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Summaries of Ph D. and Diploma Thesis

Dissertationen (Ph D. thesis)

KRüSI Bertil. Phenological methods in permanent plot research.

The indicator value of phenological phenomena. A study in limestone grassland in northern Switzerland. Veröff.Geobot. Inst.ETH, Stiftung Rübel 75, 115 S.

Phänologische Methoden bei Dauerquadratuntersuchungen.
Der prognostische Wert phänologischer Phänomene. Eine Untersuchung in Halbtrockenrasen (*Mesobrometum*) in der Nordschweiz.

The paper deals with the possible indicative value of short- and mid-term phenological observations. The investigations were carried out in *Mesobrometum* limestone grassland in northern Switzerland. The first data on the phenological behaviour as well as the cover of seven plant species within surfaces subjected to one of four different treatments (cutting in June, cutting in October, burning in March, no management) is presented. In addition, the phenological response of whole communities to the aforementioned treatments as represented by synthetic colour diagrams is considered.

Short-term phenological records collected throughout a single vegetation season led to conclusions that were not always found to be infallible. Mid-term observations, on the other hand, turned out to be quite good predictors of future development; conclusions based upon these observations were corroborated by comparing communities representing various successional stages as well as by the long term data of other authors. Phenological observations

were shown to indicate habitat alterations earlier than traditional relevés, not only when considering individual species, but also where whole communities are concerned; the time difference sometimes reached as much as ten years. Conclusions drawn from mid-term phenological data were in the long term often more correct than those based upon mid-term phytosociological records.

As far as the cover of a given species is concerned, the response to changing environmental conditions was found to be mostly slow and sometimes rather ambiguous. On the other hand, the different treatments affected the flowering intensity of the seven presented species in the following way:

- Cutting in June proved to be rather unfavourable for *Aster amellus*, *Buphthalmum salicifolium*, *Brachypodium pinnatum* and *Primula veris* s.l., advantageous for *Bromus erectus*, *Ranunculus bulbosus* and *Orchis pallens*.
- Burning in March was not shown to date to cause severe damage to any of the studied species, excepting *Ranunculus bulbosus*; it turned out to be advantageous for *Aster amellus* and particularly so far for *Brachypodium pinnatum*.
- Cutting in October was observed to considerably damage *Bromus erectus* and *Ranunculus bulbosus*; the performance of *Buphthalmum salicifolium* was only slightly affected whereas the behaviour of *Primula veris* s.l., *Aster amellus* and *Brachypodium pinnatum* apparently remained unaltered. *Orchis pallens* was not observed in those surfaces.
- 'No management' proved to have a highly unfavourable influence upon *Bromus erectus* and *Ranunculus bulbosus*; it was apparently advantageous for *Primula veris* s.l., *Aster amellus* and *Buphthalmum salicifolium*. *Orchis pallens* and *Brachypodium pinnatum* appeared to remain unaffected.

The limitations of phenological methods are briefly discussed. Phenological phenomena being very responsive to meteorological conditions, the use of control plots is most important. Furthermore, microdifferentiation occurring in some species may limit the indicator value of phenological data.

In conclusion, the significance of phenological methods in active conservation management is stressed; particularly in this connection, early indicators revealing possible unfavourable effects of a given treatment on threatened species are greatly needed.

SPIRIG Amadeus. Zum Wasserhaushalt verschiedener Strassenbaumarten unter dem Einfluss der winterlichen Streusalzanwendung. Veröff. Geobot.Inst.ETH, Stiftung Rübel 74, 68 S.

Water regime of several roadside tree species as influenced by the use of de-icing salt in winter.

The effects of de-icing salt in the waterbalance of four roadside tree species (*Quercus robur*, *Aesculus hippocastanum*, *Tilia x euchlora* and *Plantanus acerifolia*) were investigated. Transpiration, water saturation deficit, osmotic potential and waterpotential were measured in two vegeta-

tion periods; other variables were deduced from them. The results are characteristic for salt-stressed trees of the respective species on the dividing strip of a road.

The soil types were comparable for all sites, the saltstressed sites had to be classified as drier. Atmospheric waterstress was greater (*Aesculus*, *Quercus*) equal (*Tilia*) or smaller (*Platanus*) than measured for controls.

