Englische Zusammenfassungen der in den Berichtsjahr 1983 abgeschlossenen Dissertationen und Diplomarbeiten

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Summaries of Ph D. and Diploma Thesis

Dissertationen (Ph D. thesis)

LEUTERT Alfred. Einfluss der Feldmaus, *Microtus arvalis* (Pall.), auf die floristische Zusammensetzung von Wiesen Oekosystemen. Veröff.Geobot.Inst.ETH, Stiftung Rübel, *79*, 126 S.

Influence of the common vole, *Microtus arvalis* (Pall.), on the floristic composition of meadow-ecosystems.

The present paper deals with the effect of the common vole, *Microtus arvalis* (Pall.), on the coexistence of plant species in meadow ecosystems. The investigations were carried out in fertilized meadows (*Arrhenatheretum*) and unfertilized meadows (*Mesobrometum*), with low to moderate vole densities, in northern Switzerland.

1. For plants, the burrows of voles (= colonies) are distinct microhabitats whose existence varies in time and space. The soil in the area of the colonies is partly bare, covered with faeces and food remnants, and is thus nutrient-rich. At densities of about 500 voles/ha, the bare area of the meadows is approximately 6% (Table 3, Figs 7-9).
2. Analyses of plants grazed by voles and the content of the food catches showed that voles feed selectively on certain plant species (Tables 4-6).
3. The irregular use of space by the voles caused originally homogenous

meadows to change into a vegetation pattern strongly differentiated in height and biomass (Fig. 10). Vegetation height and standing crops were 1.5 times larger in colony areas than in control areas (Table 4). Plant individuals were less numerous in colony areas but were larger and flowered more frequently than those in the control areas.

4. In outdoor cages (six exclosures of 60 m^2 and four enclosures of 200 m^2 with 250 or 500 voles/ha respectively studied over a three-year period) the plant species cover changed within the vegetation period (Figs 16-18). These changes were confined to areas with diameters that were two to three times larger than the diameter of the colonies (Figs 19, 20, 29).

5. Of the species investigated, 38 of 112 showed significant differences in cover between 1 m^2-plots with colonies and 1 m^2-plots of adjacent areas (94 relevé-pairs). Forty species showed no distinct pattern and the remainder occurred to rarely for statistical analysis (Tables 9, 11, 17). The most frequent and largest increase of cover in colony areas in fertilized meadows was observed for *Dactylis glomerata, Galium album* and *Achillea millefolium* and in colony areas in unfertilized meadows for *D. glomerata, G. album, Sanguisorba minor* and *Primula veris*. The leguminosae showed a very strong decrease in cover in colony areas in both types of meadows. *Taraxacum officinale* decreased strongly in fertilized meadows whereas *Plantago media, Bromus erectus* and *Festuca ovina* decreased in unfertilized ones (Figs 12, 13, 15).

6. In the meadows investigated, some species (e.g. *Myosotis arvensis, Hypericum perforatum, Geranium pyrenaicum* and woody plants) occurred almost exclusively around the colonies and runways of the voles (see mapped distribution pattern in Figs 21-26, 30).

7. The species that increased in cover due to the vole activity usually occur ecologically at wood edges or in weed communities. In colony areas in unfertilized meadows, some plant species typical of fertilized meadows increased in cover. Many species typical of unfertilized meadows decreased in abundance (Table 17).

8. In colonies located in fertilized meadows, the number of plant species was only slightly larger than in plots without voles; in unfertilized meadows, the colonies had 16% more species than those found in control areas (Tables 12, 15).

9. Plant species responded to the different effects of the voles on vegetation (selective grazing, change of soil factors) with different strategies for colonizing and surviving in colony areas. Frequently occurring characteristics of plants are protection by production of toxic compounds, strong regeneration, lateral spreading, and an increase in competition when fertilized. Some plants (e.g. *Dactylis glomerata, Festuca pratensis*) increased in cover even when voles fed on them.

10. In agriculture, the effects of common voles at low to moderate densities can hardly be regarded as negative.

11. From the view of nature conservation, voles play a positive role: they increase in heterogeinity and floristic (and therefore probably also faunistic) diversity, particularly in unfertilized meadows.

