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BOTANY

XEROTHERMIC FORB FRINGES AND FORB MEADOWS IN THE LUBLIN AND LITTLE POLAND HIGHLANDS

BY

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SUMMARY

Phytosociology and primary site factors of xerothermic forb meadows and forb fringes have been studied on the Lublin and Little Poland Highlands (Wyżyna Lubelska and Małopolska).

We have distinguished a subcontinental *Inulo-Peucedanetum*, vicariant of the Illyric *Cirsio-Peucedanetum* and the suboceanic *Geranio-Peucedanetum* s.s., and a regional *Libanotido pyrenaicae-Geranietum* prov. The two Polish associations, in combination with the *Geranion* Tx. 60 ap. Müll. 62 associations, have been classified in the following alliance, order and class: *Brachypodio-Geranion* Tx. 60 ap. Müll. 62 em., *Brachypodietalia* Korneck 74, *Festuco-Brometea*.

As has been found on previous locations, the general site conditions of the *Brachypodio-Geranion* are: a subhumid to perhumid, warm temperate climate with subcontinental or (sub)montane features; a calcareous substrate; a southerly exposed slope; absence of pasturing, mowing or fertilising; an unwooded site, created by former anthropogenic activities or a geomorphologic factor; a nearby diaspore donor area and a restricted time habitat.

Futhermore some remarks have been made about the contemporary known and expected distribution area of the *Brachypodio-Geranion*.

As last point there is a brief discussion on the nature management, necessary to preserve semi-natural *Brachypodio-Geranion* communities both in Poland and elsewhere.

1. INTRODUCTION

The paper is a further extension on the theme of: "A study of the floristic composition, the site factors and the distribution area of xerothermic forb fringes and forb meadows characterised by the *Geranium sanguineum* group species" (van Gils & Gilissen 1972, 1976; van Gils et al. 1975; van Gils & Keysers 1977: van Gils & Kovács 1977; van Gils & Keysers in prep.; van Gils 1977). The involved communities will be referred to as "*Brachypodio-Geranion*".

As yet, the Lublin and Little Poland Highlands appeared as a northeastern "gap" (map: van Gils 1977) in the Medio-European* part of the distribution area of the *Brachypodio-Geranion*. In Little Poland communities of this latter type were expected explicitly by Dierschke (1974);

* Chorological term after Zohary (1974)

implicitly (van Gils & Keysers 1977, van Gils 1977) they were predicted in the Lublin county. These expectations were based on an analysis of phytosociological data resp. climatological and phytogeographical considerations (par. 4.3). We selected the Lublin Highland as research area especially because it might feature the presence of the *Brachypodio-Geranion* on the Wolhynic-Podolian Highland in the Ukraina (Wolyn and Podole). For us this question seems crucial, because the *Geranium* group species so clearly show subcontinental features, that in our opinion the Wolhynic-Podolian Highland must be a main distribution centre for this group.

By closing the "gap" in the Medio-European part of the distribution area of the *Brachypodio-Geranion* we hoped to have collected enough information to be able to take a comprehensive point of view in the discussion on the classification of these communities. Distinguishable are three classification types:

(a) One could put the *Brachypodio-Geranion* communities within the *Festuco-Brometea* or its subordinate units. Examples of this approach are found in Wendelberger (1954, 1956, 1969) and Holub c.s. (1967).

(b) Another possibility is to classify main subordinate units of the *Brachypodio-Geranion* as syntaxa below the alliance level in the *Quercetea pubescenti-petraeae*, class of Submeridional Oak woodlands and forests (Jakucs 1970, 1972; Förster 1968, 1975).

(c) Third and last possibility is to assign the communities concerned to a separate alliance, order and class, resp. *Geranion, Origanetalia, Trifolio-Geranietea* (Müller 1962, Korneck 1974, Dierschke 1974). Many authors followed this hierarchy (bibl. Tüxen & Dierschke 1975), though they did not add new arguments to the discussion.

