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Englische Zusammenfassungen von in den Berichtsjahren 1975 und 1976 abgeschlossenen Dissertationen und Diplomarbeiten

Summaries of Ph D. and Diploma Thesis

Um die Leser über die am Institut fertiggestellten Doktor- und Diplomarbeiten zu orientieren, soll im Folgenden eine kurze Zusammenfassung in Englisch die wichtigsten Ergebnisse mitteilen. Die Angaben wurden von den ständigen wissenschaftlichen Mitarbeitern des Institutes zusammengestellt. Die Dissertationen sind als Veröffentlichungen am Institut käuflich erhältlich, während die Diplomarbeiten nur in einem Exemplar vorhanden sind und in der Institutsbibliothek eingesehen werden müssen.

Dissertationen (Ph D. thesis)

1975

GROSSMANN, Fritz. Morphologisch-ökologische Untersuchungen an *Scabiosa columbaria* L. s. l. im mittleren und westlichen Alpengebiet. Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich, 52, 129 S.

Morphological and ecological investigations in *Scabiosa columbaria* L. s. l. from middle and western Alpine region.

The paper deals with morphology and ecology of the collective species *Scabiosa columbaria* L. from Central and Western Alps. The following taxa were studied: *S. lucida* Vill., *S. columbaria* L. s. str., *S. portae* A. Kerner, *S. gramuntia* L., *S. vestita* Jordan, *S. candicans* Jordan, *S. dubia* Vel. In addition, the author studied *S. tomentosa* Cav. from Spain, *S. unisetata* Savi from the Apennines, *S. columbaria* s. str. and *S. ochroleuca* from northern and western part of Europe as well as some material from Ethiopia.

The results point to complex relations between ecology and morphology occurring within the group. Altitude, soil temperature, exposure and degree of the vegetation cover greatly influenced most of the quantitative morphological characters, in particular the length and the breadth of the calyx bristles, relative length of the leaf segments in the uppermost pair of the cauline leaves and the height of plants. The beginning of flowering was also correlated with the above mentioned ecological factors.

Variations of some morphological characters within *Scabiosa columbaria* s. l. apparently is related to the geographical distribution of the group. For instance, the density of the pubescence of the rosette leaves

clearly increased along a north-south gradient. The distribution areas of the studied taxa being partly overlapping, numerous intermediate forms were found in the contact zones and it is conceivable that they represent products of the gene exchange.

The chromosome numbers found in the studied material stay in agreement with the previous data: all taxa of the *S. columbaria* group proved to be diploid ($2n=16$). Numeral experimental crosses performed in various combinations indicate that the taxa of the groups are fully intercompatible, neither the seed germination nor the fertility of the obtained hybrid plants being affected.

Scabiosa columbaria s. l. seems to hold an isolated position within the genus, as indicated by unsuccessful attempts to cross its representatives with those of *S. canescens* Waldst. et Kit. and *S. vestina* Facch. considered as the nearest relatives of the group.

In conclusion, the author presents a key for the determination of the taxa representing the group of *S. columbaria* in the studied area.

HAUSER Margit Luise. Zytotaxonomische Untersuchungen an *Campanula patula* L. s. l. und *C. Rapunculus* L. in der Schweiz und in Oesterreich. Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich, 53, 70 S.

Cytotaxonomical study on *Campanula patula* L. s. l. and *C. Rapunculus* L. from Switzerland and Austria.

The investigation deals with cytotaxonomy and ecology of *Campanula patula* and *C. Rapunculus* from the Alps as well as some Alpine forelands of Switzerland and Austria.

C. patula proved to be differentiated into three races: 1/ a northern diploid race ($2n=20$) that attains its southern limit in central Alpine valleys (*C. patula* L. s. str.); 2/ a southern diploid race ($2n=20$) whose northern limits correspond to the upper Rhine valley and Central Alpine valleys (*C. Costae* Willk.); 3/ a tetraploid race ($2n=40$) with the distribution area partly overlapping that of the northern diploid race (*C. jahorinae* (K. Maly) Landolt (*C. patula* var. *jahorinae* K. Maly, Oesterr. Bot. Z. 57, 1907, p. 184)).

