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Monitoring of moss species

I. PROJECT. Monitoring of protected and endangered species

Target: To research/monitor the status of protected species, in compliance with the international agreements on data supply (conventions, OECD)

To monitor the species which are on the lists of the Bern Convention and the Habitats Directive.

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General comments

Including the moss species in the Hungarian Biodiversity Monitoring System (HBMS) is appropriate for several reasons:

- Many moss species can be found in Hungary which are rare or endangered, - not only at the national level, but in Europe and even globally.
- Many habitats are valuable and should be protected because of the moss vegetation present.
- The rare and endangered moss species often live in habitats, which should be protected because of their association, vegetation history and are included in the Hungarian Biodiversity Monitoring System (HBMS).
- Our commitment of data supply (e.g. OECD) must also be met for moss species.
- Many Hungarian bryologists take an active part in the work of the ECCB (European Committee for Conservation of Bryophytes) that can easily be harmonised with the aims of the HBMS.

The person collecting data must have appropriate qualifications in botany. Bryologist qualification is preferred, because the person must also discover the appearance of new populations throughout the country. A considerable amount of archived occurrence data of populations exists, however, some data are questionable and in some other cases even if we know the exact locality, it is not easy to find the species.

1. Questions

The basic aim of monitoring is not to test a scientific hypothesis, but to provide long-term data regarding the occurrence of the selected species, the status of the populations and their changes within Hungary.

Monitoring allows for:

- International evaluation of the protection status and the threat of selected species.

- Tracking changes in the distribution of the species.
- Providing biological references to support policy decisions.
- Long-term scientific research.

There are six moss species on the lists of the Bern Conventions (1991) in Hungary & the European Habitat Directive (1992). They are recorded from 46 localities. The currently documented population numbers are shown in brackets next to the locality numbers.

Species	Habitat	Quantity of localities	Life-strategy
<i>Buxbaumia viridis</i>	Decaying wood, Humic soil	5 (1)	C
<i>Dicranum viride</i>	The bark of tree	18 (10)	P
<i>Drepanocladus vernicosus</i>	marshland	10	P
<i>Mannia triandra</i>	Limestone cliffs	1 (1)	SL
<i>Orthotrichum rogeri</i>	The bark of tree	3	C
<i>Pyramidula tetragona</i>	Sandy, humic soil	9 (3)	AS

The life-strategy categories of the moss species (During 1979, 1992, Orbán 1984):

F (fugitive): ephemer species, high reproduction rate, many, small-sized (<20 µm) spores, no asexual reproduction, sporophyton is frequent, short lifetime (<1 year), mainly acrocarp species, unpredictable habitat appearance, short permanence, not stable, for example: *Funaria hygrometrica*

C (colonist): its lifetime is some years, medium reproduction rate, many small-sized (<20 µm) spores, many vegetative propagula, sporophyton is frequent, mainly acrocarp species, the permanence of the habitat is some years, unpredictable appearance, for example: *Bryum bicolor*

AS (annual shuttle): short lifetime (<1 year), high reproduction rate, a few large-sized spores, sporophyton is frequent, asexual propagula are missing, acrocarp species, short habitat permanence, predictable appearance, for example: *Phascum cuspidatum*

SL (short-lived shuttle): its lifetime is some years, medium reproduction rate, a few large-sized spores, vegetative propagula are missing, mainly acrocarp species, the permanence of the habitat is some years, predictable appearance, for example: *Bryum angustirete s.l.*

LS (long-lived shuttle or perennial shuttle): long lifetime, low reproduction rate, a few large-sized spores, sporophyton is frequent, vegetative propagula are frequent, the permanence of the habitat is many years, but its disappearance is predictable, acrocarp and pleurocarp species, for example: *Ortotrichum species*

P (perennial): long lifetime, low reproduction rate, many, small-sized spores, sporophyton is rare, vegetative propagula are infrequent, mainly pleurocarp species, the permanence of the habitat is many years, stable, for example: *Hylocomium splendens*

The monitoring is aimed to answer three main topics of questions, which are on different spatial scales, therefore require different approaches.