We have tried to confirm and extend our knowledge about the site conditions of the *Brachypodio-Geranion*. This knowledge about site conditions could be summarized as follows:

(a) A warm temperate climate without dryness or aridity periods (sensu Walter). In considering the average month temperature curve at least in one month the temperature is near freezing point.

(b) Calcareous substrates are an obligatory site condition in the major part of the *Brachypodio-Geranion* distribution area. Under special climatic conditions it also may be found on silicateous substrates (par. 6).

(c) Another obligatory site condition for floristically fully developed associations in the Medio-European chorium is a southern exposure (par. 6).

(d) The *Brachypodio-Geranion* communities are not resistent to regular pasturing, mowing or fertilizing.

(e) Cutting, often followed by regular burning, pasturing and/or mowing

in the past, created unwooded sites which enabled seminatural *Brachypodio-Geranion* communities to establish.

(f) Natural stands have been found on unstable rock outcrops or screes and do not belong to the zonal vegetation.

(g) The development of a forb statium of *Geranium sanguineum* and/or *Peucedanum cervaria* on former cultivated areas depends, among other things, on nearby seeding populations of these two species.

2. METHODS

Fifty-six phytosociological relevés (table 1) were made during July and August 1976 based upon the method of Braun-Blanquet. Phytocenoseshave been selected for sampling in such a way as to represent the variations of the *Brachypodio-Geranion* in the Lublin and Little Poland Highlands (map research area: fig. 1). In this paper we now consider, that a stand belongs to this alliance when either *Geranium sanguineum* of *Peucedanum cervaria* or both are present with cover-abundance values above the "r" level and show optimal vitality.

Floristic homogeneity, minimum and maximum plot size have again been used as in earlier papers (l.c.).

Recognition of both differential species or differential groups of species and relevé clusters has been done with the tabular comparison method of Braun-Blanquet. From our own experience (van Gils & Kovács 1977) and literature (Mueller-Dombois & Ellenberg 1974) we know that classification of now more than fifty-six relevés with the help of a computer is not efficient because it consumes too much time.

With the initiative step of our study we fixed the (sub)alliance level. The association level has been chosen on the level where an already described association, i.e. *Inulo-Peucedanetum*, could be recognized.

In general the nomenclature of species, communities and phytochoria follows that of Rothmaler et al. (1972).
Fijałkowski's book (1975) provided us with a very useful guide in selecting relevé localities in the Lublin county.

3. COMMUNITY DESCRIPTION

3.1. *Inulo ensifoliae-Peucedanetum cervariae* Kozłowska 25 em.
van Gils & A. J. Kovács 77.

(Incl. *Inuletum ensifoliae* Kozł. 25, *Corylo-Peucedanetum* Kozł. 25 em. Medw.-Kornaś 52 p.p., *Brachypodio-Teucrietum chamaedrys* Fijałkowski (61) 64, *Carici-Inuletum ensifoliae* (Dziub. 25) p. max p. (Medw.-Kornaś 1959; Fijałkowski 1958, 1961, 1964; Izdebski & Fijałkowski 1956), *Asteri-Linetum flavia* Głazek 68; the unranked *Festucetalia* community and *Potentillo albae-Quercetum* of Głazek 1974 most probably included). Including the *Inuletum ensifoliae* Kozł. 25 and the *Carici-Inuletum* Dziub. 25 sensu Medw.-Kornaś and Fijałkowski in the *Inulo-Peucedanetum* does not

