

**Zeitschrift:** Veröffentlichungen des Geobotanischen Institutes der Eidg. Tech. Hochschule, Stiftung Rübel, in Zürich

**Herausgeber:** Geobotanisches Institut, Stiftung Rübel (Zürich)

**Band:** 75 (1981)

**Artikel:** Phenological methods in permanent plot research : the indicator value of phenological phenomena : a study in limestone grassland in Northern Switzerland = Phänologische Methoden bei Dauerquadratuntersuchungen : der prognostische Wert phänologischer Phänomene : eine Untersuchung in Halbtrockenrasen (Mesobrometum) in der Nordschweiz

**Autor:** Krüsi, Bertil

**Kapitel:** 2: Description of the study areas

**DOI:** <https://doi.org/10.5169/seals-308658>

### **Nutzungsbedingungen**

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. [Mehr erfahren](#)

### **Conditions d'utilisation**

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. [En savoir plus](#)

### **Terms of use**

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. [Find out more](#)

**Download PDF:** 28.03.2026

**ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>**

advised on phytosociological problems, Dr O. WILDI (Swiss Federal Institute of Forestry Research SFIFR) helped with the mathematical analysis and Dr H. FUNK (Geological Institute ETH) with geological nomenclature. The advice of Ms C. BROWN, who made many valuable suggestions on style and use of the English language is greatly appreciated. I have had useful discussions on various points with PD Dr A. GIGON. Mr E. SCHÄFFER assisted in the field, and Ms A. HONEGGER typed the manuscript; my sincere thanks are addressed to all these persons as well as to numerous colleagues from the Geobotanical Institute who occasionally helped throughout the course of the work. The financial support of the Swiss Federal Institute of Technology (SFIT), Zürich, Switzerland, is gratefully acknowledged.

## 2. Description of the study areas

The four study areas are localized in northern Switzerland, within the Jurassic mountains belonging to the community of Merishausen 7.5 km NNW of Schaffhausen (National Grid Reference 688 500 / 291 000, Fig. 1). The substratum consists of Upper Jurassic limestone. The soils are of a mull-like rendzina type; the content of calcium carbonate within the uppermost 5 cm of soil ranging from 29 to 60 per cent, the corresponding pH values vary from 7.6 to 8.0. Climatic conditions are diagrammatically presented in Fig. 2.

The vegetation within all study areas corresponds to grassland of the *Mesobrometum* type. In the region of Schaffhausen this meadow type is usually cut once a year in mid June and very rarely or not at all fertilized. Prior to experimental management, two study areas had been used for hay-making (study areas 1 and 2), two others having been abandoned for ten and twenty years, respectively (study areas 3 and 4). One of the areas used until experimental management was started was drier and poorer in nutrients (study area 1) than the other (study area 2).

The phytosociological classification of the study areas offers some problems as far as nomenclature is concerned. According to ZOLLER (1954), who studied the dry grasslands in this region, our study area 1 should be considered as a *Medicago falcatae-Mesobrometum*, whereas study area 2 should correspond to a *Dauco-Salvio-Mesobrometum*; the study areas 3 and 4 abandoned for ten and 20 years respectively would represent the *Seselio libanotidis-Mesobrometum*.