The chromosome sets of diploid plants consisted of metacentric and/or submetacentric chromosomes; the proportion of particular chromosome types was different in each of the two races, longer chromosomes prevailing in the karyotype of the southern diploid. The tetraploids most frequently had shorter chromosomes, resembling in this respect the northern diploid race.

The most useful morphological characters for determination of the particular races were length and form of the sepals as well as the ratio: length of the sepals/length of the free parts of the petals. The plants belonging to the northern race had short sepals, those of the southern race were much longer, whereas the tetraploids represented an intermediate type.

The northern diploid race of *Campanula patula* grows on moist or dry, only slightly fertilized soils, appearing in some variants of the *Arrhenatheretum* and the *Mesobrometum*. The southern diploid occurs in dry, not much fertilized soils inhabited by communities of the *Arrhenatherion* and *Mesobromion*. The habitats of the tetraploid race are comparable to those of the northern diploids.

Successful experimental crosses suggest no distinct genetic barriers occurring between the two diploid races of *C. patula*. The experimental data agree with the field observations, for natural hybrids were found by the author in the region where the two diploids come into contact. On the other hand, experimental hybrids between diploids and tetraploids were obtained only when diploids were used as female parents.

The results obtained in the course of the study point to a putative hybrid origin of the tetraploid race of *C. patula* that might have arisen from crosses between representants of the southern and the northern diploid races.

C. Rapunculus L. occurs all over Western and Central Europe and shows rather a limited morphological variability. Its diploid chromosome set ($2n=20$) consists of meta- or submetacentric chromosomes, rather long as compared to *C. patula* s.l. In its ecological requirements *C. Rapunculus* is comparable to the southern race of *C. patula*. Experimental crosses show a well-marked genetical affinity between *C. Rapunculus* and the whole group of *C. patula*. However, no hybrids were found in the wild and only a few herbarium specimens could have been considered as putative hybrids.

GADEKAR, HIRASA. Ecological conditions limiting the distribution of *Fagus silvatica* L. and *Abies alba* Mill. near Schwarzenberg (Lucerne), Switzerland. Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich, 54, 98 S. + Vegetationstabelle.

The aim of the investigation was to find factors limiting the distribution of *Fagus silvatica* (beech) on podsol in the northern Swiss Pre-alps. As a study site Guberwald (Schwarzenberg) near Lucerne was chosen because there two different associations occur under the same climate: *Bazzanio-Abietetum typicum*, *Leucobryum* variant with *Abies alba* (fir) as dominant on podsol and pseudogley and *Abieti-Fagetum typicum* with beech as dominant on slope brown-earth.

- The course of soil water potential (tensiometer) showed that soil water is not a factor limiting the growth of beech seedlings.
- The amount of total exchangeable metal cations is very small (13 meq./100 g) in 1 - 60 cm depth of podsol whereas it is larger (125 meq./100 g) in the same depth of brown-earth.
- Inspections in May showed that 95 - 100 % of beech nuts sown in January were eaten by birds and rodents. When wire mesh cases were installed a higher germination percentage was observed on brown-earth. Greenhouse experiments showed that beech nuts do not germinate on the surface

of the soils while fir seeds do. The failure of beech nuts is due to lack of good contact with soil. In the field, beech nuts germinate on brown-earth because rainfall, surface run-off, earthworms and frost bring them in good contact with soil. On podsol they do not germinate because they come to lie on fir litter where neither they are in good contact with soil nor can imbibe enough water. Fir seeds germinate even on litter layer; because of their fine seed coat they imbibe water quickly.

- Countings of seedlings on 4 m² plots revealed that beech regenerates profusely on brown-earth while rarely on podsol.
- Root/shoot ratio for beech seedlings is greater on podsol than on brown-earth. On podsol the tap root system is suppressed and lateral roots grow profusely in the humus layer. On brown-earth the tap root grows deep into the soil while lateral roots are suppressed. The tap root of fir seedlings grows deep into the soil.
- In the humus layer of podsol, beech nuts encounter strong root competition from *Vaccinium myrtillus*. Fir escapes root competition by sending the tap root into deeper horizons of podsol.
- Increment studies of saplings showed a trend that beech grows slowly on podsol, whereas fir saplings grow well. Therefore, fir dominates over beech already in early age under otherwise comparable conditions.