Salinity, climatic and edaphic conditions produced a different reaction in each species. *Quercus* increased its waterturnover at the saltstressed site without disadvantageous consequences for its waterbalance. This could be explained by the ecophysiological possibilities and anatomical-morphological adaptations of these species. *Quercus* has an efficient stomata-regulation system, and its low osmotic potential allows for a low water-potential, which in turn provides sufficient water supply. Salts ions were excluded.

The relatively balanced water relations of *Aesculus* at the saltstressed site were interpreted as a consequence of a decreasing transpiration rate that was veiled by the so-called Iwanoff-shock. An improved water supply caused by a decreasing waterpotential could be found, although the uptake of salt ions seemed to indicate osmotic adaptations and resulted in an apparently low osmotic potential and a surprisingly high turgor.

Tilia reduced drastically its transpirational water loss at the saltstressed site. It was concluded that the incorporated salt ions changed the stomatal and intercellular diffusion resistance to water vapour. The other measured parameters indicated small if any variation in waterbalance.

The unfavourable environmental conditions at the control site of *Platanus* together with the increased diffusion resistance - probably also due to incorporated chloride - at the saltstressed site caused a more balanced water regime of the specimen at the saltstressed site.

In this paper it was found that the tree species unable to exclude salt ions selectively and taking up chloride - eventually sodium - ions showed an increased resistance and a decreased transpiration rate. This led to an improved water balance at the saltstressed sites. Due to the increasing concentration of salt ions more negative osmotic potentials were measured at the saltstressed sites what seemed to indicate osmotic adaptation. It however must be considered that this probably does not reflect the cytoplasmatic reality, since the waterpotential did not decrease correspondingly.

As a consequence of the in general negligible changes in overall waterbalance the hypothesis that the use of the de-icing salt would cause a "physiological dryness" in the sense of SCHIMPER had to be abandoned. Conclusively, de-icing salt seems to affect the investigated roadside trees rather by the toxicity of its components than by their osmotic effects.

Diplomarbeiten (Diploma thesis)

GASSER Max. Differenzierungsmuster von Pflanzenarten, die auf verschiedenen Gesteinsunterlagen wachsen - am Beispiel von *Biscutella levigata* s.l. 143 S. (Manuskript).

Differentiation pattern in plants inhabiting various alpine substrata - exemplified by *Biscutella levigata* s.l.

The aim of the study was to get a better comprehension of ecological-genetical differentiation in *Biscutella levigata* s.l. and to assess life strategies of this group. Two populations respectively occurring upon dolomite and serpentine within the alpine vegetation belt near Davos, Grisons (eastern Switzerland) were chosen for this purpose.

Morphological variation was studied in six diagnostic characters. Except for the ratio: short/long hairs at the leaf margin, no statistically significant differences occurred between the two populations studied. All the plants examined were tetraploid ($2n=4x=36$); this result corresponded to the general distribution pattern of the *Biscutella levigata* group, tetraploids occurring within the central part of the alpine area.

Studies in germinating behaviour and first developmental stages of seedlings were carried out both in laboratory as well as in field. Seeds from both substrata germinated very well on moist blotting paper under controlled laboratory conditions. On the other hand, trials carried out with alpine soils in greenhouse were less successful, a relatively good germinating being observed only in seeds originating from dolomite and sown upon dolomite. The field trials revealed differences in germinating behaviour mostly due to a distinct influence of the substratum. A particularly strong influence of the substratum was also observed during the early developmental phases in young seedlings, not only the mortality but also the actual development of surviving individuals indicating differential responses.

Biscutella levigata s.l. was found to occur more or less continuously upon both substrata with local colonies forming a mosaic pattern. Detailed demographic studies dealing with occurrence and distribution of age-determined variants were the first of the kind carried out in the Alpine area. The population structure, studied in 22 plots of 1 m² each, varied according to the type of ecological niches. Two distinct patterns were observed:

1. Colonies occurring in grassy slopes were not densely populated and mostly consisted of irregularly distributed groups of individuals. Non-reproducing rosettes largely prevailed in a given colony, whereas seedlings were scarce.
2. Colonies inhabiting scree slopes generally consisted of about twice as many individuals as did the grassy surfaces studied. The plants were irregularly distributed and tended to occur in groups. Seedlings were particularly frequent.