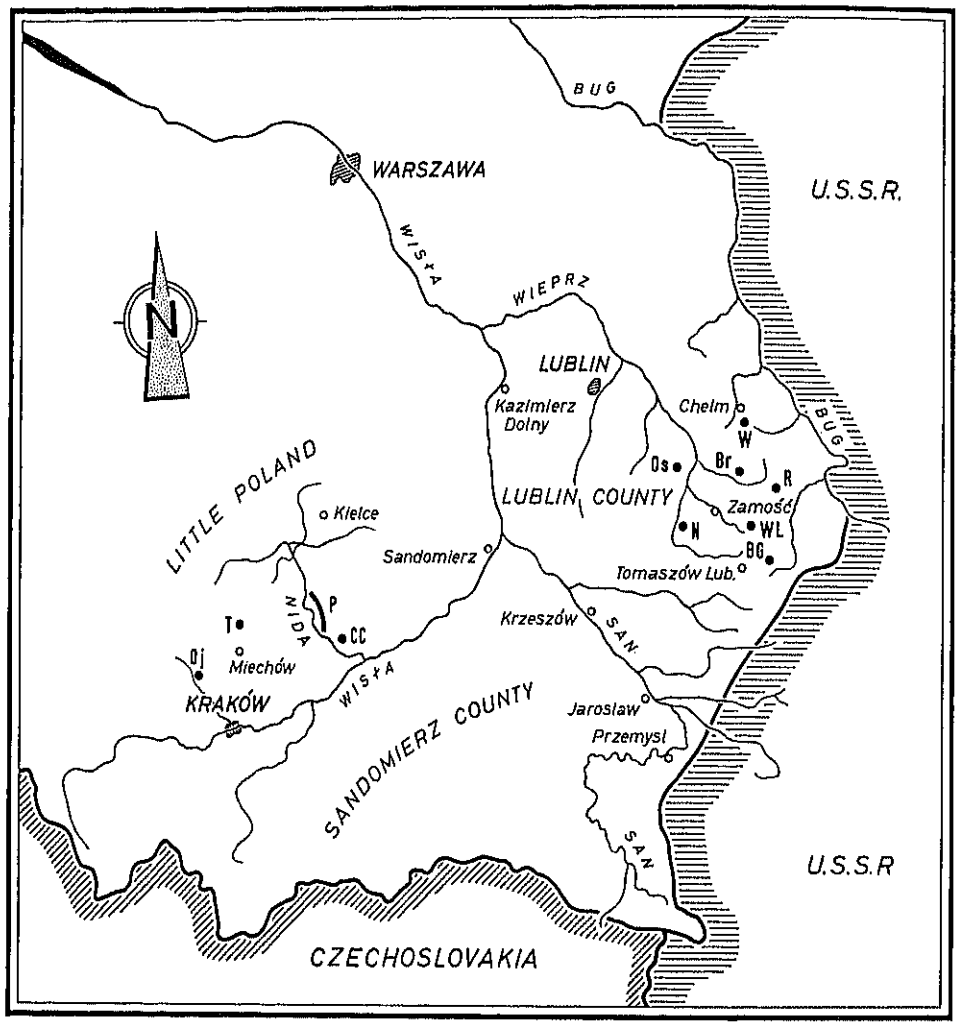

Fig. 1: Topographic map of the research area. Codes of relevé localities:

WL = forest between Wólka and Labuńska, Lublin county
R = Rogów, Lublin county: Inside (1) resp. outside (2) nature reserve
BG = Biała Gora, Lublin county
Os = Ostrzyca, Lublin county
Br = Broczówkie near Skierbieszów, Lublin county
W = Wolwinów, near Chełm, Lublin county
N = Niedzieliska – Katy, Lublin county: Inside (1) resp. outside (2) nature reserve
P = Pińczów, Little Poland, terrace slopes of Nida valley: West (1) resp. East (2) from Pińczów
CC = Chotel Czerwony, near Wiślica, Little Poland
T = Tunel, near Miechów, Kraków county
Oj = Ojców, Kraków county, National Park

exclude phytocenoses that could be a *(Carici-)Inuletum*. Stands of such phytocenoses, without any of the *Geranium* group species, have been noticed (1) in Klonów near Miechów, (2) in Tunel near our relevé localities (see table 1) and (3) on the slopes of the Vistula (Wisła) valley near Kazimierz. The *Geranium* group species are lacking here for anthropogenic (Tunel), climatic (Kazimierz; only here we find relatively "oceanic" species such as: *Berberis vulgaris, Clematis vitalba, Ligustrum vulgare*!) or reasons unknown (Klonów).