Questions:

How many occurrences exist in Hungary and how does their number change over time?

This question does not deal with the size of the local populations, it only focuses on their existence and the new appearances/disappearances. This is extremely important information which indicates the probability of survival and the threat of the species better than the status of some selected local populations. This is especially true for the following kind of species:

- (1) the lifetime of the species is comparable with their habitats' lifetime (i.e. species living on decaying wood or on live trees),
- (2) there are frequent disturbances in their habitats, which can kill the individuals of the species,
- (3) colonist species which require disturbance to establish their population, and
- (4) species which usually appear and reappear on different parts of the locality and have a short lifetime (i.e. some species of dry grasslands).

In the case of these mosses, the fluctuations of the local population size are large and the extinction and re-appearance of the population is frequent. This kind of data is very important to assess the species survival.

To what extent do the species expand within their suitable habitats?

This question is closely linked to the previous one. Colonization of species at potentially suitable habitats depends upon the dispersal ability of the species. It is very important to assess their mobility to estimate the importance of the existing local populations. We can gain knowledge on the population size required to colonize the potential habitats in different distances.

Tasks:

- To check localities based on archived data in the herbariums and references.
- To find new localities.
- To check the localities at defined intervals.

What is the size of local populations currently and how does this change over time?

This question requires finer scale information about the local populations. The aim is to assess the number of individuals, the size of their patches and their appearance/disappearance within the locality.

Tasks:

- To estimate the size of the populations at localities where the species was previously detected (based upon the data in the herbariums and references).
- To estimate the size of the populations within the newly discovered localities.
- To monitor the size of the populations within the localities at defined intervals

Are the species endangered at the sites of occurrence?

- a. What are the biotic and abiotic properties of the localities?
- b. How does the local population respond to the changes of the different environmental factors (what is the limiting ecological variable)?

The main endangering factors are the loss of habitats, degradation of habitats and significant changes of the ecological and environmental factors.

Tasks:

- record all remarkable information on site about the state of the habitat,
- Use the indication of the vascular vegetation to detect degradation or changes of the ecological/environmental factors.

1. Sampling Sites

Sampling sites are located within the known 46 localities of the six selected species. After rechecking known places, the number can decrease if the species have disappeared, but this number can also increase with species establishment in new localities.

2. Frequency of sampling

Sampling must be completed every 3 years for the perennial (P) species and every year for colonist (C) and short-lived shuttle (SL) species. Sampling should always be carried out in the most convenient period of the year according to the herbarium data. Sampling must always be completed in the same season at the same locality. In the case of the very short-lived, annual shuttle (AS) species sampling must be completed twice per year, in the spring (April) and in the autumn (November). For the first time to discover the existing populations sampling will likely need to be performed continuously or many times throughout the defined period (During 1979, 1992).

3. Sampling method

Distribution of the endangered species in Hungary:

Based on the archived locality data of the species, the recently existing and extinct populations should be explored. The main resources of the information are the floristical literature and the specimens deposited in herbariums. In the case of the short lived species, which can be detected only in a defined period of the year and do not appear absolutely on the exactly same place, it is very important to search for the species in the adequate period of the year and check all the suitable microhabitats within the locality and even after several unsuccessful years checking should continue for long time. For these species the size of sampling site could be extended.

Tasks:

- To mark the locations of existing population of endangered species in the **country map**
- **Point mapping** of the populations of the endangered species (**on 1:10000 scale map**).
- **Marking the locality**, the permanent sampling site

Locality: a geographical site, which can be marked and exactly delimited on the map, and its ecological characteristics can be described. Within this area the spread, reproduction of the species is not limited spatially, the adequate substrates are available and they are colonized by the individuals (patches) of the species. The size of the locality could be variable, but it should be marked on a map of 1:10 000 or 1: 5000 scale (eg. a valley, a forest stand or a rock wall). The different localities of the species are delimited spatially from each other and between them the spread of the species or migration is limited.