The results obtained suggest a local racial differentiation within *Biscutella levigata*, reflected already in early life phases of the plants and

possibly influenced by the substratum type as well as niche conditions. An apparently flexible behaviour of *B. levigata* might prove advantageous in revegetation trials carried out in machine-prepared alpine ski runs.

GASSER Ubald. Zum Verhalten der Buche auf organischen Nassböden.
62 S. (Manuskript).

Ecological conditions limiting the distribution of *Fagus silvatica* on wet organic soil.

The aim of the present investigation was to describe the factors that limit the distribution of beech (*Fagus silvatica*) along a humidity gradient in the Swiss Midlands, using phytosociological and pedological methods. Places with the same general climate were chosen as study sites: Boneggen (Rifferswil), Chatzensee (Regensdorf and Zürich) and Schorenwald (buch near Frauenfeld and Warth).

A vegetation table, the phytosociological part of the paper, shows that beech in the lower tree layer advances from *Galio odorati* - *Fagetum typicum* to *Pruno-Fraxinetum* and *Pino-Betuletum pubescentis*. In the shrub layer, beech can also be found in the transition zone between *Pino-Betuletum pubescentis* and *Carici elongatae* - *Alnetum glutinosae*.

The results of the soil profiles have been combined in figure B. The profiles could be divided into three main soil units: parabrown-earth, gley and fen. At the limit of beech trees, the peat layer often reached 100 cm. On some study sites, the ground water level was also measured. During the measuring period, the ground water level under *Pruno-Fraxinetum* and *Pino-Betuletum pubescentis* oscillated between 20 and 60 cm underground. Wherever the ground water level reached a maximum of 5 cm underground, beech could be found only in the shrub layer.

HINZ Petra-Andrea. Zum Verhalten der Buche in feuchten Laubmischwäldern.
106 S. (Manuskript).

Ecological conditions limiting the distribution of *Fagus silvatica* on wet mineral soils derived from young moraines.

The present paper deals with the phytosociological and ecological conditions limiting the distribution of *Fagus silvatica* along a humidity gradient on mineral soils. Five study sites in the northern Swiss Midlands are described.

Vegetation relevés have been arranged in a table according to increasing humidity, as indicated by ground water measurements, by the presence of indicator plants, and by the level above the lowest topographical point. The vegetation units were categorized according to the forest associations described by ELLENBERG and KLÖTZLI (1972):

- *Galio odorati* - *Fagetum luzuletosum*
- *Galio odorati* - *Fagetum typicum*
- *Aro* - *Fagetum**
- *Ulmo* - *Fraxinetum listeretosum*
- *Pruno* - *Fraxinetum**
- *Carici elongatae* - *Alnetum glutinosae*

(and transition vegetation units between those marked with an asterisk).

Based on the vegetation units, an absolute limit of beech within wet mineral soils can be seen at the transition area from *Pruno-Fraxinetum* to *Pruno-Fraxinetum/Carici elongatae - Alnetum glutinosae*, whereas regular beech regeneration (in the herbaceous layer) can only advance as far as the *Ulmo-Fraxinetum listeretosum/Pruno-Fraxinetum* areas.

The soil profiles show that fastidious beech forests grow on parabrown-earth, which may occasionally exhibit gleyification spots. The black alder swamp forest grows on wet soils, which are at times saturated to the surface. The transition zone is characterized by pseudo-gleys, where the water contains more moisture. *Fagus silvatica* reaches a growth limit, according to the moisture of wet soils, as soon as the permanently oxidized horizon is less than 20 cm deep.

The study site Abist (Marthalen), named "Abist-variant", is treated separately in this study. There *Fagus silvatica* can grow on sandy-silty gley which at times is saturated to the surface by a higher permeability than that of wet clay soils.

On wet pseudogley, *Fagus silvatica* requires a permanently oxidized soil depth of at least 20 cm to be able to grow. Therefore, beech can only advance into *Pruno-Fraxinetum* and *Carici elongatae - Alnetum glutinosae* is beech free.

JUCHLER Stephan. Junge Böden auf Strassenböschungen; eine Untersuchung von jungen, geschütteten Böden in der Nordschweiz unter Berücksichtigung der Vegetation. 84 S. (Manuskript).

New soils and vegetation on highway slopes.