Dissertationen (Ph D. thesis)

1976

MEYER, Martin. Pflanzensoziologische und ökologische Untersuchungen an insubrischen Trockenwiesen karbonathaltiger Standorte. Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich, 57, 145 S. + 2 Vegetationstabellen.

Phytosociological and ecological investigations on dry grasslands on calcareous habitats in Insubria.

The phytosociology and ecology of natural anthropogeneous *Chrysopogon gryllus*-grasslands on calcareous soils were studied in the area between Lago Maggiore (southern Switzerland) and Lago di Garda (northern Italy).

These grasslands can be grouped into the association of the *Carici humilis-Chrysopogonetum grylli*, which is relatively independent from the *Bromion* and the *Displachnion* and also from *Chrysopogon gryllus* grasslands on Yugoslavia, Hungary and Romania. The association can be subdivided as follows (order of decreasing aridity):

- (a) *Carici humilis-Chrysopogonetum grylli fumanetosum*, consisting of:
 - (1) *Diplachne serotina* variant
 - (2) *Helianthemum italicum* variant
 - (3) typical variant
 - (4) *Aster linosyris* variant
- (b) *Carici humilis-Chrysopogonetum grylli galietosum*, consisting of:

- (5) *Leontodon tenuiflorus* variant
- (6) typical variant
- (7) *Vinca minor* variant

On slightly acid soils an additional association occurs, the *Holco-Chrysopogonetum grylli*.

The successional relations between these various plant communities are shown in a diagram.

The *Carici humilis-Chrysopogonetum grylli* grasslands replace the *Fraxino orni-Ostryetum* forests in sites periodically burnt or cultivated extensively. Another factor determining the occurrence is radiation: it must reach 220 kcal/cm² year in the region of Lago di Garda and has to more than 260 kcal/cm² year in the region of Lago Maggiore.

The soils of subassociation (a) are mainly shallow of moderately deep moderrendzinas or mullrendzinas. The other subassociation occurs on relatively deep and slightly acid soils, which are much influenced by human activity.

Measurements of soil water contents during several months, desorption curves and other investigations allowed to estimate contents of readily available water in soils. The moisture gradient in respect to these contents corresponds to that shown by the vegetation table. On Monte Caslano the (top) soil water stress was often higher than 15 atm.

BURNAND, Jacques. *Quercus pubescens*-Wälder und ihre ökologische Grenzen im Wallis (Zentralalpen). Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich, 59, 138 S. + 2 Vegetationstabellen.

The *Quercus pubescens* woodlands in the Valais (Swiss Central Alps) and their ecological limits.

As a part of the general investigations on the limits between deciduous and coniferous forests, the common area of *Pinus silvestris* and *Quercus pubescens* forests was analysed in the Valais, a region with continental climate where these two species are the only important forest trees at lower elevations.

On the base of a model it has been shown that the distribution is mainly determined by irradiation and altitude and not by parent rock or nutrient supply. The oaks are restricted to the sites with strong irradiations, the minimum irradiation increasing with increasing altitude. *Quercus* further avoids depressions where the late spring frosts occur. *Pinus* grows on all sites where *Quercus* cannot exist.

The not destroyed forests suffered the influence of human activities (fire, pasturing, coppicing) for centuries, and some oak woodlands were transformed into pine or more pine rich stands. It became evident that the distribution of *Quercus* species and conifers in Valais is determined by the same factors as in other mountain regions with continental climate and

similar irradiation conditions (inner valleys of central and western Alps, mountains of the south-western United States, inner valleys of the north-western Himalayas, some Caucasus valleys).

From the phytosociological point of view, the Valais oak woods can be divided into two associations according to climate and parent rock conditions: into the *Campanulo (trachelii)-Quercetum pubescentis* under less continental climate at the limit towards the outer Alps, on silicate soils, and into the *Saponario (ocymoidis)-Quercetum pubescentis* in the center of the Valais.

Special suggestions are given for the conservation of the most outstanding oak woods.

WILDI, Otto. Beschreibung exzentrischer Hochmoore mit Hilfe quantitativer Methoden. Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich, 60, 128 S. (erschienen 1977).

Numerical analysis of vegetation and site conditions on excentric peat bogs.