LüöND Annamaria. Das Wachstum von Wasserlinsen (*Lemnaceae*) in Abhängigkeit des Nährstoffangebots, insbesondere Phosphor und Stickstoff.
Veröff.Geobot.Inst.ETH, Stiftung Rübel, *80*, 116 S.

Growth of duckweeds (*Lemnaceae*) depending on nutrient supply, especially phosphorus and nitrogen.

Laboratory studies: The influence of various concentrations of phosphorus and nitrogen ($0.69 \cdot 10^{-3}$ - 1356.5 mg P/l and $4.48 \cdot 10^{-3}$ - 1750.0 mg N/l) on the growth of *S. polyrrhiza, L. minor, L. minuscula* and *L. gibba* was tested under controlled climatic conditions. The following data were scored:

- multiplication rate (growth rate)
- frond size
- root length

The multiplication rate proved to be the best criterion for distinguishing between nutrient concentrations as well as between species. Optimal growth in all four species studied was observed at middle to high concentrations of phosphorus and nitrogen (P = 0.08-10.9 mg/l, N = 0.56-70.0 mg/l). On the other hand, differences between particular species were observable at low concentrations: growth rates of *L. minor* and *L. minuscula* still represented nearly optimal values, whereas those of *L. gibba* and *S. polyrrhiza* were distinctly reduced. *L. minor* and *L. minuscula* were apparently able to endure relatively low N- and P-concentrations for a rather long time. At the highest concentrations (P = 1356.5 mg/l and N = 1750.0 mg/l), all four tested species died during the accommodation phase.

As far as the frond size and the root length are concerned, no special differences occurred among the species studied. Under optimal conditions, large fronds and short roots were observed. As soon as growth was reduced due to too high or too low nutrient concentrations, the roots increased in length and the frond size diminished.

Field studies: In Swiss Midlands, northwestern Switzerland, northern and southern lowlands of the Upper Rhine (F, D) and the lowlands of the Po (I) 79 sites were sampled for water analyses. Places inhabited by duckweeds, as well as those without *Lemnaceae*, were evaluated. Notes on the occurrence of *S. polyrrhiza, L. aequinoctialis, L. minor, L. minuscula, L. gibba* and *L. trisulca* were taken. The following elements were studied: NH_4-N, NO_3-N, o-P, K, Na, Ca, Mg). Phosphorus proved to be the major factor limiting the occurrence of the duckweeds, and over a three-year period was present at an average value of 0.006 mg/l. The species of the *Lemnaceae* studied had different requirements as to the most important elements (Table 20). *L. minor* was found in waters with the lowest concentrations of phosphorus, nitrogen, magnesium and potassium, whereas *S. polyrrhiza, L. trisulca* and *L. minuscula* followed, respectively, in waters with increasing amounts of those elements. *L. gibba* was observed in eutrophic waters. *L. trisulca* appeared in waters with rather high concentrations of calcium.

The following conclusions based on this study can be made:

In the long run, *L. gibba* can exist only in waters rich in nutrients; it

is, therefore, suitable for waste water treatment and could also serve as animal feed source. It might also be considered as an indicator of eutrophic waters. *L. minor* occurred in nearly all tested waters; this species, as well as *L. minuscula,* apparently has a rather broad tolerance range to high P- and N-concentrations. On the other hand, the occurrence of *S. polyrrhiza* and *L. trisulca* in waters with medium concentrations of these elements, suggests their rather limited tolerance to extreme conditions.

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ZUMBÜHL Georg. Pflanzensoziologisch-ökologische Untersuchungen von gemähten Magerrasen bei Davos.
Veröff.Geobot.Inst.ETH, Stiftung Rübel, *81*, 101 S.

A study of the phytosociology and ecology of mowed grassland poor in nutrients near Davos, Switzerland.

The present study deals with the *vegetation of regularly mowed grassland of localities poor in nutrients* (Parsennmähder) in a subalpine zone near Davos (Grisons, Switzerland). Phytosociological and ecological aspects were studied and the significance of the vegetation for farming and nature conservation was also discussed. Altogether, 226 relevés (166 mowed and generally unfertilized meadows [Mähder] located on morains consisting of mixtures of various rocks; 28 mowed, fertilized grasslands; and 32 pastures poor in nutrients) were mathematically processed; subsequently data were arranged manually in a vegetation table and classified. In addition to traditionally recorded habitat data, the pH value of the topsoil was measured in all stands where relevés were taken; samples of the topsoil of 59 of them, covering the entire range of grassland types studied, were subjected to a complete chemical analysis. The management of each area was determined from 1968 onwards.