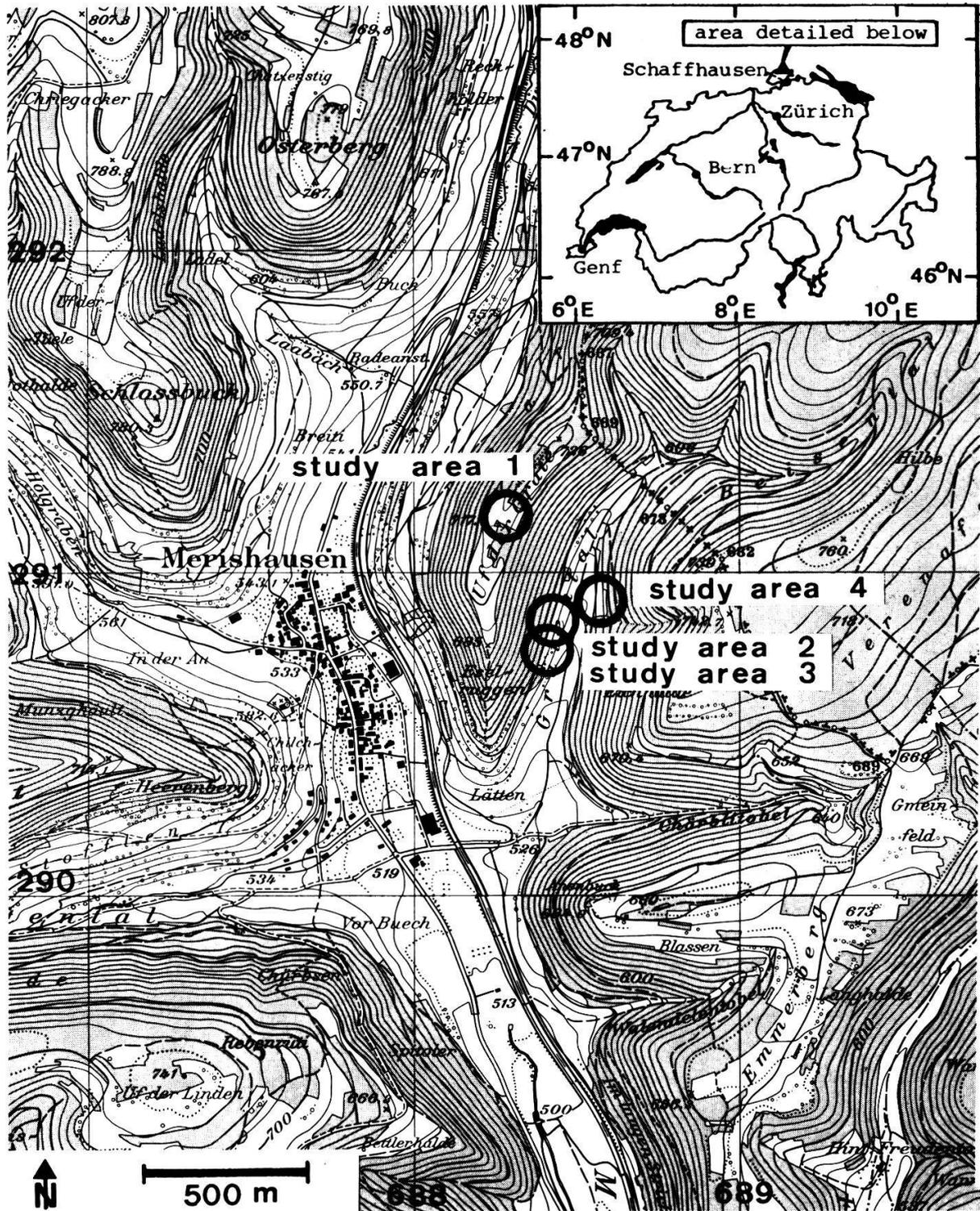


Fig. 1. Location of the four study areas investigated and (inset) their relationship to other places in Switzerland. Scale 1:25000. (Reproduced with permission of the Swiss Federal Office of Topography from May 6, 1981).

The nomenclature proposed by ZOLLER (1954) not being generally recognized, the classification of OBERDORFER (1957, 1978) was followed. According to this author, our study areas 1 and 2 correspond to a *Mesobrometum* Br.-Bl. 1925, the first area being a type with *Trisetum flavescens* and *Medicago falcata* whereas the second, having a soil richer and more humid, represents a type with *Trisetum flavescens* and *Centaurea jacea*. The study areas 3 and 4 correspond to successional stages towards a *Geranion sanguinei*, the former area representing a less advanced stage than the latter.

The floristic composition of the four study areas is shown in a frequency table based upon 18 relevés per area (Table 1); the resemblance of the 72 relevés considered is shown in Figs 3 and 4 representing scatter diagrams constructed by principal component analysis using a cross product matrix. Further characteristics of the four study areas are summarized in Table 2. The study areas will be referred to by their respective numbers in further parts of the present paper.

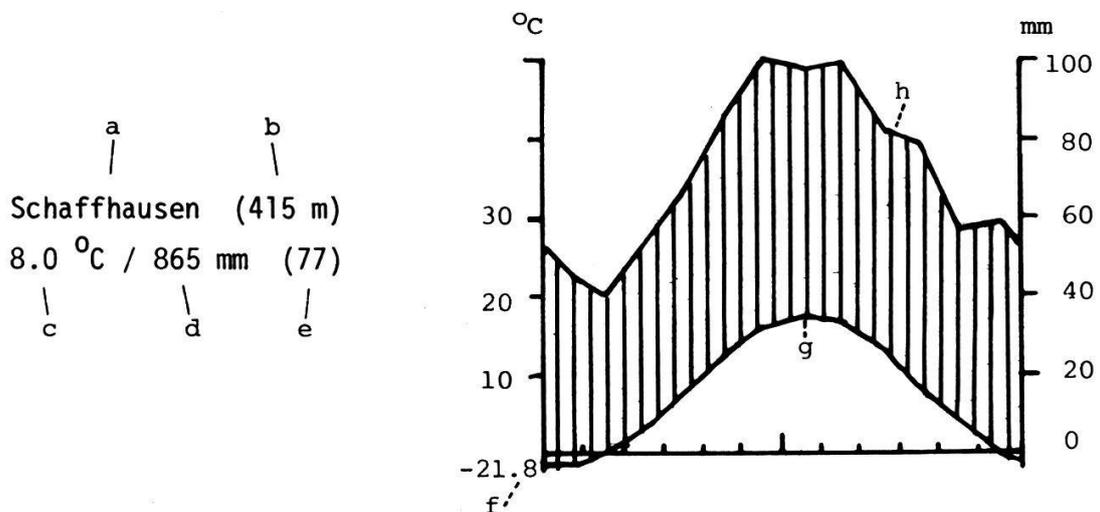


Fig. 2. Climatic diagram of Schaffhausen (from WALTER and LIETH 1960-1967).

- |                                   |  |
|-----------------------------------|--|
| a: station                        | e: duration of observations (years)    |
| b: high above sea level           | f: lowest temperature recorded (°C)    |
| c: mean annual temperature (°C)   | g: curve of mean monthly temperature   |
| d: mean annual precipitation (mm) | h: curve of mean monthly precipitation |

Ordinate: one division = 10 °C or 20 mm rain

Abscissa: months (January-December)

Table 1. Frequency table representing the floristic composition of the four study areas based upon 18 relevés (50 m<sup>2</sup>) per each area (\*: value is less than 0.05, 'species value': see page 21).

