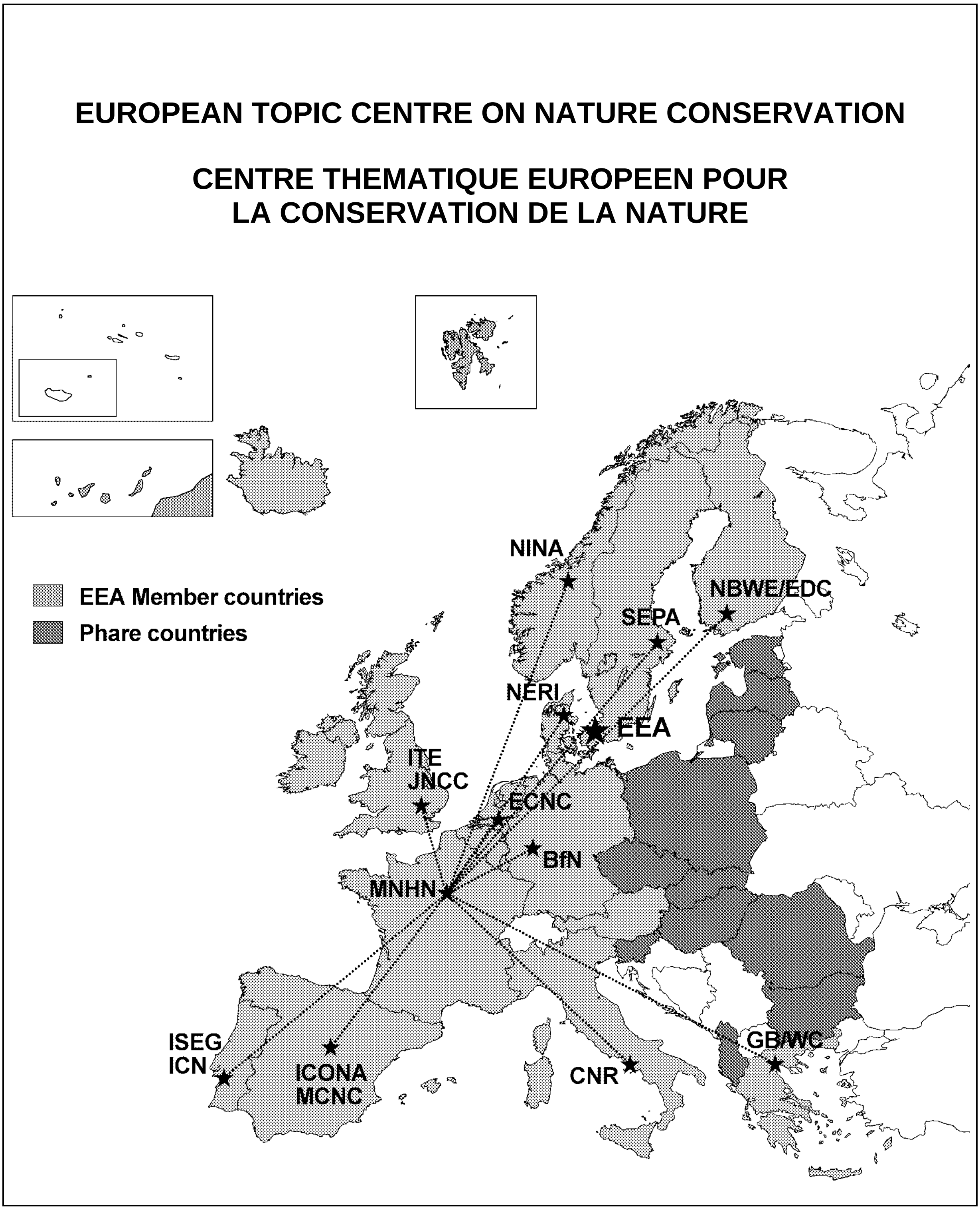


Fig. 3: EEA countries (18 countries) and ETC/NC consortium partners.

THE ROLE OF THE EUROPEAN ENVIRONMENT AGENCY

provide

AN OBJECTIVE, RELIABLE AND COMPARABLE INFORMATION AT EUROPEAN LEVEL

to

THE COMMISSION AND MEMBERS STATES

to help them

- ☞ **taking necessary measures for environment protection**
- ☞ **evaluating their implementation**
- ☞ **assuring good information to the public about the state of environment**

Fig. 4: Role of the EEA.

TASK OF THE EEA

- to establish the EEA network and to continue the work started under Corine;
- to provide the Community and Member States, and ‘in particular the Commission with the information that it needs to be able to carry out successfully its tasks of identifying, preparing and evaluating measures and legislation in the field of the environment’;
- to gather and organise data which the Commission will use in its task of ensuring the implementation of Community legislation on the environment;
- to ensure comparability ‘at European level’;
- to incorporate European environmental information into international monitoring programmes;
- to disseminate reliable environmental information;
- to stimulate environmental forecasting;
- to stimulate environmental assessment, preventive, protection and restoration policies;
- to stimulate information on best available technologies;
- to co-operate with the components of the network.