Based upon classification of relevés, the following vegetation units were distinguished:

Group I : Meadows in locations naturally rich in nutrients (*Ligusticum mutellina-Festuca violacea* type), units 1,2,3,4
Group II : Meadows on acidic soils, poor in nutrients (*Hypochoeris uniflora-Nardus stricta* type), units 5,6,7
Group III: Meadows in locations of moderate conditions (*Pulsatilla sulphurea-Helianthemum grandiflorum* type), units 8,9,10,11
Group IV : Meadows on alkaline soils, poor in nutrients (*Laserpitium latifolium-Globularia nudicaulis* type), units 12,13,14
Group V : Fertilized grassland (*Polygono-Trisetion*), units 15,16,17
Group VI : Pastures poor in nutrients (*Nardion, Seslerietalia*), units 18, 19,20,21

Ordination of the relevés using principal component analysis clearly shows the continuous character of the vegetation studied. An exception is the fertilized grassland, which turned out to be a group by itself. Two main floristic gradients characterize the unfertilized meadows (Mähder). They can be explained ecologically as follows: *Gradient A,* encompassing units 5,6,7,8,9,10,12,13,14, is distinctly correlated to the *content of*

bases and soil acidity. The gradient is quite steep and of great significance for distinguishing different vegetation types within an oligotrophic range. *Gradient B*, encompassing units 1,2,3,4,8,9, can be explained by a combination of factors such as relief, supply of water, bases and nutrients, soil depth and duration of snow cover. This combination of factors is best described by the term "*sink*". In addition to the gradients mentioned above, units 6,7 and 14 are characterized by *favourable temperature conditions*.

It proved to be difficult to *assign* most of the units described to *existing phytosociological units*. This is due to the fact that the vegetation units distinguished in the present paper are not "typical" communities identified by character species. The meadows in locations naturally rich in nutrients (units 1-4) are close to the *Caricion ferrugineae* Br.-Bl. 1931 and the *Polygono-Trisetion* Br.-Bl. 1947. The meadows in acidic locations, poor in nutrients (units 5-7), as well as the acidophilous pastures (units 18,19,20), could best be assigned to the *Nardo-Trifolion alpini* Preisg. 1949 and to the *Eu-Nardion* Br.-Bl. 1926, respectively. The meadows in locations of moderate conditions (units 8-11) fall between the *Eu-Nardion* Br.-Bl. 1926, the *Seslerion coerulea* Br.-Bl. 1926 and the *Caricion ferrugineae* Br.-Bl. 1931. Finally, the meadows and pastures on alkaline soils, poor in nutrients (units 12-14, 21), are considered to be closest to the *Seslerion coerulea* Br.-Bl. 1926 and the *Caricion ferrugineae* Br.-Bl. 1931.

Regarding the effect of different management treatments on mowed and generally unfertilized meadows (Mähder), application of fertilizers and grazing by sheep, in particular, resulted in marked changes in vegetation. As for *fertilizer applications*, only meadows in locations with moderate conditions proved to be responsive to them, but not those in locations with extreme conditions (groups II and IV) where no significant improvement was found. The effects of *grazing by sheep* must be considered as unfavourable on steep slopes as it leads to increased erosion, decreased fodder quality and a monotonous appearance of the stand. During the first 10 to 20 years following cessation of management, only changes in relative abundance of the species and in physiognomy of the stand occur whereas the floristic composition itself remains basically unchanged.

The meadows (Mähder) studied are an intriguing, aesthetically appealing element of the landscape and a habitat harbouring many rare and endangered species; it is definitely worthwhile to preserve them. Recommandations are given that would ensure adequate management of these meadows (including moderate application of fertilizers and grazing by sheep). It goes without saying, however, that the traditional utilization (i.e. mowing every second year without applying fertilizers) remains the optimal management to preserve these meadows for the future.