	Study area 1	Study area 2	Study area 3	Study area 4
Total number of species (herbs/shrubs/cryptogames)	96 (79/3/14)	98 (88/3/7)	120 (103/9/8)	144 (111/21/12)
Mean number of species per 50 m <sup>2</sup> (range):	54.8 (48- 62)	54.1 (42- 62)	55.4 (42-68)	62.7 (52- 70)
- herbs	47.4 (43- 53)	51.3 (39- 59)	50.0 (36-62)	54.5 (43- 65)
- shrubs	0.8 ( 0- 2)	0.6 ( 0- 2)	2.0 ( 1- 4)	4.4 ( 1- 17)
- cryptogames	6.6 ( 5- 10)	2.2 ( 1- 5)	3.4 ( 2- 5)	3.8 ( 1- 6)
Mean cover-percentage (range)				
- herbs	98% (90-100)	84% (75- 95)	81% (50-95)	80% (60- 95)
- shrubs	<1% ( 0- <1)	<1% ( 0- <1)	2% (<1-10)	4% (<1- 20)
- cryptogames	42% (10- 90)	91% (70-100)	81% (50-95)	89% (70-100)

Species	Study area 1	Study area 2	Study area 3	Study area 4
<i>Prunella grandiflora</i>	F. (%) 95 M.c. (%) 1.5 species value s.v. 1.4	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -
<i>Chrysohypnum chrysophyllum</i>	F. (%) 72 M.c. (%) 6.2 species value s.v. 4.5	F. (%) 6 M.c. (%) 0.2 species value s.v. *	F. (%) 6 M.c. (%) 0.1 species value s.v. *	F. (%) 6 M.c. (%) 0.1 species value s.v. *
<i>Galium verum</i>	F. (%) 72 M.c. (%) 1.0 species value s.v. 0.7	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -
<i>Festuca pratensis</i>	F. (%) 72 M.c. (%) 0.7 species value s.v. 0.5	F. (%) - M.c. (%) - species value s.v. -	F. (%) 6 M.c. (%) 0.1 species value s.v. *	F. (%) - M.c. (%) - species value s.v. -
<i>Centaurea scabiosa</i>	F. (%) 44 M.c. (%) 0.4 species value s.v. 0.2	F. (%) - M.c. (%) - species value s.v. -	F. (%) 6 M.c. (%) 0.1 species value s.v. *	F. (%) - M.c. (%) - species value s.v. -
<i>Scleropodium purum</i>	F. (%) 44 M.c. (%) 0.4 species value s.v. 0.2	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -	F. (%) 17 M.c. (%) 0.8 species value s.v. 0.1
<i>Anthoxanthum odoratum</i>	F. (%) 39 M.c. (%) 0.4 species value s.v. 0.2	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -
<i>Polygala comosa</i>	F. (%) 33 M.c. (%) 0.3 species value s.v. 0.1	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -
<i>Anacamptis pyramidalis</i>	F. (%) 33 M.c. (%) 0.3 species value s.v. 0.1	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -
<i>Cladonia cf. rangiferina</i>	F. (%) 17 M.c. (%) 0.2 species value s.v. *	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -	F. (%) - M.c. (%) - species value s.v. -

<i>Trisetum flavescens</i>	100	1.2	1.2	1.2	83	1.0	0.8	-	-	-	6	0.1	*
<i>Trifolium campestre</i>	67	0.7	0.4	-	100	1.5	1.5	-	-	-	-	-	-
<i>Rhinanthus minor</i>	100	1.3	1.3	-	39	0.4	0.2	-	-	-	-	-	-
<i>Potentilla heptaphylla</i>	95	1.1	1.1	6	22	0.2	0.1	0.1	*	-	-	-	-
<i>Achillea millefolium</i>	100	1.1	1.1	95	83	1.2	1.0	4.1	3.9	11	0.2	-	*
<i>Carex verna</i>	95	1.6	1.5	50	100	1.2	1.2	0.9	0.4	6	0.1	-	*
<i>Centaurea jacea</i>	39	0.4	0.2	67	100	7.7	7.7	0.7	0.5	6	0.1	-	*
<i>Camptothecium lutescens</i>	100	20.8	20.8	78	22	1.2	0.3	6.6	5.1	6	0.1	-	*
<i>Euphorbia cyparissias</i>	95	1.0	1.0	72	22	0.3	0.1	0.8	0.6	22	0.2	-	*
<i>Inula conyza</i>	-	-	-	44	6	0.1	*	0.4	0.2	-	-	-	-
<i>Convolvulus arvensis</i>	-	-	-	44	6	0.1	*	0.4	0.2	11	0.1	-	*
<i>Koeleria cristata</i>	-	-	-	39	-	-	-	0.4	0.2	-	-	-	-
<i>Medicago sativa</i>	-	-	-	6	6	0.1	*	0.3	0.1	6	6	-	*
<i>Geranium sanguineum</i>	-	-	-	22	-	-	-	0.4	0.1	-	-	-	-
<i>Vicia sepium</i>	-	-	-	89	1.0	0.9	0.9	1.0	1.0	17	0.2	-	*
<i>Satureja vulgaris</i>	-	-	-	67	0.7	0.4	0.4	9.7	9.7	17	0.3	0.1	0.1
<i>Silene nutans</i>	17	0.2	*	83	1.9	1.6	1.6	1.1	0.9	6	0.1	-	*
<i>Sedum sexangulare</i>	-	-	-	95	1.3	1.2	1.2	0.6	0.3	-	-	-	-
<i>Pastinaca sativa</i>	-	-	-	39	0.4	0.2	0.2	1.0	0.9	6	0.1	-	*
<i>Silene vulgaris</i>	11	0.1	*	33	0.4	0.1	0.1	0.8	0.5	6	0.1	-	*
<i>Cerastium caespitosum</i>	17	0.2	*	67	0.7	0.4	0.4	0.2	*	6	0.1	-	*
<i>Thlaspi perfoliatum</i>	-	-	-	17	0.2	*	*	0.6	0.3	-	-	-	-
<i>Geranium pyrenaicum</i>	-	-	-	39	0.4	0.2	0.2	0.3	0.1	-	-	-	-
<i>Rumex acetosa</i>	17	0.2	*	44	0.4	0.2	0.2	0.2	0.1	-	-	-	-
<i>Trifolium repens</i>	17	0.2	*	44	0.4	0.2	0.2	0.2	*	-	-	-	-
<i>Heracleum sphondylium</i>	-	-	-	33	0.3	0.1	0.1	0.2	*	17	0.2	-	*
<i>Peltigera canina</i>	6	0.1	*	50	0.5	0.3	0.3	-	-	-	-	-	-
<i>Glechoma hederaceum</i>	-	-	-	39	0.4	0.2	0.2	-	-	11	0.1	-	*
<i>Mysotis arvensis</i>	6	0.1	*	22	0.2	0.1	0.1	-	-	-	-	-	-
<i>Thesium bavarum</i>	-	-	-	17	0.2	*	*	0.1	*	83	1.2	1.0	1.0
<i>Quercus petraea</i> (seedlings)	-	-	-	28	0.3	0.1	0.1	-	-	50	0.5	0.3	0.3
<i>Origanum vulgare</i>	-	-	-	28	1.0	0.3	0.3	-	-	33	0.4	0.1	0.1