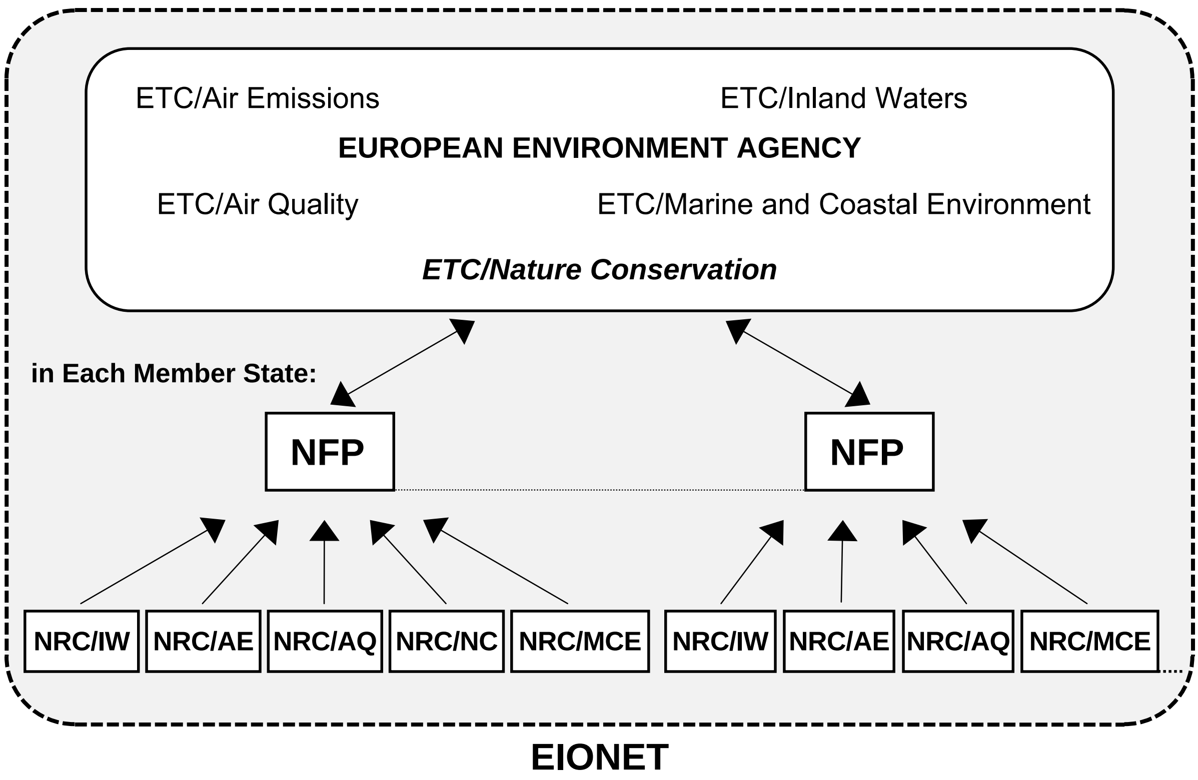
Fig. 5: Tasks of the EEA.

2.2 EIONET

THE EUROPEAN INFORMATION AND OBSEVATION NETWORK (EIONET)

- The Main Components Elements identified by each Member State and transmissed to the Agency
- ***The National Focal Points (NFP)***, designated by each Member State and in charge of coordination and/or transmission of information at national level to the Agency and others institutions or organisations, network partners
- ***The National Reference Centres (NRC)***, designated by each Member State and in charge of collecting standardised information at national level on specific themes
- ***The European Topic Centres (ETC)***, suggested by Members States and agreed unanimously by the EEA Management Board, in charge of cooperation with the EEA about specific themes, being real contcts of this Community organisation

Fig. 6: EIONET composants.



ETC ..... European Topic Centre; **NFP** ..... National Focal Point; **NRC** ..... National Reference Centre

Fig. 7: EIONET structure.

3 NATURE CONSERVATION INSTRUMENTS:

3.1 Overview: CONSERVATION MEASURES, RELEVANT FOR NATURE CONSERVATION

3.1.1 Global initiatives affecting Europe

Conventions:
- Convention on Biological Diversity, (Rio, 1992)
- Convention on the conservation of wild migrating species (Bonn, 1979)
- Convention concerning the Protection of the World Cultural and Natural Heritage (1975)
- Convention on Wetlands of International Importance (Ramsar, 1975)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1975.

Designated Areas:
- World Heritage sites
- Biosphere Reserves
- Ramsar sites.

3.1.2 European and Regional initiatives

Conventions and Directives:
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), 1979
- Council Directive 79/409/EEC on the conservation of Wild Birds, (Birds Directive, 1979)
- Convention on the protection of the Alps, 1991
- Pan-European Biological and Landscape Diversity Strategy, 1995
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive, 1992)
- Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention, 1976)
- Helsinki Convention, 1974, 1992 (to improve the quality of the Baltic environment, including through marine and coastal protected areas)
- Council of Europe Model Act on the Protection of the Environment.

Designated Areas:
- European Diploma
- Biogenetic reserves
- Special Protection Areas under the Birds Directive
- Special Areas of Conservation under the Habitat Directive (on-going process, to be established from 1998)
- Protected areas under the Barcelona Convention
- Protected areas under the Helsinki Convention

IUCN Action Plan "Parks for Life: Action for Protected Areas in Europe"

3.2 Selected articles of the "Fauna, Flora and Habitats-Directive"

3.2.1 Article 3, Objective

§ 1. A coherent European ecological network of special areas of conservation shall be set up under the title Natura 2000. This network, composed of sites hosting the natural habitat types listed in Annex I and habitats of the species listed in Annex II, shall enable the natural habitat types and the species' habitats concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range.

The Natura 2000 network shall include the special protection areas classified by the Member States pursuant to Directive 79/409/EEC (Birds Directive).

3.2.2 Article 4, obligation to designate sites

§ 4. Once a site of Community importance has been adopted in accordance with the procedure laid down in paragraph 2, the Member State concerned shall designate that site as a special area of conservation as soon as possible and within six years at most, establishing priorities in the light of the importance of the sites for the maintenance or restoration, at a favourable conservation status, of a natural habitat type in Annex I or a species in Annex II and for the coherence of Natura 2000, and in the light of the threats of degradation or destruction to which those sites are exposed.

3.2.3 Article 11, monitoring

Member States shall undertake surveillance of the conservation status of the natural habitats and species referred to in Article 2 with particular regard to priority natural habitat types and priority species.

3.2.4 Article 17, reporting

§ 1. Every six years from the date of expiry of the period laid down in Article 23, Member States shall draw up a report on the implementation of the measures taken under this Directive. This report shall include in particular information concerning the conservation measures referred to in Article 6 (1) as well as evaluation of the impact of those measures on the conservation status of the natural habitat types of Annex I and the species in Annex II and the main results of the surveillance referred to in Article 11. The report, in accordance with the format established by the committee, shall be forwarded to the Commission and made accessible to the public.

3.2.5 ANNEX III of FFH-Directive:

CRITERIA FOR SELECTING SITES ELIGIBLE FOR IDENTIFICATION AS SITES OF COMMUNITY IMPORTANCE AND DESIGNATION AS SPECIAL AREAS OF CONSERVATION

STAGE 1: Assessment at national level of the relative importance of sites for each natural habitat type in Annex I and each species in Annex II (including priority natural habitat types and priority species)

A. Site assessment criteria for a given natural habitat type in Annex I

(a) Degree of representativity of the natural habitat type on the site.

(b) Area of the site covered by the natural habitat type in relation to the total area covered by that natural habitat type within national territory.