We believe that the *Inulo-Peucedanetum*, the Illyric *Cirsio-Peucedanetum* and the suboceanic *Geranio-Peucedanetum* s.s. should be included in the *Geranio-Peucedanetum* chief association.

The association is floristically characterised by the diagnostic species group S_1 and regionally by S_2—S_6 (codes in table 1) and the (co-)dominance of *Peucedanum cervaria, Inula ensifolia, Brachypodium pinnatum* and/or *Geranium sanguineum*.

Site characters of the association in Poland are:

(a) distribution on the southerly exposed chalk, marl and gypsum outcrops of the valleys of the Vistula (Wisła) and its tributary rivers ("Stromtal-element") in the Lublin and Little Poland Highlands. Outside of Poland the association has been described from Transsylvania (van Gils & Kovács 1977).

(b) relatively small inclination.

(c) At the present the land use is as most frequent field edge or road side. Former land use was as field or pasture. The frequency of primary stands in Poland is low, but it is higher in Transsylvania.

(d) a relatively high covering herb layer.

(e) relatively large stands without any or only with small influence coming from the bordering woody vegetation.

(f) frequent traces of burning.

3.1.1 Subassociation with *Adonis vernalis*.

Differential taxon: *Adonis vernalis*.

This subunit connects the *Inulo-Peucedanetum* with the East-German *Adonido-Brachypodietum* (Passarge 1964). This last association has also been found along the Lower Vistula (Ceynowa 1968). The *Inulo-Peucendanetum adonidetosum* is the xerophytic, mature form of the *Inulo-Peucedanetum*.

Variant with *Serratula tinctoria*.

Possibly including the unranked *Festucetalia* community described by Glazek (1974).

Other differential taxa: *Carlina vulgaris, C. onopordifolia*.

The latter two taxa are probably pasture relicts. There is no further information about the site characters of this variant, unlike the next variant.

Variant with *Anemone sylvestris*.
Second differential taxon: *Thymus pannonicus*.

This variant has only been recorded along the Lower Nida in the neighbourhood of Pińczów. All relevés of the *Anemone* variant have been made on field edges or former fields.

3.1.2 Subassociation with *Aster amellus* (incl. *Asteri-Linetum flavae* Glazek 68, *Brachypodium pinnatum-Teucrium chamaedrys*-community and *Carici-Inuletum* typicum Fijałkowski 61).
Differential taxa: *Aster amellus, Linum flavum, Teucrium chamaedrys*. The *Inulo-Peucedanetum asteretosum* is furthermore characterised by the absence of several taxa of group S_2 (see table 1), i.e. *Lembotropis nigricans, Carex montana, Tanacetum corymbosum, Ranunculus polyanthemos*.

This subunit is the xerophytic, pioneer form of the association. The latter site character is featured by negligible cover values of the shrub layer.

Variant with *Peucedanum alsaticum*

The site of the variant is level or southerly exposed, inside the range of a *Querco-Carpinetum* or a thermophytic *Quercus petraea*-forest.

Variant with *Clematis recta*

Senecio umbrosus, sometimes recorded also in the *Inulo-Peucedanetum* in Transsylvania (Van Gils & Kovács 1977), is only found in this variant. According to Szafer et al. 1967 this species has not been recorded in Poland until now.

The site of this variant is a western exposed and strongly inclined slope inside the range of a *Cephalanthero-Fagion*.

3.1.3 Subassociation with *Cirsium pannonicum*.
Other differential taxa: *Carlina acaulis, Campanula glomerata, Melittis melissophyllum*.