Table 1 (continued)

Species	Study area 1		Study area 2		Study area 3		Study area 4	
	f.	m.c. s.v.						
<i>Scabiosa columbaria</i>	95	1.1 1.0	83	1.0 0.8	11	0.1 *	100	1.3 1.3
<i>Linum catharticum</i>	100	1.6 1.6	39	0.4 0.2	6	0.1 *	61	0.7 0.4
<i>Onobrychis arenaria</i>	100	1.4 1.4	33	0.3 0.1	6	0.1 *	28	0.3 0.1
<i>Fissidens taxifolius</i>	95	3.2 3.0	-	- -	-	- -	17	0.2 *
<i>Pinus silvestris</i> (seedlings)	50	0.5 0.3	-	- -	-	- -	22	0.2 0.1
<i>Carex flacca</i>	95	2.8 2.6	-	- -	28	0.4 0.1	100	2.1 2.1
<i>Rhynchosium rugosum</i>	39	0.4 0.2	-	- -	83	6.5 5.4	89	42.0 37.3
<i>Aster amellus</i>	95	1.0 0.9	-	- -	11	0.1 *	95	4.7 4.5
<i>Medicago falcata</i>	100	1.6 1.6	-	- -	22	0.4 0.1	17	0.2 *
<i>Thuidium tamariscifolium</i>	78	3.5 2.7	-	- -	11	0.1 *	39	1.9 0.8
<i>Gentiana ciliata</i>	56	0.6 0.3	-	- -	11	0.1 *	50	0.5 0.3
<i>Leontodon hispidus</i>	67	0.7 0.4	11	0.1 *	28	0.3 0.1	72	1.8 1.3
<i>Trifolium medium</i>	100	1.9 1.9	11	0.1 *	28	0.4 0.1	33	0.6 0.2
<i>Ononis repens</i>	95	10.3 9.8	28	0.3 0.1	33	0.5 0.2	83	1.7 1.4
<i>Trifolium pratense</i>	89	1.2 1.1	83	1.0 0.8	17	0.2 *	44	0.4 0.2
<i>Chrysanthemum leucanthemum</i> s.l.	100	1.8 1.8	100	1.7 1.7	39	0.4 0.2	39	0.4 0.2
<i>Salvia pratensis</i>	100	7.0 7.0	100	20.6 20.6	6.1	8.4 5.2	22	0.2 0.1
<i>Plantago media</i>	100	2.3 2.3	100	1.8 1.8	6.1	0.6 0.4	39	0.4 0.2
<i>Primula veris</i> s.l.	95	1.0 0.9	100	2.6 2.6	100	3.3 3.3	100	8.5 8.5
<i>Buphthalmum salicifolium</i>	56	0.6 0.3	100	1.4 1.4	100	5.0 5.0	100	11.4 11.4
<i>Thymus froehlichianus</i>	28	0.3 0.1	89	2.3 2.1	95	2.3 2.2	89	3.3 3.0
<i>Thymus pulegioides</i>	17	0.2 *	100	6.7 6.7	100	4.7 4.7	100	9.9 9.9
<i>Lathyrus heterophyllus</i>	17	0.2 *	67	0.8 0.5	100	4.1 4.1	100	1.2 1.2
<i>Acer pseudoplatanus</i> (seedlings)	17	0.2 *	56	0.6 0.3	61	0.6 0.4	61	0.6 0.4
<i>Lathyrus pratensis</i>	11	0.1 *	100	1.9 1.9	100	1.3 1.3	95	1.0 1.0
<i>Daucus carota</i>	6	0.1 *	100	2.0 2.0	95	1.5 1.4	39	0.4 0.2
<i>Veronica chamaedrys</i>	-	- -	78	0.9 0.7	50	0.5 0.3	39	0.4 0.2
<i>Fraxinus excelsior</i> (seedlings)	-	- -	67	0.7 0.4	33	0.3 0.1	22	0.2 0.2
<i>Asperula cynanchica</i>	-	- -	56	0.6 0.3	78	1.0 0.8	72	1.1 0.8
<i>Viola hirta</i>	-	- -	39	0.4 0.2	78	1.4 1.2	100	4.7 4.7