(c) Degree of conservation of the structure and functions of the natural habitat type concerned and restoration possibilities.

(d) Global assessment of the value of the site for conservation of the natural habitat type concerned.

B. Site assessment criteria for a given species in Annex II

(a) Size and density of the population of the species present on the site in relation to the populations present within national territory.

(b) Degree of conservation of the features of the habitat which are important for the species concerned and restoration possibilities.

(c) Degree of isolation of the population present on the site in relation to the natural range of the species.

(d) Global assessment of the value of the site for conservation of the species concerned.

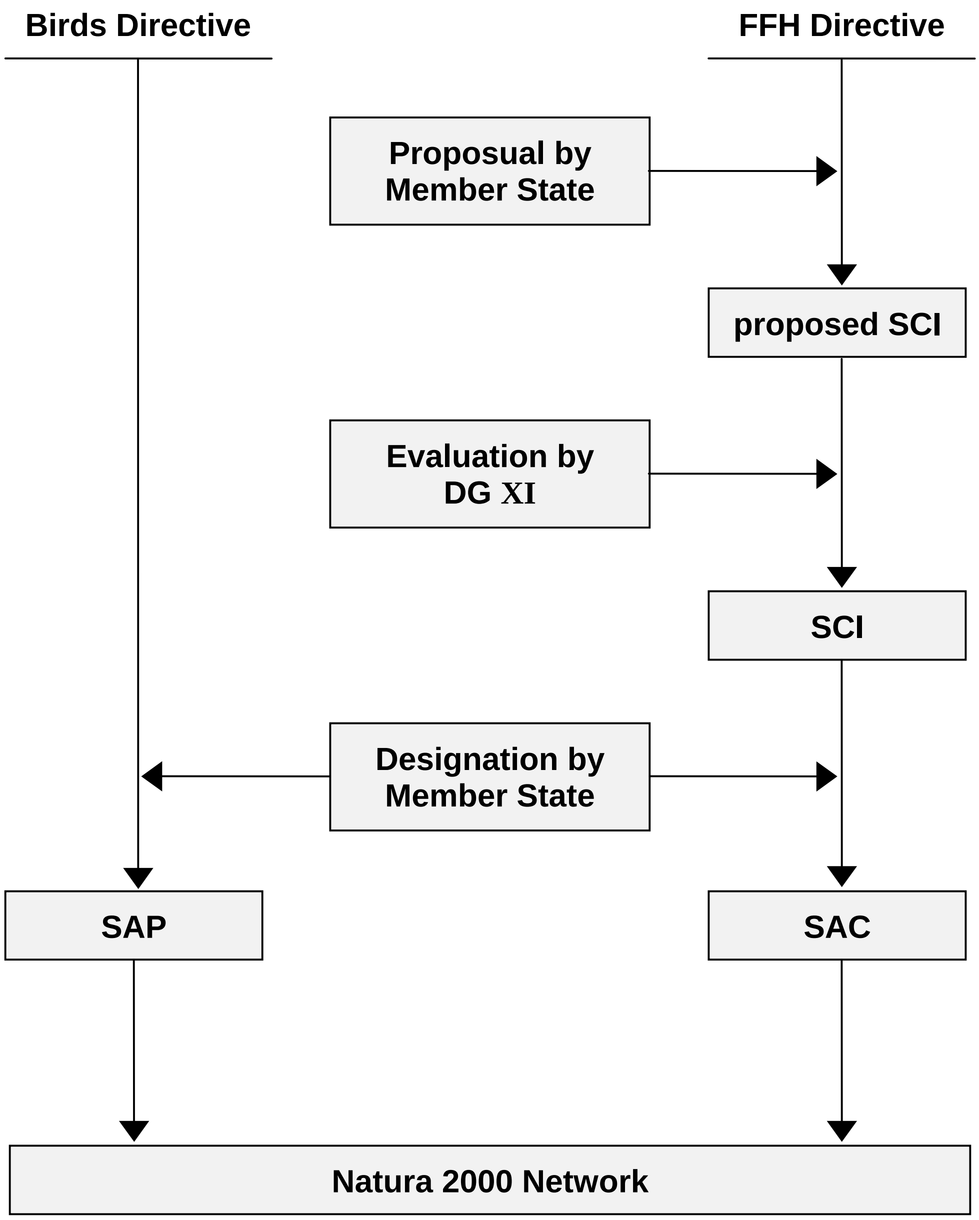
C. On the basis of these criteria, Member States will classify the sites which they propose on the national list as sites eligible for identification as sites of Community importance according to their relative value for the conservation of each natural habitat type in Annex I or each species in Annex II.

D. That list will show the sites containing the priority natural habitat types and priority species selected by the Member States on the basis of the criteria in A and B above.

STAGE 2: Assessment of the Community importance of the sites included on the national lists

1. All the sites identified by the Member States in Stage 1 which contain priority natural habitat types and/or species will be considered as sites of Community importance.
2. The assessment of the Community importance of other sites on Member States' lists, i. e. their contribution to maintaining or re-establishing, at a favourable conservation status, a natural habitat in Annex I or a species in Annex II and/or to the coherence of Natura 2000 will take account of the following criteria:
   (a) relative value of the site at national level;
   (b) geographical situation of the site in relation to migration routes of species in Annex II and whether it belongs to a continuous ecosystem situated on both sides of one or more internal Community frontiers;
   (c) total area of the site;
   (d) number of natural habitat types in Annex I and species in Annex II present on the site;
   (e) global ecological value of the site for the biogeographic regions concerned and/or for the whole of the territory referred to in Article 2, as regards both the characteristic of unique aspect of its features and the way they are combined.

Selektion of Sites forNature 2000 Network



FFH ....Flora Fauna Habitats
SCI ....Site of Community Interest
DG XI ....Directorate General for Environment
SPA ....Special Protection Area
SPC ....Special Area of Conservation

Fig 9: Calendar for Natura 2000Fig 8: Selection of Sites for Natura 2000 Network.