In this subassociation the *Potentillo albae-Quercetum rosetosum gallicae* Glazek 1974) can be classified because of its floristic similarity. Even structurally this "*Potentillo-Quercetum*" seems to be more a forbland than a shrub-or woodland vegetation. The coverage of a tree layer reaches in one case up to 35% but is considerably lower in the other ones. A shrub layer may reach the 40%. An interesting detail could be that these relevés derive from a plot where a forest has been felled in 1913 (Glazek 1974). The discussed vegetation seems therefore to be a good illustration for what is known about the successional character of the *Brachypodio-Geranion* (par. 6).

This subassociation represents the *Inulo-Peucedanetum* in a *Querco-Carpinetum* climax belt near Tunel and may be seen therefore as a mesophytic form of the association.

Tentatively, we may distinguish an *Inulo-Peucedanetum molinietosum* prov., including p.p. the *Brachypodio-Teucrietum, Inuletum ensifoliae* and

Corylo-Peucedanetum of Fijałkowski (1971). Differential taxa are species of the "*Molinion*" group species (sensu Krause 1958):

Inula salicina, Molinia coerulea, Betonica officinalis, Serratula tinctoria, Cirsium pannonicum, Selinum carvifolia, Galium boreale**. The two marked (*) species have been added to this "*Molinion*" group. Personally we made only one incomplete relevé of such an *Inulo-Peucedanetum molinietosum* near Srebrzeszyce (Chelm). Under this *Inulo-Peucedanetum molinietosum* the ground water level may be reached already on a depth of 0.7–1.0 m (compare Fijałkowski 1971), whereas under the other *Inulo-Peucedanetum* subunits such levels are to be detected considerably deeper, if at all.

3.2. *Libanotido pyrenaicae-Geranietum sanguinei* prov. (Incl. *Corylo-Peucedanetum* Kozł. 25 em. Medw.-Kornaś 52 p.p., *Origano-Brachypodietum* prov. Medw.-Kornaś 63 p.p.).

Floristically, the *Libanotido-Geranietum* has been characterised by the diagnostic species group S_7 and regionally by S_8 or S_9 (legend in table 1).

The association is (co-)dominated by *Geranium sanguineum, Libanotis pyrenaica* and/or *Brachypodium pinnatum*.

Site characters of the association are:

(a) distribution in Ostrzyca (Lublin county) and the Ojców National Park.

(b) a relatively strong inclination.

(c) the former land use: forest or pasture.

(d) a relatively low covering herb layer.

(e) relatively small stands with considerable influence from adjacent woody vegetation.

Similar ecotopes are extremely rare in Lublin county, but may be found in the adjacent Ukraina.

3.2.1 Subassociation with *Verbascum austriacum*.

Characterised by group S_8, including *Verbascum austriacum, Primula officinalis, Festuca cinerea, Jovibarba sobolifera, Acer platanoides, A. pseudoplatanus* (transgr.). The first four species indicate a stony primarily unwooded site, the last two taxa an adjacent maple slope forest (*Aceri-Tilietum*).

Verbascum austriacum is not merely a floristic link between the *Libanotido-Geranietum verbascetosum* and the Illyric *Origano-Cnidietum* but moreover it indicates a primary site without human interference. This subunit includes the majority of primary stands of the association and it is found, in contrast with the next subassociation, on hard chalk only. Besides this, none of its stands has a tree or shrub layer.

Variant with *Melampyrum nemorosum*.

Other differential taxa (in comparison with the *inops* variant): *Trifolium medium, Acer pseudoplatanus*.

This variant has quite a patchy vegetation cover.

Variant *inops*.
Only characterised by the absence of the differential taxa of the *Melampyrum* variant and therefore named *inops* variant (cf. Westhoff & Van der Maarel 1973).

In general, this variant has a close vegetation cover.

3.2.2 Subassociation with *Trifolium alpestre*.

Floristically the subassociation is characterised by group S_9 (see table 1), including the following taxa: *Trifolium alpestre*, *Iris* cf. *aphylla*, *Thalictrum minus*, *Seseli annuum*, *Hieracium umbellatum*, *Campanula rapunculoides*, *Filipendula vulgaris*.