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Diplomarbeiten (Diploma thesis)

BEYER Bernhard Hans. Oekologisch-systematische Differenzierung in der Familie der *Lemnaceae* in bezug auf den Bedarf an Calcium und Magnesium. 137 S. (Manuskript).

Ecological and systematic differentiation of duckweeds (*Lemnaceae*) in relation to calcium and magnesium demand.

The influence of different calcium and magnesium concentrations in a nutrient solution on growth rate, root length, frond length, frond width, and length/width ratio of fronds was studied in eight duckweed taxa. Two clones of *Spirodela intermedia, S. biperforata, Lemna gibba, L. disperma, Wolffiella hyalina, W. neotropica, Wolffia australiana* and *W. angusta* from various regions of the world were cultivated under constant conditions at various Ca and Mg concentrations. For each clone, the range of Ca and Mg concentrations necessary for survival of the fronds and the range of Ca and Mg concentrations allowing rapid growth were derived from the observed multiplication rate.

Some of the studied clones could survive at Ca concentrations from 0.5 mg Ca/l to 4800 mg Ca/l and at Mg concentrations from 0.03 mg Mg/l to 1700 mg Mg/l. Some clones grew rapidly between Ca concentrations of 2.1 mg Ca/l and 1800 mg Ca/l and between Mg concentrations of 0.06 mg Mg/l and 850 mg Mg/l. These extreme values of Ca and Mg concentrations depended on the Ca/Mg ratio. Some of the clones survived at Ca/mg ratios of 0.03 to 2100 and grew rapidly at Ca/Mg ratios between 0.07 and 520.

The range of survival and the range of rapid growth are characteristic for every taxa. The closely related taxa of *Spirodela* have similar ranges, while unrelated taxa of *Wolffiella* are different.

Size, shape and location of the range of survival and the range of rapid growth are connected with the climate and chemistry of the water at the place of orogin. Some characteristics, however, cannot be explained by climatic conditions and the Ca and Mg content of the water at the place of origin, but are specific for the taxa.

In some taxa, both clones differ in growth and morphological characteristics. In contrast, two clones of other taxa show no significant differences in growth and frond characteristics.

A comparison of the results of cultivation under constant conditions with the results of field observations published in literature showed that very low concentrations of Ca and Mg in water limit the distribution of duckweeds. On the other hand, all taxa can grow under constant conditions at much higher Ca and Mg concentrations than those ever found in the field.

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BOCHERENS Yves. Vitalität bei Pflanzen als Mass für die Eutrophierung von Streuwiesen (*Molinion*). 62 S. (Manuskript).

Vitality of plants as an indicative value for eutrophication on straw-meadows (*Molinion*).

One of the main problems concerning the conservation of straw-meadows (*Molinion*) is how to keep them in a low nutrient state; nutrients leached from adjacent fertilized meadows or cultures tend to cause undesirable changes in the vegetation. It is highly important to detect such euthrophications early enough to be able to react in an efficient manner. For this reason, the indicative value of several morphological characteristics of *Inula salicina* L. and *Briza media* L. were investigated on straw-meadows in the lower Reuss valley on the plots also used by Th. EGLOFF (1983 and in prep.).

Except for the control plots, all of the plots had been fertilized in various ways in order to simulate eutrophication. By the additional mowing of some plots over a two year period, one year in June and the next year in July, along with the usual autumn mowing, the extraction of undesirable surplus nutrients and regeneration of the initial low nutrient state was attempted.

The results allow assertions of two kinds:
- They give additional information concerning the experiment of EGLOFF (1983) as yet another method that points out differences between the differently treated plots
- They allow one to estimate the indicative value of the characteristics examined.

The following distinctions between the plots could be ascertained:
- Except for the height of *Inula salicina* on the "regenerated" plots, all of the characteristics were less developed on the control plots than on the fertilized plots.
- *Inula salicina* showed no significant differences in height between the "regenerated" and the control plots, whereas the plants in the "regenerated" plots were significantly taller. The "regeneration" of the fertilized plots, as indicated by the height of *Inula salicina*, would therefore be perfect. The number of spikelets of *Briza media*, though by far less extreme, results.
- The highly significant differences between all the characteristics of the plants in plots fertilized with phosphorus and potassium, and the characteristics of plants in the control plots indicate that phosphorus is the prime limiting nutrient; on the other hand, the fact that *Inula salicina*, collected on the plots fertlized with nitrogen, phosphorus and potassium, was slightly taller than that collected on plots fertilized with onla the two latter nutrients shows that nitrogen probably becomes limiting after phosphorus fertilization.
- There were no differences between the plants of the June-mowed and the July-mowed plots. Therefore, it cannot be said which mowing-date is best for regenerating eutrophicated surfaces.