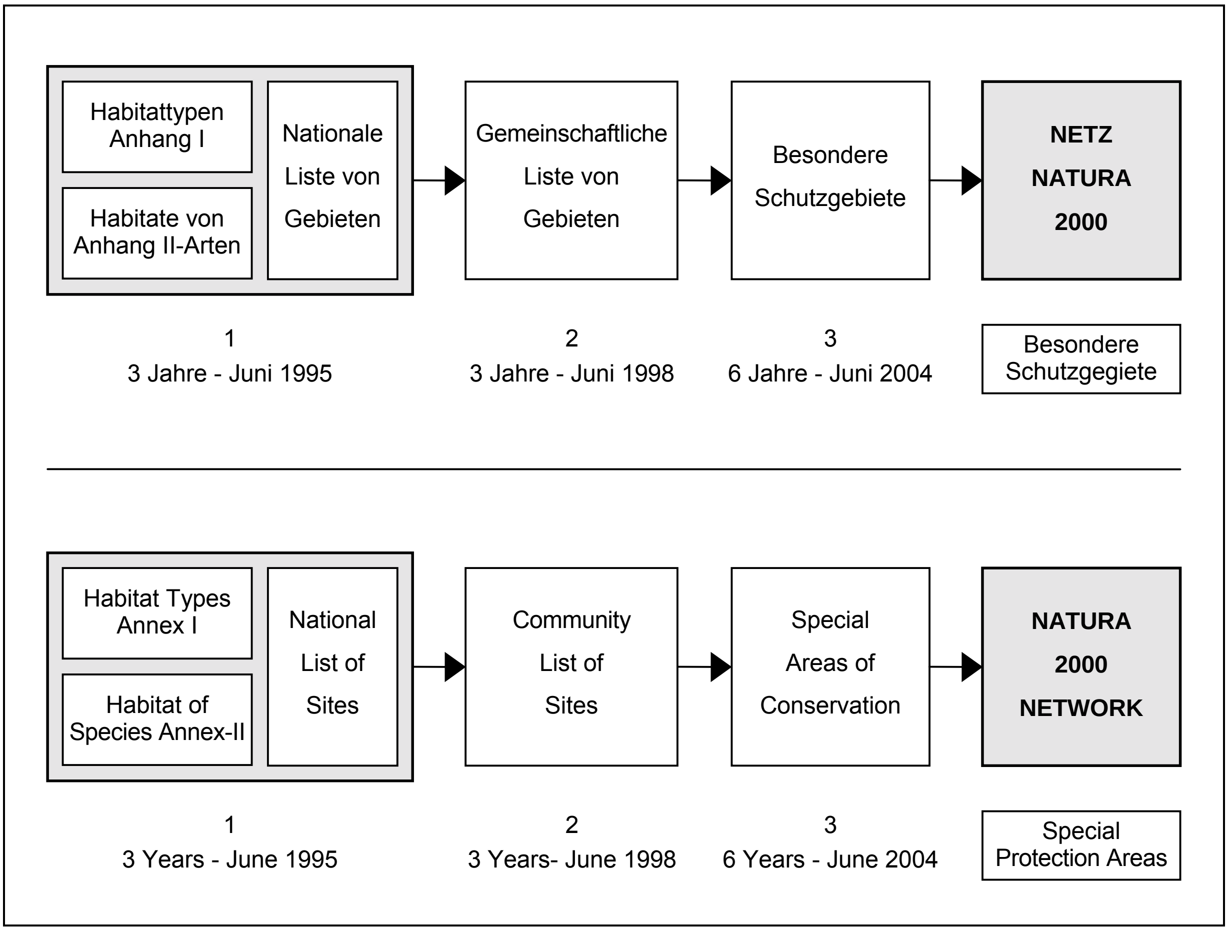


Fig. 9: Calendar for Natura 2000.

3.2.6 Article 1, definition of terms

For the purpose of this Directive:

(a) conservation means a series of measures required to maintain or restore the natural habitats and the populations of species of wild fauna and flora at a favourable status as defined in (e) and (i);

(b) natural habitats means terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or semi-natural;

(c) natural habitat types of Community interest means those which, within the territory referred to in Article 2:

(i) are in danger of disappearance in their natural range;

or

(ii) have a small natural range following their regression or by reason of their intrinsically restricted area;

or

(iii) present outstanding examples of typical characteristics of one or more of the six following biogeographic regions: Alpine, Atlantic, Boreal, Continental, Macaronesian and Mediterranean.

Such habitat types are listed or may be listed in Annex I;

(d) priority natural habitat types means natural habitat types in danger of disappearance, which are present on the territory referred to in Article 2 and for the conservation of which the Community has particular responsibility in view of the proportion of their natural range which falls within the territory referred to in Article 2; these priority natural habitat types are indicated by an asterisk (*) in Annex I;

(e) conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2.

The conservation status of a natural habitat will be taken as 'favourable' when:

- ∗ its natural range and areas it covers within that range are stable or increasing, and
- ∗ the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- ∗ the conservation status of its typical species is favourable as defined in (i);

(f) habitat of a species means an environment defined by specific abiotic and biotic factors, in which the species lives at any stage of its biological cycle;

(g) species of Community interest means species which, within the territory referred to in Article 2, are:

(i) endangered, except those species whose natural range is marginal in that territory and which are not endangered or vulnerable in the western palearctic region;

or

(ii) vulnerable, i. e. believed likely to move into the endangered category in the near future if the causal factors continue operating;

or

(iii) rare, i. e. with small populations that are not at present endangered or vulnerable, but are at risk. The species are located within restricted geographical areas or are thinly scattered over a more extensive range;

or

(iv) endemic and requiring particular attention by reason of the specific nature of their habitat and/or the potential impact of their exploitation on their habitat and/or the potential impact of their exploitation on their conservation status.

Such species are listed or may be listed in Annex II and/or Annex IV or V;

(h) priority species means species referred to in (g) (i) for the conservation of which the Community has particular responsibility in view of the proportion of their natural range which falls within the territory referred to in Article 2; these priority species are indicated by an asterisk (*) in Annex II;

(i) conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory referred to in Article 2;

The conservation status will be taken as 'favourable' when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis;

(j) site means a geographically defined area whose extent is clearly delineated;

(k) site of Community importance means a site which, in the biogeographic region or regions to which is belongs, contributes significantly to the maintenance or restoration at a favourable conservation status of a natural habitat type in Annex I or of a species in Annex II and may also contribute significantly to the coherence of Natura 2000 referred to in Article 3, and/or contributes significantly to the maintenance of biological diversity within the biogeographic region or regions concerned.