<i>Solidago virga-aurea</i>	-	-	-	22	0.2	0.1	33	0.3	0.1	95	1.0	1.0
<i>Seseli libanotis</i>	-	-	-	17	0.2	*	44	0.6	0.3	100	7.1	7.1
<i>Campanula rapunculoides</i>	-	-	-	17	0.2	*	83	1.0	0.8	28	0.3	0.1
<i>Prunus spinosa</i>	-	-	-	17	0.2	*	22	0.9	0.2	28	0.3	0.1
<i>Galium pumilum</i>	6	0.1	*	6	0.1	*	61	0.8	0.5	22	0.2	0.1
<i>Fragaria vesca</i>	-	-	-	-	-	-	78	4.2	3.2	100	2.1	2.1
<i>Cornus sanguinea</i>	-	-	-	-	-	-	39	1.1	0.4	56	2.8	1.5
<i>Tragopogon minor</i>	-	-	-	-	-	-	39	0.4	0.2	50	0.5	0.3
<i>Aegopodium podagraria</i>	-	-	-	-	-	-	33	4.4	1.5	17	0.2	*
<i>Acer campestre</i>	-	-	-	-	-	-	33	0.6	0.2	50	0.5	0.3
<i>Prunus avium</i>	-	-	-	-	-	-	33	0.3	0.1	39	0.4	0.2
<i>Clematis vitalba</i>	-	-	-	-	-	-	22	2.4	0.5	17	0.2	*
<i>Carex ornithopoda</i>	-	-	-	-	-	-	17	0.4	0.1	89	1.6	1.4
<i>Anthericum ramosum</i>	-	-	-	-	-	-	17	0.2	*	83	2.4	2.0
<i>Euphorbia verrucosa</i>	-	-	-	6	0.1	*	17	0.2	*	39	0.4	0.2
<i>Carex montana</i>	-	-	-	-	-	-	-	-	-	95	8.1	7.7
<i>Aquilegia atrata</i>	-	-	-	-	-	-	-	-	-	89	1.6	1.5
<i>Polygala amarella</i>	-	-	-	-	-	-	-	-	-	89	1.0	0.9
<i>Carlina simplex</i>	-	-	-	-	-	-	-	-	-	83	2.3	1.9
<i>Gentiana germanica</i>	-	-	-	-	-	-	-	-	-	83	1.3	1.1
<i>Cephalanthera longifolia</i>	-	-	-	-	-	-	-	-	-	78	0.8	0.6
<i>Orobanche alsatica</i>	-	-	-	-	-	-	6	0.1	*	61	0.6	0.4
<i>Hylocomium splendens</i>	-	-	-	-	-	-	-	-	-	50	10.8	5.4
<i>Phyteuma orbiculare</i>	-	-	-	-	-	-	-	-	-	50	0.6	0.3
<i>Gymnadenia conopea</i>	-	-	-	-	-	-	-	-	-	50	0.5	0.3
<i>Melittis melissophyllum</i>	-	-	-	-	-	-	6	0.1	*	44	0.4	0.2
<i>Teucrium chamaedrrys</i>	-	-	-	11	0.1	*	6	0.1	*	39	0.8	0.3
<i>Viburnum lantana</i>	-	-	-	-	-	-	-	-	-	39	0.4	0.2
<i>Rhynchospora triquetrus</i>	-	-	-	-	-	-	-	-	-	33	2.0	0.7
<i>Agrimonia eupatoria</i>	-	-	-	-	-	-	-	-	-	33	0.4	0.1
<i>Carlina vulgaris</i>	-	-	-	-	-	-	-	-	-	33	0.4	0.1
<i>Chrysanthemum corymbosum</i>	-	-	-	-	-	-	-	-	-	22	0.3	0.1
<i>Sorbus aria</i>	-	-	-	-	-	-	-	-	-	22	0.2	0.1
<i>Thalictrum saxatile</i>	-	-	-	-	-	-	-	-	-	17	0.3	0.1
<i>Hepatica triloba</i>	-	-	-	-	-	-	6	0.1	*	17	0.2	*
<i>Hieracium murorum</i>	-	-	-	-	-	-	-	-	-	17	0.2	*
<i>Orchis pallens</i>	-	-	-	-	-	-	-	-	-	17	0.2	*

Table 1 (continued)