Relations between vegetation and site factors on peat bogs were investigated in the surroundings of Rothenthurm and Einsiedeln (cantons of Schwyz and Zug) employing various quantitative methods.

As a result, four groups of site factors were distinguished, viz. the acid-base conditions of water and peat, factors connected with physical conditions of peat, water economy of the peat bog, electric conductivity of the water.

Relations between the vegetational set-up and the site factors proved to be differentiated. The highest affinity of vegetational structure was found in respect to the pH of the turf, then to exchangeable H^+ -ions, the phosphate content of peat, the pH of the water, the base saturation, the content of Ca^{++} of the water and the cation exchange capacity. The diversity of vegetation tended to increase with the degree of decomposition of the peat. The best correlation was found between the number of species per square meter and the ash in the peat, followed by the cation exchange capacity and exchangeable H^+ -ions.

The ecological classification of peat bogs can be based on base saturation of the peat, a criterion which is at least as good as the commonly used Ca^{++} concentration of water.

Besides assessing mean values and standard deviations of the measured site factors in the proposed units of vegetation and considerations on a site characterisation based on vegetation and vice versa (ordination), further numerical analysis were used to give

- information about resemblance structure of the vegetation data in a geometric similarity model (factor analysis),
- a proposal of classification of the vegetation data (cluster analysis,

- discriminant analysis),
- a description of alteration of several site factors along a vegetational gradient (trend surface analysis).

In conclusion, systems analysis is considered as an effective method to explain the function of an excentric peat bog.

Diplomarbeiten (diploma thesis)

1975

GRÜNIG, Andreas. Lochbildungen im Röhricht. 66 S. + 8 Karten und Luftbilder (Manuskript).

Formation of gaps in reed-belts.

Regression of reed-belts near Altenrhein on Lake Constance (Swiss part) was evaluated for the period 1926 - 1974. Out of various methods used photogrammetrical analysis of aerial photos proved to be best. The limits of reed beds during this period were printed on maps 1 : 1500 and their surfaces were planimetrised with a Hewlett-Packard electronic digitizer enabling a comparison of their status in different years. During the evaluated period this regression amounted to at least 60 % of the original surface, thereby also changing the respective profiles of the shore bench.

Factors responsible for the regression of reed beds and so-called gap formation are discussed. Water and nutrient regime are considered as the most important factors. They have changed most during the last 50 years and are connected with many other factors. However, no single leading factor can be isolated out of this complex characterizing eutrophication and change of water regime.

ROOS-SCHENKER, Luzia. Oekologie langjähriger Schafweiden im nördlichen Mittelland. 46 S. + 1 Vegetationstabelle (Manuskript).

Vegetation and site conditions on continuously grazed sheep pastures in the northern Swiss Midlands.

In the northern Swiss Midlands sheep pastures were compared with common cattle pastures as well as fertilized and unfertilized meadows. As a result of selective sheep grazing many species - mostly meadow plants (*Arrhenatherion*) - disappear; most frequently however, it does not concern taxa deserving a special protection.

The effects of grazing on the top soil conditions are tolerable, soil compression being dependent on parent rock only and not on pasturing intensity, the soil recovering quickly from excessive pasturing. Humus content is highest on cattle pastures followed by sheep pastures and regularly mown meadows. Comparison with dry meadows showed the prevalent influence of water regime and not of pasturing upon the composition of the sward. Differential species on sites with somewhat compressed topsoils were the drought-tolerant species *Plantago media*, *Agrimonia eupatoria*, and *Leontodon hispidus*, whereas typical plants of sheep pastures were *Trifolium fragiferum* and *Potentilla anserina*, both tolerating trampling and typical for optimum light conditions down to the soil surface.

SPRENG, Beatrice. Wirkung von Schafbeweidung in der alpinen Stufe.

73 S. + 1 Vegetationstabelle (Manuskript).

Effect of sheep grazing on alpine vegetation.