For animal species ranging over wide areas, sites of Community importance shall correspond to the places within the natural range of such species which present the physical or biological factors essential to their life and reproduction;

(l) special area of conservation means a site of Community importance designated by the Member States through a statutory, administrative and/or contractual act where the necessary conservation measures are applied for the maintenance or restoration, at a favourable conservation status, of the natural habitats and/or the populations of the species for which the site is designated;

(m) specimen means any animal or plant, whether alive or dead, of the species listed in Annex IV and Annex V, any part or derivative thereof, as well as any other goods which appear, from an accompanying document, the packaging or a mark or label, or from any other circumstances, to be parts or derivatives of animals or plants of those species;

(n) the committee means the committee set up pursuant to Article 20.

4 THE EUROPEAN TOPIC CENTRE ON NATURE CONSERVATION

4.1 The EEAs and ETC/NCs work programmes

4.1.1 The EEA-frame and the past ETC/NC-work

EEA – Programme areas:

1 – Information dissemination and pooling
2 – Periodic reports on state of the environment
3 – Guidelines for reports
4 – Media oriented monitoring
5 – Source oriented monitoring
6 – Integrated environmental assessment
7 – Scenarios for environmental improvement
8 – Instruments for policy development
9 – Capacity building for EEA and EIONET
10 – Exchange and dissemination of information

Fig. 10: EEA Multi-Annual Work Programme areas.

Programme Group – MONITORING AND DATABASES

4. MEDIA ORIENTATED MONITORING.
ASSESSMENT OF THE STATE AND TRENDS OF THE ENVIRONMENT

MW1 Water resources – general approach to assessment
MW2 Inventory of water resources monitoring networks
MW3 Design of a freshwater water monitoring network
MW4 European freshwater monitoring network and databases – development and establishment
MW5 Water resources evaluation
MW6 Information on coastal and marine water quality

MA1 Air quality – general approach to assessment
MA2 European air quality monitoring network and databases – establishment and maintenance
MA3 Harmonisation in the use of models for ambient air quality and pollution dispersion/transport
MA4 Ambient noise levels and exposure

MN1 Nature protection – general approach to assessment
MN2 State and trends of biodiversity in Europe
MN3 Support to NATURA 2000 network
MN4 Land cover – ecological monitoring
MN5 Forest conditions – monitoring network and databases

MS1 Soil quality and degradation – general approach
MS2 Soil characteristics, monitoring and mapping
MS3 Methodologies for inventories of contaminated sites

Fig. 11: EEA Multi-Annual Work Programme area 4: Media Oriented Monitoring.

ETC/NATURE CONSERVATION'S WORK PROGRAMME 1995

TASKS	DESCRIPITION	LEADER
MN1.1	General approach	Central Team
MN1.2	Survey of existing databases	MNHN (F)
MN1.3	Proposal for further data collection and tools	Central Team
MN2.1	Conceptual framework for biodiversity monitoring	ECNC (NL)
MN2.2 (a)	Biogeographic digitazed map	ISEGI (P)
MN2.2 (b)	Pilot studies: methodology & coordination	ECNC (NL)
MN2.3	Survey of use of indicators	NERI (DK)
MN2.4	Survey of nomenclatura activities	MNCN (E)
MN2.5	Final CORINE habitat classification	ITE (UK)
MN2.6	Methodology for monitoring natural sites	NERI (DK)
MN2.7	Criteria for identification of ecological corridors	ECNC (NL)
MN3.1	Maintain CORINE biotopes database	ITE (UK)
MN3.2	Initiate creation of NATURA 2000 database	Central Team
MN3.3	Common European wide nature protection data base	MNHN (F)

Fig. 12: ETC/NC Annual work programme 1995.

4.1.2 ETC/NC 1996 Work Programme (1995 and 1996 subvention)

TASK 1. ETC MANAGEMENT AND CO-ORDINATION

TASK 2. MAINTAIN AND DEVELOP THE NATURE CONSERVATION ASPECTS OF EIONET

TASK 3. AD-HOC TECHNICAL SUPPORT TO EEA

TASK 4. INFORMATION SYSTEM ON NATURE (EUNIS)

TASK 5. SUPPORT TO NATURA 2000

TASK 6. INFORMATION AND REPORTING ON EUROPE'S NATURE

4.2 Details of the 1996 work tasks

4.2.1 TASK 4. – INFORMATION SYSTEM ON NATURE (EUNIS)

Overall Objective

To develop the concept of the European Information System for Nature (EUNIS) and to begin to acquire data stepwise and in blocks.

EUNIS Conception and development Activities:

- General conception
- Identification of information needs
- Data sources, identification and evaluation
- Development of handling data procedures.

EUNIS Preparatory Activities:

- Harmonisation of data terminology, species
- Harmonisation of data terminology, habitats.

EUNIS Activities concerning acquisition and input of relevant data:

- Basic layers
- Designated areas (site-based data)
- Site-based data
- Biodiversity information: Species
- Biodiversity information: Habitats.

4.2.2 TASK 5. – SUPPORT TO NATURA 2000

Overall Objective

To give technical support to the Commission, DG XI. D2 in handling and assessing data for evaluation of proposed sites for the European list under the NATURA 2000 activity of the Commission.

Activities

- NATURA 2000 Software issues
- Handling NATURA 2000 data
- Data analysis procedure
- Objective

  To describe and develop relevant data analysis procedures for assessing NATURA 2000 proposals within 4 stages to be used:
  - assessment of the acceptability of national list-related datasheets
  - analysis of the national list coverage on species and habitat types
  - analysis of the national list representativity of species and habitat types
  - assistance to the Commission to build the Community list
- Assessment of NATURA 2000 proposals

  Objective:

  To assist the Commission in the evaluation of the national lists of sites proposed by Member States, as well as in the building of the Community List of sites of special conservation interest. The evaluation shall be based on existing information, obtained through the EUNIS system activities. The form and products must be agreed with the Commission. The possibility of using the results as information in EUNIS or as part of the Agency reporting activities should always be considered and agreed with the Commission.
- Reporting on the NATURA 2000 activity of the ETC/NC

4.2.3 TASK 6. – INFORMATION AND REPORTING ON EUROPE'S NATURE

Overall Objective

To support the Agency in including nature conservation issues in the EEA information and reporting activities.

