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Bryophyte community monitoring

IIb. PROJECT Wetlands
V. PROJECT Forest reserves – managed forests
VIII. PROJECT Saline-alkali habitats
IX. PROJECT Dry grasslands

Target: Trend monitoring of bryophyte communities of wetlands, saline-alkali habitats, dry grasslands, forests.

Target oriented monitoring: In some cases detection or evaluation of the effects caused by environmental impacts, land use, treatment (ground water level decrease, mowing, grazing, fragmentation, climate change stb.).

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General comments concerning the bryophytes can be found in the bryophyte species protocol of the I. project. The sampling of the bryophyte communities in these projects is completely connected with the sampling of higher plant communities, and sampling should be carried out by expert bryologist.

1. Questions

How does the species composition of the bryophyte vegetation change in various higher plant communities due to different effects or treatments (e.g. forestry activity, fragmentation, climate change)?

2. Sampling sites

Monitoring of bryophyte communities is carried out in 11 wetland, 8 forest, 2 saline-alkali and 11 dry grassland communities linked to the higher plant community monitoring project. The sites can be seen in the following table. In the case of forest communities the sampling sites mean sampling triplets: sampling plot in the core area of the forest reserve, in the buffer zone and a planted forest with non-native trees under similar habitat conditions. On the sites designated for trend monitoring sampling is carried out only in the core area of the forest reserve (*).

serial number	Association	Locality	Quadrate number	National Park
WETLANDS				
1	Caricetum appropinquatae	Inke		DD
2	Caricetum elatae	Barcs	58	DD
3	Carici lasiocarpae-Sphagnetum	Csaroda	64	H
3	Carici lasiocarpae-Sphagnetum	Kelemér	73	A
4	Carici echinatae-Sphagnetum	Őrség	85	FH
5	Eriophoro vaginati-Sphagnetum	Csaroda	64	H
5	Eriophoro vaginati-Sphagnetum	Kelemér	73	A
6	Schoenetum nigricantis	Káli medence	70	Bf
6	Schoenetum nigricantis	Fertő	66	FH
7	Calamagrostio-Salicetum cinereae	Gömörszőlős		A
8	Salicetum cinereae-Sphagnetum recurvi	Kelemér	73	A
9	Salici pentandrae-Betuletum pubescentis	Piricse, Júlia-liget		H
9	Salici pentandrae-Betuletum pubescentis	Bátorliget	59	H
10	Betulo pubescenti-Sphagnetum recurvi	Kelemér	73	A
11	Carici flavae-Eriophoretum	Gömörszőlős		A
FORESTS				
1	Thelypteridi-Alnetum	Bikafej (Hanság)		FH
2	Fraxino-Ulmetum*	Ócsa		DI
3	Corno-Quercetum	Cserépfalu, Kispiliske		B
4	Phyllitidi-Aceretum *	Hór-völgy		B
5	Mellitio-Fagetum	Csörgő-völgy		B
6	Querco petraeae-Carpinetum	Kelemér - Serényfalu		A

7	Querco robori-Carpinetum	Dédai		H
8	Quercetum petraeae-cerris	Várhegy		B
SALINE-ALKALI GRASSLANDS				
1	Artemisio-Festucetum pseudovinae	Angyalháza	56	H
1	Artemisio-Festucetum pseudovinae	Apaj	56	H
2	Achilleo-Festucetum pseudovinae	Angyalháza	56	H
2	Achilleo-Festucetum pseudovinae	Apaj	56	H
DRY GRASSLANDS				
1	Festucetum vaginatae	Csévharaszt		DI
2	Festuco vaginatae-Corynephoretum	Bolhás	58	DD
3	Festucetum pallentis	Pilistető	86	DI
4	Sedo sopianae-Festucetum dalmaticae	Szársomlyó	88	DD
5	Seseli leucospermo-Festucetum pallentis	Csákberény		DI
6	Minuartio-Festucetum pseudodalmaticae	Szarvaskő		B
7	Potentillo-Festucetum pseudodalmaticae	Tapolca/SztGyörgy hegy	90	Bf
8	Festuco pallenti-Brometum pannonici	Csákberény		DI
9	Chrysopogono-Caricetum humilis	Szár		DI
10	Seslerietum sadlerianae	Sas-hegy		DI
11	Potentillo arenariae-Festucetum pseudovinae	Bugac		K

3. Frequency of sampling

The sampling time is usually fit to the monitoring of the higher plant vegetation and the monitoring of bryophyte communities should be carried out in the same growing season (vegetation is not monitored each year, either).

In wetlands (II.b project) the sampling frequency is 3 years. It can be carried out in May or June, because the ephemer species appearing in spring are few in these habitats. It means the study of 2-9 sampling sites per year.

In forests wetlands (V. project) the sampling frequency is 4 years. It means the study of 2 sampling sites per year.

In saline-alkali grasslands (VIII. project) yearly sampling should be carried out in March or April, because the ephemer and short lived species (annual shuttle (AS), colonist (C) species) appear in spring with considerable frequency and abundance in these habitats. It means the study of 4 sampling sites per year.

In dry grasslands (IX. project) sampling should be more frequently than for the higher plant vegetation; the frequency of 2 years in necessary, because the frequency and abundance of species adapted to changing environmental condition is considerable in these habitats and the changes of the occurrence of these species should be monitored more frequently to track their dynamics. The sampling should be carried out in April as the ephemers appear mostly in spring. It means the study of 5 sampling sites per year. (The *Potentillo-Festucetum pseudodalmaticae* community due to its vulnerability can only be sampled every 6th year.)