The localities found should be drawn up on a field sketch and should also be marked in the field in order to allow for subsequent sampling. A description on how to approach the site is also essential.

Population size of the endangered species

At the given permanent sampling site or locality

- **estimation of the number of individuals** (at least using the values given in the IUCN categories: 50, 250, 1000, 2500, 10000 individuals (Hallingbäck, T. et al. 1998)
- in the case of the species living on the bark of trees or on decaying wood (*Buxbaumia viridis*, *Dicranum viride*, *Orthotrichum rogeri*) according to the recommendation of ECCB (European Committee for Conservation of Bryophytes) the population size is equivalent to the **number of trees colonized** by the species
- in the case of the species forming mat or patches the number of individuals is equivalent to the number of patches.

Pyramidula tetragona – growing in small patches of 2 x 2 cm². According to the recommendation of ECCB (European Committee for Conservation of Bryophytes) the number of these patches is the number of individuals.

Drepanocladus vernicosus – the rare, endangered *Drepanocladus* species on the wetlands of Hungary can usually be found in patches of 1-3 dm². The number of these patches is the number of individuals.

Mannia triandra – thalloid liverwort. Number of thalli found is the number of individuals.

Is the species endangered on the given sampling site, locality due to the degradation or unfavorable changes of the environmental conditions?

- record site characteristics: forest clear-cutting, changes in the light conditions, degradation of the forest, appearances of weeds etc.

1. Variables studied

- how many localities, sampling sites of the species can be found in the country – **number of localities**
- **individuals/locality**

6. Data derived

Distribution in the country:

- number of localities of the species in the country/ number of localities of the species in the country in the previous sampling time x 100 – **actual number of localities/ previous number of localities x 100**
- number of localities of the species in the country/ number of localities of the species in the country in the first year of the monitoring x 100 - **actual number of localities/ number of localities in the first year of the monitoring x 100**

Changes of the population size of the endangered species on the given locality:

- **actual number of individuals/ previous number of individuals x 100** (changes of number of individuals in percentage)
- **actual number of individuals/ number of individuals in the first year of the monitoring x 100** (changes of number of individuals in percentage) – the data of the first year of the monitoring is not adequate in the case of short lived species as *Pyramidula* (AS), *Buxbaumia* (C), because the appearance of these species in a given year highly depends on the weather and other environmental conditions, hence in the case of these species the highest number of individuals estimated in the first 3-5 years can be regarded as the number of individuals of the starting point of the monitoring.

Estimation of the total population size of the endangered species in the country (number of individuals)

- **total population size in the given year (number of individuals)/ total population size in the given year (number of individuals) in the previous sampling year x 100** (changes of number of individuals in percentage)
- **total population size in the given year (number of individuals)/ total population size in the given year (number of individuals) in the first year of the monitoring x 100** (changes of number of individuals in percentage) – the data of the starting year of the monitoring is not adequate in the case of short lived species as *Pyramidula* (AS), *Buxbaumia* (C), because the appearance of these species in a given year highly depends on the weather and other environmental conditions, hence in the case of these species the highest number of individuals estimated in the first 3-5 years can be regarded as the number of individuals of the starting point of the monitoring.

7. Effort estimations

At each sampling site at least one person/day, but during the first sampling to find the existing populations and define the exact localities even 3-5 person/days could be necessary. The distributions of the localities in the country (distance and pattern of localities) support the sampling of the known localities of the six species with the defined frequency by 34 field days per year.

8. Antecedents

The localities are known due to classical botanical studies, the previously known localities at least once were already visited. The localities of the recently existing populations were designated, the monitoring has been started. The reinvestigation of archive occurrence sites where the checking was unsuccessful and the search for potential new localities are continuous tasks.

9. Evaluation

Explanation of the changes of the derived data

10. Summary

number of sampling sites	number of sampling sites/year	sampling unit/sampling site	person/day/sampling site	person/day/year field	person/day/year laboratory
46	34	1	1	34 (in the first year 68)	10

Literature

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