EEA information and reporting activities:

- **Development of the EEA Information Strategy for Nature**
- **Ecological regions in Europe, map**

  Objective:

  To finalise a map outlining the ecological regions of Europe. The work is the second phase of the 1995 activity MN 2.2a. The ecological region information shall be seen as a bloc in EUNIS. It is to be used in the evaluation of NATURA 2000 data as part of the necessary ecological information behind the biogeographic regions, but also for the reporting activities. The map information is necessary for the monograph on landscapes, started by the Agency in 1996 under a separate contract.

  The region boundaries shall be digitised in a format, which can easily be transformed to GIS-use, among these the EEA Arc-Info system. A computerised description of each class used on the map shall also be delivered. Computerised boundaries of biogeographic regions shall be included.

  The goal is to have a product which can be used together with other Agency products from land cover, CORINE Biotops, NATURA 2000 and with water catchment information. Since no agreement is yet reached as to the final product of such combinations (possibly on CD ROM), the activity for 1996 is only concerned with finalising the map and the class descriptions.
- **Reference sites for assessment of changes in biodiversity**

  Objective:

To survey the possibilities for establishing a net of reference sites for assessment of changes in nature to be used as a background for assessment of changes in biodiversity.

On the basis of the recommendations from the Nature Workshop in Copenhagen May 1996 ETC/NC shall work towards development of a concept for establishment of a net of reference sites to act as background for assessment of long-term changes in biodiversity to be used both for NATURA 2000 and for wider general assessment of changes in nature due to climate, introduction of species, air pollution etc.

ETC/NC shall look into the possibilities for co-ordination to similar activities performed under other topic centres (water, air) as well as with the monitoring network under the UN/ECE Integrated Monitoring under the Convention on long-range transboundary air-pollution, the monitoring network under IPCC programme (Intergovernmental Panel on Climate Change), the monitoring network under the BRIM programme (Biosphere Reserves Integrated Monitoring) and others as appropriate. The ETC/NC shall also seek advise from the Scientific Committee.

- **Site-based data collection methodologies**

  Objective:

  In order to ensure that data from monitoring and reporting on sites are comparable for future mutual use by Member States, for the Commission and for the Agency in reporting, the methodologies used to collect site-based data must be well described.

  Additionally, it is critical to understand the quality of data collected and methodologies used in producing the initial status assessments for the sites. The form and content of the initial status assessments will be deciding for the suitability of subsequent site monitoring, but they will also determine the extent to which data can be combined to produce assessments of favourable conservation status both at national and European level as well as for follow-up on individual NATURA 2000 sites.

  Many Member States and several international bodies are developing or interested in developing site monitoring methodologies. These efforts are at present not well known or coordinated, and methods are often very poorly described. This will render use of data for amalgamation and aggregation difficult even for the same species or other taxa. An evaluation of methodologies and approaches used is necessary to understand the existing data and as a basis for recommendations for a possible common approach.

  The ETC/NC will undertake an evaluation of the range of methodologies used for status assessments as the basis for choosing suitable methods for monitoring features of interest on NATURA 2000 sites and other sites of major nature conservation interest.

  The work shall be based on initiatives arising from JNCC and NERI and be based also on the reports from ETC/NC on site monitoring methodologies from 1995, on the UN/ECE Integrated Monitoring methodologies and on discussion with relevant national bodies and with the Commission. The Scientific Committee shall be involved directly or with advice.

- **Indicators for biodiversity status and change**

  Objective:

  On the basis of the 1995 reports on use of indicators for monitoring and on the 1995 and 1996 reports on assessment of biodiversity as well as on the recommendations from the workshops in Paris October 1995 and in Copenhagen 1996 a report shall be prepared concluding on the results and outlining the contents of a possible scientific seminar in early or mid 1997. The aim of the seminar shall be to give scientific in depth evaluation of the problems and possibilities in using biodiversity indicators.

  A small reflection group shall be set up in close collaboration with the Scientific Committee.

- **Development of frame for EEA Reporting 1996-1997**

- **Data analysis procedures**

- **Specific products for the EEA Reporting 1996-1997**

4.3 Data analysis procedure for Natura 2000, proposed by the ETC/NC

NATIONAL LIST COVERAGE ON SPECIES AND HABITAT TYPES.

To verify that each National List covers all the concerned habitat types (Annex I) and species (Annex II),

- setting up, on the basis of the existing scientific knowledge, a "national reference list" of Annex I habitat types and Annex II species recorded for each Member State;
- comparing it with the list of habitat types and species involved in the concerned National List;
- underlining the most relevant absences (endemic, threatened or priority species and habitat types).

NATIONAL LIST REPRESENTATIVITY ON SPECIES AND HABITAT TYPES.

To provide the Commission with the appropriate scientific information to evaluate if each National List is sufficient to ensure a favourable conservation status for species and habitat types at national level,

- compiling (mainly through the National Reference Centres but, if necessary, using other data sources) relevant information (population size, range and kind of distribution, variability, isolation, trends) on the habitat types and species recorded for each Member State;
- comparing it with the national Natura 2000 proposal;
- assessing on the representativity of the proposed sites sample for each habitat type and species.

BUILDING COMMUNITY LIST.

To help the Commission in the building of a well-balanced Community List (Sites of Community Importance),

- verifying that all the concerned species and habitats are sufficiently represented to ensure a favourable conservation status at biogeographic regions level.

5 WORK ON NATURE MONITORING IN EUROPE

5.1 Examples for ongoing work

5.1.1 Monitoring of Natura 2000 sites, objectives elaborated by the ETC/NC

Objective:
Assess the efficiency in the long term of the Natura 2000 network,

- with regard to the conservation of the designated sites: check that the designated sites do not undergo any irreversible deterioration of their general conservation status;
- with regard to the conservation of the concerned habitat types and species (including those outside of designated sites): check that the concerned habitat types and species (of annex I and II of the FFH-Directive and of annex I of the Birds Directive) are not subject to a deterioration of their general conservation status;

- with regard to the maintain of European biodiversity in general: check that other remarkable elements of biodiversity (states indicators?) are not subject to a significant deterioration.

5.1.2 Contribution of the ETC/NC consortium partner NERI under 1994 subvention

Sub-project MN2.3 – Nature Indicators Survey:

- survey by questionnaire;
- standardised methodology and biogeographic approach are recommended;
- a tentative list of candidate indicators is presented;
- … model for selection, prioritisation and evaluation of nature indicators is proposed;
- further research is needed.