4. Sampling methods

At each site and vegetation type 2 kinds of sampling method are used, there is an additional 3rd type of sampling method for forests:

I. Complete species list of the quadrates

Within the plots of 50 x 50 m marked for the higher plant community monitoring permanent quadrates of 10 x 10 m (16 x 16 m in forests) are selected and marked for bryophyte community monitoring. Species occurring in the quadrate are recorded and their abundance-frequency values are estimated in different substrates separately and summarised. The substrates can be soil, rocks, decaying woods, and living trees. The abundance-frequency value of each species is estimated on an ordinal scale of 4 levels as follows:

1 – very rare: only few individuals are detected.

2 – rare: the frequency of the species is intermediate but its abundance is low.

3 – frequent: the frequency is high but the abundance of the species is low or it appears in a few, large patches.

4 – abundant: both the frequency and the abundance of the species are high, it forms large patches, it plays an important role in the species composition.

II. Systematic sampling on the ground level of the quadrate

In the quadrates of 10 x 10 m (100 m^2) the bryophyte vegetation is systematically sampled in 25 sampling units of 0.5 x 0.5 m size that are set out along a grid at 2 m intervals. In forests the quadrate size is larger (16 x 16 m) and the number of sampling units is 64 using the same grid design. In the sampling units the occurrences of species are recorded (presence/absence data) and the substrates (soil, rock, decaying wood) of the species are also recorded.

III. Systematic sampling of epiphytic bryophyte vegetation in forests

Every standing tree (living or dead) present in the quadrate are included in the sampling of epiphytic bryophyte vegetation, which have a diameter of at least 19 cm at breast height. The sampling of epiphytic bryophytes is carried out at three levels: 10 cm (1. level), 70 cm (2. level), 140 cm (3. level) upwards from the base of the tree. A 10 cm wide cylinder is examined at each level (from the marked level 5-5 cm upward and downward), where the occurrences of the species are recorded (presence/absence data). The diameter, the species and the living/dead status of the trees is also recorded in each sampling unit (only for trees above the size limit). Usually the sampling quadrates contain 8-10 trees.

5. Variables studied

I. Complete species list of the quadrates

- The abundance-frequency value of each species estimated on an ordinal scale of 4 levels

II. Systematic sampling on the ground level of the quadrate

- frequency of the species (number of quadrates, where the species occur)
- relative frequency of the species (number of the occurrence of a given species/summarised number of occurrences of all species)

III. Systematic sampling of epiphytic bryophyte vegetation in forests

- frequency of the species in each level on the trees (number of samples, where the species occur)
- relative frequency of the species in each level on the trees (number of the occurrence of a given species/summarised number of occurrences of all species)
- diameters and species of the trees in the quadrate

6. Data derived

I. Complete species list of the quadrates

- species richness of the quadrate
- species richness on different substrates separately
- frequency of different life strategy type categories
- frequency of different life strategy type categories in different substrates separately
- proportion of F+AS+SL+C/F+AS+SL+C+LS+P life strategy type categories
- proportion of F+AS+SL+C/F+AS+SL+C+LS+P life strategy type categories in different substrates separately

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 proportion of F+AS+SL+C / F+AS+SL+C+LS+P life strategy categories means the proportion of short-lived species in the bryophyte community.

- proportion of water requirement categories (W value)
- proportion of water requirement categories (W value) in different substrates separately

The water requirement categories (W value) are defined on an ordinal scale of 11 levels according to Zólyomi and Précsényi (1964). Life strategy categories and water requirement categories (W value) for the Hungarian bryophyte flora were given by Orbán (1984).

Only in the case of dry grasslands additional data:

- proportion of composite European distribution categories
- proportion of composite European distribution categories in different substrates separately

European distribution categories given by Düll (1983, 1984, 1985, 1992) were composed for the evaluation; the composite European distribution categories are the follows:
1. med: submed (submediterranean)+suboc (subatlantic)+med (mediterranean)+oc (atlantic)
2. temp: temp (temperate zones of Europe)
3. kont: subkont (subcontinental)+kont (continental)
4. bor: subbor (subboreal)+bor (boreal)+mont (montane)
5. cosm: cosm (cosmopolitan)

II. <u>Systematic sampling on the ground level of the quadrate</u>

- species richness of the quadrate
- mean species richness of sampling units (average±standard deviation)
- Simpson diversity and evenness of quadrates (Tóthmérész 1996)
- frequency of different life strategy type categories weighted by the frequency of species
- proportion of F+AS+SL+C/F+AS+SL+C+LS+P life strategy type categories weighted by the frequency of species
- proportion of water requirement categories (W value) weighted by the frequency of species
- proportion of composite European distribution categories weighted by the frequency of species, only in dry grasslands

III. Systematic sampling of epiphytic bryophyte vegetation in forests

Following derived data for each level on the trees:

- species richness of the quadrate
- mean species richness of sampling units (average± standard deviation)
- Simpson diversity and evenness of quadrates (Tóthmérész 1996)
- frequency of different life strategy type categories weighted by the frequency of species
- proportion of F+AS+SL+C/F+AS+SL+C+LS+P life strategy type categories weighted by the frequency of species
- proportion of water requirement categories (W value) weighted by the frequency of species

7. Effort estimations

sampling sites	38
sampling sites / year	(2-9)+2x(1-3)+4+5
sampling units / site	25 or (1-3) x 64 + (1-3) x (8-10) x 3
person/ day/ sampling site	2
person / day / year field work	26 - 48
person / day / year laboratory work and data processing	26 - 48

8. Antecedents

The localities are selected on the base of field knowledge. The method was elaborated during the pilot project at three localities.

9. Evaluation

Besides the explanation of the changes of the derived data there is a possibility to analyse the long-term dynamics of the bryophyte assemblages.

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
38	13-24	25-282	2	26-48	26-48