Species	Study area 1			Study area 2			Study area 3			Study area 4		
	f.	m.c.	s.v.									
<i>Bromus erectus</i>	100	55.5	55.5	100	35.6	35.6	100	15.4	15.4	100	15.1	15.1
<i>Sanguisorba minor</i>	100	1.0	1.0	100	2.3	2.3	100	3.0	3.0	95	1.7	1.6
<i>Knautia arvensis</i>	100	1.2	1.2	100	2.3	2.3	95	2.8	2.7	100	1.7	1.7
<i>Medicago lupulina</i>	100	1.2	1.2	100	1.0	1.0	83	0.8	0.7	100	1.1	1.1
<i>Festuca ovina</i>	100	1.1	1.1	100	21.5	21.5	83	4.9	4.1	95	3.2	3.0
<i>Pimpinella saxifraga</i>	72	0.7	0.7	100	2.0	2.0	100	1.0	1.0	100	1.1	1.1
<i>Plantago lanceolata</i>	100	1.6	1.6	95	1.5	1.4	89	0.9	0.8	83	0.9	0.7
<i>Campanula rotundifolia</i>	89	1.0	0.9	100	1.0	1.0	95	1.4	1.3	83	0.8	0.7
<i>Lotus corniculatus</i>	78	0.8	0.6	100	1.6	1.6	95	1.0	1.0	89	1.3	1.2
<i>Thuidium abietinum</i>	83	4.0	3.3	100	93.3	93.3	100	56.2	56.2	78	16.0	12.4
<i>Galium album</i>	61	0.7	0.4	100	5.6	5.6	100	7.4	7.4	89	1.3	1.2
<i>Arrhenatherum elatius</i>	95	1.0	0.9	100	8.5	8.5	100	12.6	12.6	50	0.7	0.3
<i>Picris hieracioides</i>	95	1.7	1.6	100	2.9	2.9	89	0.9	0.8	61	1.0	0.6
<i>Briza media</i>	100	1.2	1.2	83	0.9	0.7	67	0.7	0.4	95	1.0	1.0
<i>Brachypodium pinnatum</i>	100	4.1	4.1	67	0.7	0.4	89	1.8	1.6	100	9.4	9.4
<i>Hippocrepis comosa</i>	100	1.1	1.1	95	1.2	1.2	33	0.4	0.1	100	3.9	3.9
<i>Anthyllis vulgaris</i> s.l.	100	1.6	1.6	72	0.8	0.6	67	1.7	1.2	95	2.6	2.5
<i>Dactylis glomerata</i>	95	1.0	0.9	100	1.1	1.1	78	0.8	0.6	56	0.6	0.3
<i>Poa angustifolia</i>	50	0.5	0.3	100	1.9	1.9	100	2.5	2.5	72	1.1	0.8
<i>Ranunculus bulbosus</i>	95	1.0	0.9	100	1.0	1.0	39	0.4	0.2	89	0.9	0.8
<i>Hieracium pilosella</i>	50	0.5	0.3	78	0.8	0.7	89	1.1	1.0	89	0.9	0.8
<i>Arabis hirsuta</i>	83	0.8	0.7	100	1.0	1.0	83	0.8	0.7	33	0.3	0.1
<i>Helictotrichon pubescens</i>	56	0.6	0.3	95	1.3	1.2	89	1.7	1.5	33	0.3	0.1
<i>Hypericum perforatum</i>	50	0.5	0.3	72	0.7	0.5	78	0.9	0.7	56	0.6	0.3
<i>Taraxacum officinale</i> s.l.	61	0.6	0.4	83	0.8	0.7	11	0.1	*	50	0.5	0.3
<i>Vicia cracca</i>	33	0.3	0.1	78	1.0	0.8	50	0.7	0.4	39	0.4	0.2
<i>Weisia viridula</i>	50	0.5	0.3	39	0.4	0.2	6	0.1	*	33	0.3	0.1
<i>Entodon orthocarpus</i>	33	1.2	0.4	17	0.7	0.1	56	3.4	1.9	17	0.2	*
<i>Fagus sylvatica</i>	11	0.1	*	6	0.1	*	6	0.1	*	22	0.2	0.1
<i>Festuca rubra</i>	17	0.2	*	17	0.2	*	-	-	-	6	0.1	*
<i>Allium</i> sp.	-	-	-	11	0.1	*	22	0.2	0.1	6	0.1	*

<i>Brachyhectium rutabulum</i>	6	0.1	*	11	0.1	*	6	0.1	*	11	0.1	*
<i>Potentilla reptans</i>	-	-	-	-	-	-	11	0.1	*	22	0.2	0.1
<i>Mnium rostratum</i>	17	0.2	*	11	0.1	*	-	-	-	-	-	-
<i>Rosa canina</i>	-	-	-	-	-	-	17	0.2	*	6	0.1	*
<i>Geum urbanum</i>	-	-	-	-	-	-	17	0.2	*	6	0.1	*
<i>Pirus malus</i>	-	-	-	-	-	-	6	0.1	*	17	0.2	*
<i>Tragopogon orientalis</i>	17	0.2	*	-	-	-	-	-	-	6	0.1	*
<i>Ligustrum vulgare</i>	-	-	-	-	-	-	11	0.3	*	6	0.1	*
<i>Ophrys insectifera</i>	6	0.1	*	-	-	-	-	-	-	11	0.1	*

Species only found in one or two relevés

Study area 1: *Ctenidium molluscum* (2x), *Dianthus carthusianorum* (2x), *Agrostis stolonifera* (1x), *Bellis perennis* (1x), *Brachyhectium laetum* (1x), *Campanula patula* (1x), *Euphrasia rostkoviana* (1x), *Nostoc communis* (1x), *Peucedanum cervaria* (1x).