Influences of increased sheep grazing upon the floristic richness, the erosion and the value for nature conservation and recreation of alpine grasslands were studied in the region of the Säntis (eastern Switzerland). Areas heavily grazed by sheep have a vegetation which covers only about 50 - 90 % of the soil and is only about 4 - 8 cm tall. It is rich in rosette plants and pasture weeds such as *Nardus stricta*. The numbers of species per relevé is 15 - 36 (average 28). Areas grazed by chamois are characterized by a denser vegetation, 5 - 15 cm tall. It is richer in species (26 - 45, average 32), but not so much in flowers because the chamois like to eat them. Moderately grazed sheep pastures differ floristically if they are on different (always calcareous) parent materials of soil formation; heavily grazed pastures on the other hand are always very similar to each other. In four enclosures started in July the number of flowers after 3 - 4 weeks was about 52 per m², outside the enclosure being only 16.

Diplomarbeiten (diploma thesis)

1976

FOSSATI, Alessandro. Die Keimung von Gebirgspflanzen. 176 S. (Manuskript).

Germination of alpine plants.

The work deals with the germination of alpine species. In the first part, the germination behaviour of 27 taxas was studied without any pre-treatment and two groups were distinguished: 1/ plants with seed dormancy and 2/ those manifesting various degrees of a spontaneous germination.

Responses to various photoperiodic conditions as well as the germination rate and speed proved to be differentiated within either group. The seed dormancy occurring in the studied material appeared to be influenced by a single factor or resulted from several factors operating in a complementary way.

In the second part, various pre-treatments applied to six taxa are described. *Carex sempervirens* did not respond to any sort of treatment, its germination remaining nil or erratic. *Pulsatilla alpina*, *Gentiana Clusii* and *G. Kochiana* correspond very well to a treatment with the giberellin but their germination was belated for about three weeks; it is probable that seed dormancy in these taxa is primarily influenced by undersized embryos and perhaps remains affected, in addition, by particular properties of the pericarp. *Geum montanum* responded spontaneously to a chemical scarification, its seed dormancy being apparently due to the inhibitors occurring within the pericarp. *Gnaphalium supinum* showed no distinct seed dormancy; however, a gibberellin treatment improved the germination rate.

Greatly diversified germination behaviour of the alpine taxa may reflect diverse reproductive strategies important for their survival, extreme life conditions often occurring in heterogenous Alpine stations above the timberline.

RUGGLI-WALSER, Anna. Vikariierende Arten auf Kalk und Silikat.

127 S. + 3 Vegetationstabellen (Manuskript).

Vicariant taxa on carbonate and silicate soils.

Ecological and phytosociological factors limiting the distribution of vicariant taxa were studied in the alpine zone of Raetikon and near Davos (the Grisons, Switzerland). Three pairs of vicariants were investigated: *Pulsatilla alpina* - *P. sulphurea*, *Gentiana Clusii* - *G. Kochiana* and *Ranunculus montanus* - *R. Grenierianus*.

All the studied taxa were comparable as to the altitude a. s. l., the exposition and the slope. On the other hand, differences were found as to the pH of the soil, modal frequency values being particularly informative; *Ranunculus Grenierianus* was found most frequently in acid soils with a low pH (4 - 5), whereas *Gentiana Clusii* represented another extreme with the modal frequency value corresponding to the soils with the pH of 6 - 8. Intermediate pH values appeared to be well-tolerated by all the six taxa.

Phytosociological affinities of the studied vicariants were rather distinct. It should be noted that each of the three investigated pairs had a different specific limit of occurrence in the particular plant communities.

VETTERLI, Luca. Vegetationskartierung in der alpinen Stufe.

85 S. + 1 Vegetationstabelle (Manuskript).

Vegetation mapping in the alpine zone.

In the purpose to get a basis for a vegetation map and to gain a better understanding of the ecology of the plant communities and individual species 105 detailed relevés on chosen homogeneous plots were made in an area of 3 km² in the alpine zone on acidic silicate soils near Davos (eastern Swiss Alps). Special attention was paid to habitats that are situated in the middle range of environmental gradients and that are therefore difficult to characterize. The relevés were grouped into 8 plant communities using a combined method including also computer techniques (factor analysis, cluster analysis). These communities do not correspond well to those described in the literature because in the literature only communities which are "typical" and rich in (character-) species are considered. The grouping of the 8 plant communities can be correlated to three major factors: water factor, base factor and wind. 13 soil profiles showed that a great diversity of acidid silicate soils exists in the ares, also in respect to the base factor.

A new technique is described for noting down the relevés in the field and then transscribing them on computer cards.