Concerning the indicative values of the examined characteristics, the following statements can be made:
- The height of *Inula salicina* showed the most differentiated response to

the different types of plot management and therefore seems to be best suited for supervising actions.
- The dollowing characteristics reacted only to more extreme differences (e.g. fertilized/unfertilized) but could also be taken in consideration when determining whether to use a management system on straw meadows:
  - The number of spikelets of *Briza media*,
  - the length of the inflorescence of *Briza media*,
  - the diameter of the calyx of *Inula salicina*.

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HUBER Walter. *Ranunculus aconitifolius* L. s.l. x *R. plantagineus* All. (*R. lacerus* Bell.): Ein natürlicher Bastard aus den Alpen. 51 S. (Manuskript).

Ranunculus aconitifolius L.s.l. x *R. plantagineus* All. (*R. lacerus* Bell.): A natural hybrid from the Alps.

Ranunculus lacerus Bell., the hybrid of *R. aconitifolius* L.s.l. (*R. aconitifolius* L.s.str. and *R. planifolius* L.) and *R. plantagineus* All. (*R. pyrenaeus* L. ssp. *plantagineus* [All.] Rouy et Fouc.) was investigated by the following methods: morphology, geographical distribution, ecology, cytology, and crossing experiments.

The unusual shape of the leaves of this hybrid is caused by the extreme differences between the leaf shapes of its parents. The geographical distribution of *R. lacerus* is restricted to a few places in the Central and Western Alps. Microbial investigations of mitoses resulted in the determination of the following chromosome numbers: *R. aconitifolius* and *R. platanifolius*: 2n=16; *R. platagineus*: 2n=32 and 2n=24 (not known in literature); *R. lacerus*: 2n=32 (not known in literature, only one mitose investigated). Pollen of *R. aconitifolius* and *R. platanifolius* developed normally at a 65-95% rate, that of *R. plantagineus* at 15-40%, and that of *R. lacerus* at 0-15%. Crossing experiments were successful (formation of fruit) only when *R. aconitifolius* or *R. platanifolius* were mother plants and pollen was taken from *R. platagineus*. Neither fruits of the parents nor of the habrid germinated.

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LIEBENDÖRFER David. Taxonomisch-chorologische und ökophysiologische Studien zur Pilzgattung *Strobilurus* (*Agaricales*). 62 S. (Manuskript).

Taxonomical, chorological and ecophysiological studies of the genus *Strobilurus* (*Agaricales*).

1. Description and a key, based on microscopic characteristics, are given for the 9 known species of *Strobilurus*.
2. The area of distribution of each species was examined. The genus *Strobilurus* is known only in the northern hemisphere: 5 species (*St. coni-*

genoides, St. kemptonae, St. lignitilis, St. occidentalis, St. albipilatus) are from North America; 3 species from Europe and Asia (*St. esculentus, St. stephanocystis, St. tenacellus*).

3. The 3 European species were cultivated on 2% malt agar. Only one strain of *St. staphanocystis* fructificated in culture after incubation at 2°C.
4. Growth rates of the 3 species were examined at various temperatures between 0-35°C. The optimum growth temperature was 20°C. The growth curves were nearly uniform for all strains tested.
5. Syringaldazin test and Bavendamm's test were positive for all 3 species; i.e. they all produced extracellular phenoloxidases (degradation of lignin).
6. The spores of the European species all contain one nucleus. Four residual nuclei degenerate in the basidia when spores are formed.

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SCHüTZ Martin. Keimverhalten und frühe Lebensphase alpiner Pflanzen von Silikat- und Karbonatschuttstandorten.
123 S. (Manuskript).

Germinating behaviour and early life phases in alpine taxa from acidic silicate and carbonate scree slopes.