Study area 2: *Campanula patula* (1x), *Festuca arundinacea* (1x), *Malva moschata* (1x), *Orobanche vulgaris* (1x), *Valerianella locusta* (1x).

Study area 3: *Sedum maximum* (2x), *Stachys recta* (2x), *Epipactis latifolia* (1x), *Erigeron acer* (1x), *Linaria vulgaris* (1x), *Melandrium diurnum* (1x), *Melilotus officinalis* (1x), *Senecio erucifolius* (1x), *Veronica hedericifolia* (1x), *Tortella tortuosa* (1x).

Study area 4: *Corylus avellana* (2x), *Crataegus oxyacantha* (2x), *Rhamnus cathartica* (2x), *Carex digitata* (1x), *Campanula persicifolia* (1x), *Cephalanthera damasonium* (1x), *Cephalanthera rubra* (1x), *Coronilla coronata* (1x), *Evonymus latifolius* (1x), *Festuca duriuscula* (1x), *Hedera helix* (1x), *Juniperus communis* (1x), *Lactuca perennis* (1x), *Lonicera alpigena* (1x), *Melampyrum pratense* (1x), *Platanthera bifolia* (1x), *Picea abies* (1x).

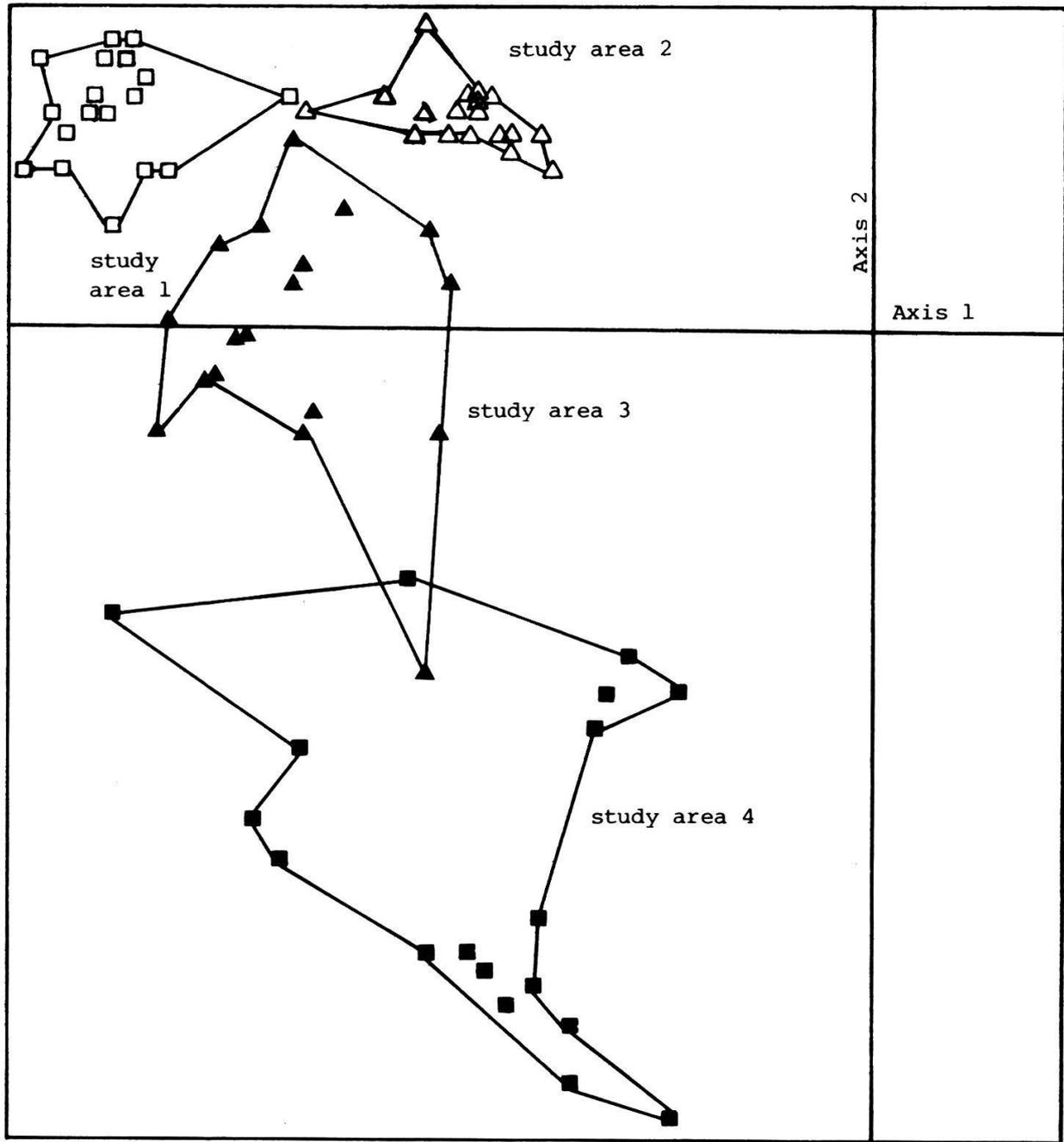


Fig. 3. Ordination by principal component analysis of 72 relevés ( $50 \text{ m}^2$ ) within the four study areas (18 relevés per each area). Axis 1 and 2 are presented.  
 Axis 1: percentage of variation accounted for: 45.81%  
 range of co-ordinates: - 15.48 to 3.14  
 Axis 2: percentage of variation accounted for: 12.99%  
 range of co-ordinates: - 13.64 to 4.98