Sub-project MN2.6 – Site Monitoring Methodology:

- survey by questionnaire;
- most European countries do some kind of monitoring, mainly concerning birds, mammals, invertebrates, vascular plants, phytoplancton and lichens;
- only widely accepted nature monitoring methods should be suggested for wider use (e. g. cover analysis, point counts, quantitative counts, transect survey);
- harmonised data is necessary;
- further research is needed.

5.1.3 Contribution of the ETC/NC consortium partners, ECNC co-ordinator, under 1994/95 subvention:

Biogeographic Pilot Studies (phase I and II):

Objective:

- To test, validate and finalise the proposed methodology for the monitoring of biodiversity in Europe and for assessing its current state and trends;
- To validate the coherence of the European division in ecological regions proposal (resulting from MN2.2 a sub-project).

Tested methodology (using form sheets for 10x10km squares):

- *Landcover:* factors controlling biodiversity: population, production, livestock, human activity, pollution, protected areas, landscape values, other;
- *Habitats:* habitat connectivity, quality indicator, legal protection;
- *Species:* total number, endemic nb., exotic nb., protected nb.
- *Assigning biodiversity values:* naturalness, ecological quality, habitat threat, species value, landscape value;

5.1.4 Projects under EU-LIFE-funding as examples

Evaluation of the conservation status of natural habitats in the continental region according to the Habitats Directive by German Federal Agency for Nature Conservation (BfN)

Objectives:

- a simple, standardised procedure for the assessment of the conservation status of continental natural habitat types;
- transposable to other Members States;
- become an "early warning system".

Integrated monitoring with management planning: a demonstration of good practice on Natura 2000 sites in Wales by Countryside Council for Wales

Objectives:

- develop a monitoring methodology for terrestrial habitats of Annex I;
- link the habitat monitoring programme with management plans.

5.2 An outlook towards the next steps

5.2.1 Nature Monitoring in Europe, ETC/NC with consortium partner ECNC,

1996 work

Introduction: 3 parallel approaches

1. Monitoring of state and trends of biodiversity in Europe will certainly be based on existing designated sites (protected areas), as they represent an important infrastructure for its application.
2. Monitoring could also be done in so-called "hot-spots", areas with high species numbers, that are detected using species atlas data, but that are not necessarily located in protected sites.
3. An optimum proposal concerns a concept of horizontal monitoring (stratified sampling) throughout the entire area, done by sampling in sample stations that are newly selected for each monitoring campaign. It should be considered as ideal requirement, to complement in parallel the procedures in points 1 and 2.

Justification:

1. Nature monitoring should inform about state and trends in nature patterns and in biodiversity in Europe.
2. Nature monitoring concerns all aspects of nature, i. e. protected areas as well as the wider landscape.
3. The monitoring must explicitly take the dynamics of habitats/ecosystems into account, as well as aspects of functionality.
4. Hypothesis: there are very little and in any case not enough natural and pristine areas in Europe left to be considered as reference sites for the major nature patterns in Europe.
5. Instead of an ideal pristine state a known state should be deliberately chosen as a reference state, without judgement of its absolute value or quality. This known state should be one which is sufficiently well documented, i. e. 1930 or 1950 or even today (= first monitoring campaign).

Requirements:

1. The monitoring should be carried out in analogy to an opinion poll.
2. Sampling should be stratified by (i) ecological regions and by (ii) land use/land cover (translating some kind of human impact).
3. Inside the zones considered homogeneous with regard to the above criteria, samples should be chosen by random for each campaign.

4. At each sample station, an agreed minimum set of criteria should be investigated, to be completed by additional ones by request of national/regional authorities and/or management organisms.
5. This monitoring and its data must be compatible with the format of the European Nature Information System EUNIS.

5.2.2 Contribution of the ETC/NC consortium partner ECNC under 1995 subvention

A draft report (June 1996) including a final proposal on the methodology for the monitoring of state and trends of biodiversity in Europe:

- defining the most appropriate approach to the concept of biodiversity in the European (ecological and socio-economical) context;
- describing in detail the tested methodology, including a description of the testing procedures;
- listing data requirements (and gaps) for the implementation of this proposed methodology, as well as the necessary working mechanisms.

PERMANENT PLOT STUDIES ON VEGETATION FOR NATURE CONSERVATION IN AUSTRIA

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The first monitoring and surveillance projects of vegetation and plants started in Austria 8 years ago and got more and more popular until now.

A total number of 30 to 50 monitoring projects on vegetation is estimated but the exact number is not known yet. There is also no platform of botanists performing monitoring projects in Austria and also very few of the results are published. Hence no comparable methods are used and no discussions about methods and evaluation of data collection or analysis exist.

Therefore the Federal Environmental Agency committed a study which aims at collecting detailed information on all permanent plot surveys in our country. A first query should screen all monitoring studies and was recently dispatched nation-wide to all botany institutes of the universities, institutes of nature conservation in the counties, private offices of nature conservation, offices of the national parks and people which are involved in nature conservation and botany science.

In a detailed questionnaire the following information to each project will be gathered for this study: Locality, duration, number of permanent plots, permanent plot size, grid size, estimation scale, monitored plant communities, monitored plant species, photographic documentation, use of aerial maps, address of the office, publishing journal and many other details.

The important matter is that one can find a list of all plants and plant communities monitored already. Double work on the same vegetation type should therefore be avoided. Furthermore one can use the results of similar studies and compare it with the own dataset to improve the own results.

Another important goal of the study is the role of vegetation monitoring and surveillance in the practical work of nature conservation. An analysis about the practical implementation for nature conservation has been worked out for two permanent plot studies, one in the Nationalpark Neusiedler See-Seewinkel (Burgenland) and the other at the March River in Lower Austria

One common method of monitoring on vegetation is the use of permanent plots which are marked durable at the study site to be documented frequently over years. These permanent plots demonstrate in detail how plants perform in time and also the speed of vegetation dynamics under different environmental or management conditions. In both surveys (Seewinkel and March) it is demonstrated that for nature conservation the results of the permanent plots became not effective before years after beginning. But this method is one of the best to create an excellent management plan for a certain area, which bases on detail knowledge about single endangered plant species or plant communities.

On the other hand the frequent presence of the monitoring scientists in the study area should be more emphasised as a side effect which leads to fast and effective conservation work immediately after the incipience of the study. If one visits his permanent plots frequently, there is nearby a constant control of the environmental condition and all kinds of impact in the study area. And this controlling has lead in practise to fast actions like replacing wrong management or the implementation of first monitoring results in certain sites.