In northern Switzerland, soil and vegetation of a one-year-old highway slope were compared with those of five railway embankments that were over 100 years old. Due to the method of construction, the top soil of the highway slope is loose and humus rich, and has layers parallel to the slope; beneath the top soil, the layers are horizontal and very compact. This compactness inhibits root penetration below 50 cm. The pH is 7.6 - 9.0, lime content is about 20%, K-supply is medium, and P-supply is deficient. In contrast, the 100-year-old soils are rich in humus and show no distinct layers. The pH is 6.7 - 7.8, lime content is about 10%, K-supply is sufficient, and P-supply is medium.

About 50% of the 19 to 40 species found in the railway embankments are characteristic of dry limestone grasslands (*Meosbrometum*), the rest are typical of fertilized grasslands, forest fringe and ruderal habitats.

Among the factors inhibiting the development of typical *Mesobrometum* are the relatively low limestone content, the excessive nutrient supply and the frequent mowing. For establishing *Mesobrometum* grasslands on highway slopes and railway embankments, it is suggested that only non-weathered coarse soil material be used, that as few nutrients as possible (thin or no humus layer) be applied, and that mowing take place at least once but no more than twice a year (no mulching).

MARTI Roland. Zum Wasserhaushalt von Düngewiesenpflanzen.
61 S. (Manuskript).

Water relations in plants of fertilized grasslands.

In a *Arrhenatheretum* and a *Mesobrometum* grassland near Schaffhausen the variability of stomatal leaf resistance against water vapour transfer (r_1) was studied for four species, each according to the level of the population, the individual plant, and the single leaf. The variability on all these levels was quite significant. A standard leaf section was defined for every species as the youngest, fully-expanded mature leaf section with the lower r_1 and the lowest variability of r_1 between the different individuals. The standard leaf section in *Taraxacum officinale* was at the tip, in *Centaurea jacea*, in the middle and in *Trisetum flavescens*, at the base of the leaf. *Dactylis glomerata* showed no significant differences in r_1 along the entire leaf. It is proposed for standardization that r_1 measurements always be carried out on the youngest, fully expanded, mature leaf at its largest section.

Measurements on *Centaurea jacea* showed that the intrapopulation variability of r_1 is as large as the interpopulation variability (standard deviation of the logarithms of r_1 is 30-40% of the mean). As expected, old leaves had higher r_1 values than mature or young leaves, with differences up to 100% of the r_1 for the mature leaf. During r_1 measurements, xylem water potentials and microclimate factors were also measured. Considerable improvements in the calibration procedure of the automatic porometer (Mk 3 by Delta-T Devices, Cambridge) were achieved.

SALVIONI Marco. Bestandesdichte der Feldmaus (*Microtus orvalis*, Pallas) in verschiedenen Oekosystemen bei Merishausen (SH).
81 S. (Manuskript).

Population density of the common vole (*Microtus orvalis*) in grassland ecosystems of northern Switzerland.

The relation between vole density and the number, distribution and turnover of vole burrows (colonies) was studied on three fertilized and two unfertilized limestone meadows in northern Switzerland. The role of vole colonies as microhabitats for certain plant species is also discussed.

The density showed significant variation between meadows and during different seasons. The lowest density was 0 vole and 9 abandoned colonies/ha;

the highest density was 408 voles and 32 colonies/ha, which covered 6% of the meadow. At higher densities the distribution of the colonies tended to be regular. The number of burrow entrances of a colony showed a positive correlation with its area, whereas no correlation was found between the area of a colony and the number of its inhabitants.

New vole colonies were often established in abandoned burrows of moles (*Talpa europea*) and water voles (*Arvicola terrestris*). The colonies on fertilized meadows were smaller than those on unfertilized meadows. Small colonies often arose and disappeared within one year, whereas large colonies seemed to be more stable in time and areas occupied. This turnover rate was more pronounced in fertilized grasslands. For example, voles of two meadows left their colonies after hay harvest, translocated into hedges, and then returned after a few weeks.

ZUUR-ISLER Doris. Zum Keimverhalten von alpinen Pflanzen auf Serpentinböden. 104 S. (Manuskript).
(Gekürzte Fassung in Englisch s.S. 76 dieses Bandes).
Germinating behaviour and early life phases of some species from alpine serpentine soils.
(See p. 76 short-version in English).

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