Germinating behaviour and early life phases in some taxa from alpine scree slopes were studied under laboratory conditions and in the field.

In the laboratory, seeds of 31 taxa from acidic silicate and caebonate were investigated in 33 series. Without pretreatment, seeds in 9 taxa did not germinate al all; in 9 taxa, germinated seeds represented less than 50%; in 13 taxa, germination exceeded 50%; and in 2 taxa, complete germination was observed. The most successful treatment for interrupting seed dormancy and/or improving germination proved to be mechanical scarofication, with quite spectacular results sometimes obtained. Pretreatment with gibberellic acid was effective in 4 taxa.

In the greenhouse, some young plants accumulated biomass mostly above the ground, whereas others showed only advanced root-system development. Development rates were also variable. Because of great fluctuations in temperature, the rather high mortality of young plants could not be assessed precisely.

In the field, germination rates were much lower than in laboratory trials. The exceedlingly high mortality rate (80-100%) in young plants might be partly due to the exceptionally dry and hot summer of the study period. Individual development was much slower than in the greenhouse.

The importance of data in germinating behaviour and early development of alpine taxa for high altitude revegetation trials carried out with using native material is stressed.

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WITTWER Fredi. Untersuchungen der Wuchsform verschiedener Pflanzenarten in Abhängigkeit von der Bewirtschaftung.
88 S. (Manuskript).

Investigations on the growth form of different plant species in relation to management.

The aim of this study was to assess the effect of six years of varied types of management on the morphological characteristics (modifications or microevolutionary differences) of four grassland species. The effects of cutting in June, burning in March or of non-management on dry, non-fertilized limestone grasslands (*Meosbrometum*) and the effects of cutting in June and September on fertilized grassland (*Arrhenatheretum*) was studied in a field near Merishausen (northern Switzerland). The effects of similar treatment on transplanted individuals were studied for one year under identical conditions in an experimental garden at Hönggerberg, near Zürich. The species were: *Plantago lanceolata* L., *Bromus erectus* Huds., and *Dactylis glomerata* L. For *Primula veris* s.l. populations from a dry forest near Merishausen and from a dry, fertilized grassland near Rüti/ZH were also included to determine the taxonomy of the *Primula*.

Results:

1. All of the *Primula* from Merishausen belonged to *P. columnae* Ten.; the population from Rüti was *P. veris* L.
2. *Primula columnae* in the field had the largest number of flower stems and flowers in the fallow plots, an intermediate number in the cut plots, and the smallest number in the burnt plots. In the experimental garden, individuals from the fallow plots had taller flower stems than those from the burnt plots.
3. The different management types had significant effects on the number of flower heads, on leaf lengths and on many other morphological characteristics of *Plantago lanceolata* both in the field and in the experimental garden.
4. Significant effects of the different management systems were also noted for *Bromus erectus* and, to a lesser degree, for *Dactylis glomerata* both in the field and in the experimental garden. Statistically proven differences were found, e.g. in the length of the tallest inflorescences and in the dry weight of the panicles.
5. The fact that several statistically valid differences were also found among the plants growing under identical conditions in the experimental garden indicates that microevolutionary adaptation to different management types may occur within six years, The implications of this observation are discussed.

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ZIMMERLI Stephan. Einfluss der Bewirtschaftung auf die Entwicklung und Struktur der *Cardamine*-Populationen auf dem Urnerboden. 142 S. (Manuskript).

The influence of the management upon the development and the structure of the *Cardamine* populations at Urnerboden

The study deals with further investigations in a large hybridogenous population of *Cardamine* L. at Urnerboden (Central Switzerland). Interviews with farmers revealed that fenced manured hay meadows, the represemtative biotope of triploid hybrid *C. insueta*, were established between 1901 and 1905; a better assessment of age of *C. insueta* as well as that of the autoallopolyploid *C. Schulzii* occurs to date within open pastures and drainage channels adjacent to hay meadows.

The management in the three principal biotopes was studied, small surfaces owned by various farmers were investigated within the hay meadows. Demographical methods were employed to study the population structure in *C. insueta*. Variation within the population density followed sometimes a small-scale pattern. A drastic reduction of the flowering intensity observed in some sectors seemed to be the rapid response of *C. insueta* to unfavourable conditions.

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