Both the slow effects of monitoring plot studies and the fast controlling and implementation effects are demonstrated in the following diagram.

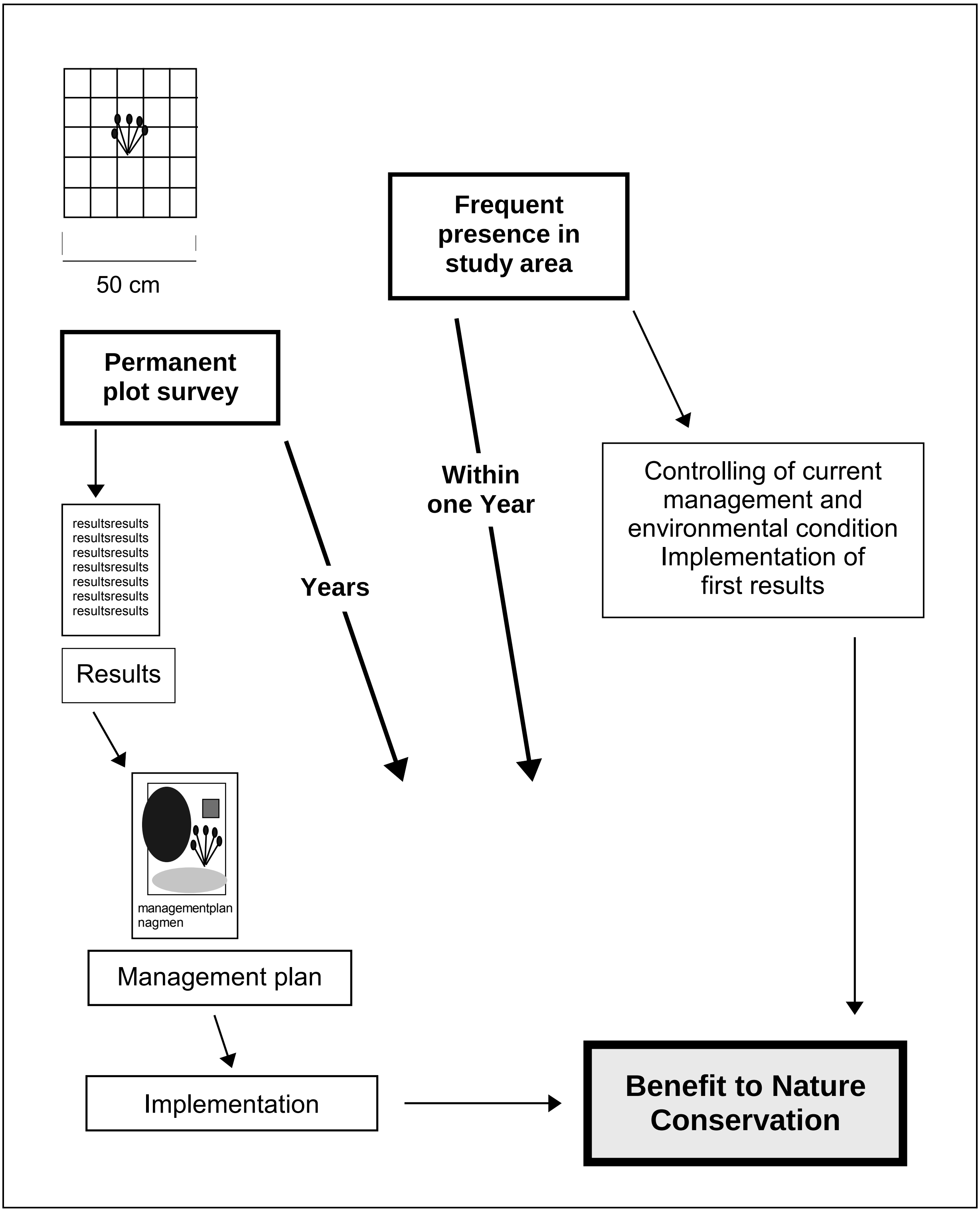

Fig. 1: Use of permanent plot studies for Nature Conservation.

ECOSYSTEM – MONITORING IN THE NATIONAL PARK HOHE TAUERN

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1 INTRODUCTION

The National Park Hohe Tauern intends to install a monitoring system to survey the development and dynamics of alpine habitats, communities and species for a space of time of one century.

Conception and methodological approach are being prepared at the moment by the Institute for Applied Ecology (Klagenfurt). A basic study on the topic has been ordered by the Ministry of Environment and the national park authority (Nationalparkrat). It should be finished at the end of the year.

2 MONITORING IN NATIONAL PARKS

National parks and large scale protected areas are important areas for long term ecological research. Therefor monitoring systems in protected areas are well advanced: An international inquiry amongst 150 national parks shows that most parks have set up (72 %) or are planning (24 %) permanent observation of selected species, habitats and ecosystems (JUNGMEIER, 1996). In addition to results for basic research the monitoring systems are used as tools in every-day´s-national-park-management in order to control, evaluate and improve measures and programs (e. g. VDBIOL., 1995; ANDERSON & ROMERIL, 1992; CANADIAN PARK SERVICE, 1991; NATIONALPARK NIEDERSÄCHSISCHES WATTENMEER, 1994).

The monitoring systems vary greatly in terms of objectives, basic structure and methodology.

3 INTENDED RESULTS

The basic study, being initiated at the moment, focuses mainly on three results:

- Theoretical fundamentals: Beside general theoretical approaches to dynamic of ecosystems the dynamics of the specific alpine systems are to be summarised (e. g. EGGER, 1996; GOTTFRIED et al., 1994; HEGG, 1982, ANL, 1991)
- Conceptional structure: Considering limited resources not each natural feature in the park can be subject for a long time survey. The targets and objectives of the monitoring are to be defined as precisely as possible. The definition will be developed in close cooperation with the different administrative and scientific bodies of the national park. Based on these aims the methodological sets will be composed.
- Without anticipating the results, a basic module will be designed, which combines large scale monitoring (remote sensing/statistical data), monitoring on community level (mainly vegetation based) and monitoring of special species. A set of completing and deepening

modules will be concepted and can get added, if ressources allow it (e. g. ANL, 1991; SCHMIDT, 1994).

- Technical handbook: The methods of monitoring and a detailed description of technical standards (sampling, documentation, data processing, etc.) will be documented in a handbook.

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