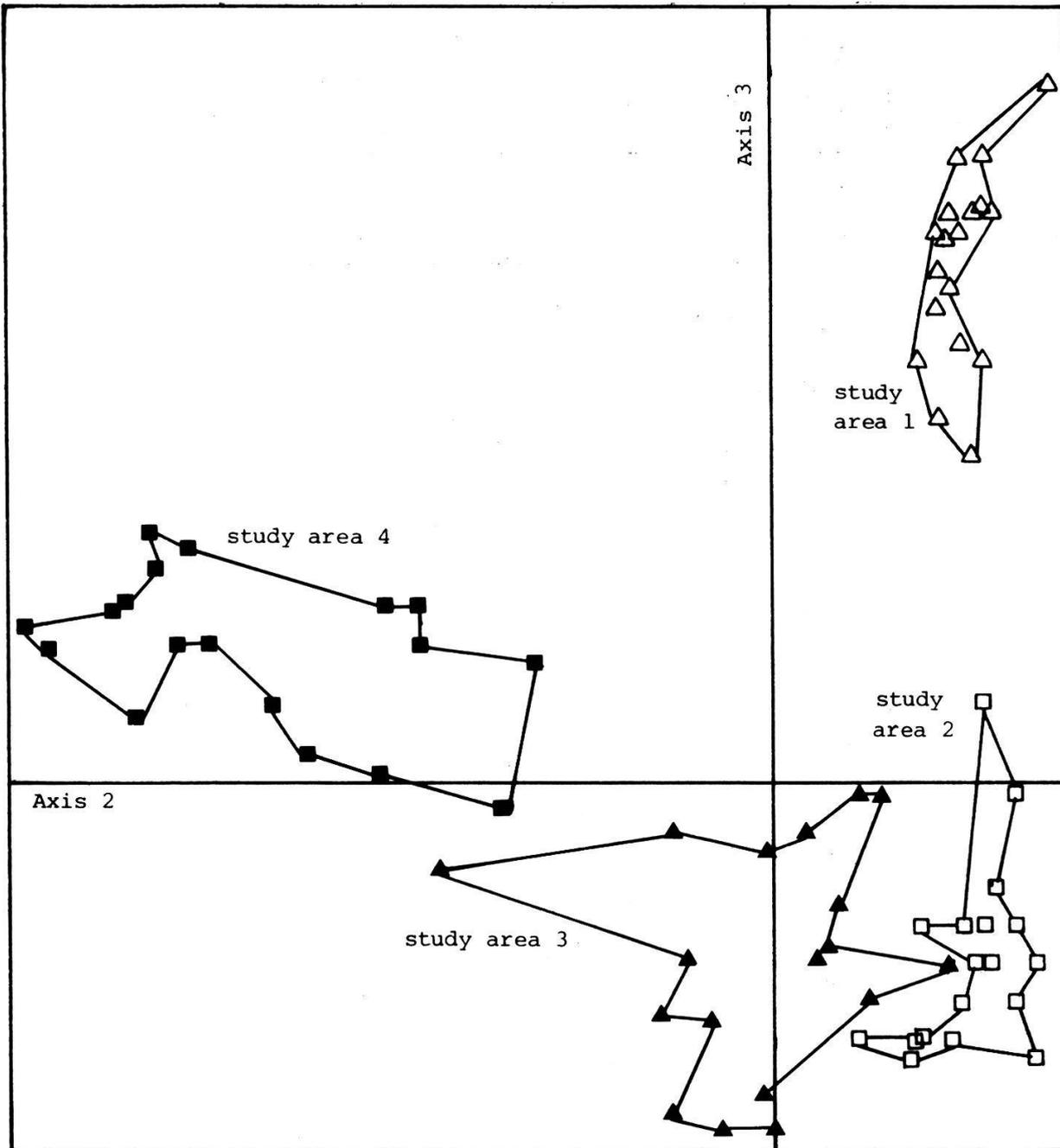


Fig. 4. Ordination by principal component analysis of 72 relevés ( $50 \text{ m}^2$ ) within the four study areas (18 relevés per area). Axis 2 and 3 are presented.  
 Axis 2: percentage of variation accounted for: 12.99%  
 range of co-ordinates: - 13.64 to 4.98  
 Axis 3: percentage of variation accounted for: 11.10%  
 range of co-ordinates: - 6.07 to 12.55

Table 2. Characteristics of the four studied areas

Study area	Grassland type according to ZOLLER (1954)	Grassland form	Treatment prior to experimental management	Experimentally managed since	Geology	Aspect (°)	Slope (%)	Altitude a.s.l.
1	<i>Medicago falcatae-Mesobrometum</i>	dry	annually cut in mid June	1978*	Gamma-Marl	124 (SE)	27	710 m
2	<i>Dauco-Salvio-Mesobrometum</i>	dry-fresh	annually cut in mid June	1977**	talus of Beta-limestone	111 (SE)	45	565 m
3	<i>Seselio libanotidis-Mesobrometum</i>	dry	abandoned for 10 years	1977**		114 (SE)	47	570 m
4	<i>Seselio libanotidis-Mesobrometum</i>	dry	abandoned for 20 years	1977**		265 (NW)	43	588 m

\* burnt for the first time in 1979

\*\* burnt for the first time in 1978