Stands of the subassociation have been found in Ostrzyca (Lublin county) at secondarily unwooded as well as ungrazed sites at steep loess slopes of a hollow way. On similar loess slopes in the same region, however, we normally found semi-ruderal (*Artemisio-Agropyrion intermedii*), or other xerothermic grasslands (*Festuco-Brometea*), or a mixture of both.

4. SYNSYSTEMATICS OF THE ASSOCIATIONS

In an earlier paper (van Gils & Kovács 1977) we discussed three alternative classifications for the *Inulo-Peucedanetum* and related associations without making a choice between them.

4.1. In view of the following arguments the classification of our relevés (references in introduction) within the *Quercetea pubescenti-petraeae* (Jakucs 1970, 1972; Förster 1968, 1975) is rejected:

(a) The *Geranium* group species can not be considered as being characteristic species for the entire *Quercetea* class. This is neither so in the Pannonean area nor in other areas (van Gils & Kovács 1977).

(b) The Pannonean area is not the distribution centre for any of the *Geranium* group species (van Gils 1977) nor for the *Quercetea pubescenti-petraeae* (van Gils et al. 1975), contrary to the opinion of Jakucs (l.c.). In addition it may be emphasised that the majority of characteristic arboreous species of the *Quercetea pubescenti-petraeae* in Pannonicum (i.e. *Quercus pubescens*, *Q. cerris*, *Q. polycarpa*, *Fraxinus ornus*, *Cotinus coggyria*, *Tilia tormentosa*, *Carpinus orientalis*, *Acer monspessulanum*, *Colutea arborescens*, *Cornus mas*) are submediterrannean-Euxinean species and border on their northeastern (continental) distributional limit in Pannonicum.

(c) In a central part of the area of the *Quercetea pubescenti-petraeae*, i.e. the Karstplateau, Yugoslavia, the *Geranium* group species are nearly absent in the forests belonging to this class (van Gils et al. 1975).

(d) In the course of our investigations we could not detect a significant correlation between the presence of the *Brachypodio-Geranion* and *Quercetea pubescenti-petraeae* communities. More than fifty percent of our *Brachypodio-Geranion* relevés were made outside of the *Quercetea*

climax belt. Within considerable areas of this climax belt, the absence of the alliance is conspicuous. The ecological explanation of this phenomenon has been described elsewhere (van Gils & Kovács 1977).

4.2. Classification of our relevés in a separate *Origanetalia* order and *Trifolio-Geranietea* class, implies recognition of an unit which is only characterised by the approximately 10 *Geranium* group species, contrary to the related *Festuco-Brometea* and *Quercetea pubescenti-petraeae*. Many other class and order character taxa given by Müller (1962), Korneck (1974) and Dierschke (1974) can not be seen as such outside Germany (compare our tables l.c.).

In many parts if the "class" distribution area (e.g. Wallis, Poland) several *Geranium* group species (e.g. *Dictamnus albus, Trifolium rubens*) are absent or seldom found in stands belonging to this "class"; others (e.g. *Trifolium alpestre*) are limited to a certain association.

Further these *Geranium* group species do not enclose any endemic taxon, contrary to the *Festuco-Brometea* and the *Quercetea pubescenti-petraeae*.

Structure as criterium in classifying vegetation, i.e. the conceivable dominance of scapose hemicryptophytes, may not help in maintaining a "*Trifolio-Geranietea*" class. Many stands are dominated or at least co-dominated by caespitose hemicryptophytes (e.g. *Brachypodium pinnatum, Carex humilis*).

4.3. Classification of the "*Geranion*" as *Brachypodio pinnati-Geranion* Tx. 60 apud Müll. 62 em. (characterised by species group S_{10}) in the *Brachypodietalia* Korneck 74 and the *Festuco-Brometea* is considered reasonable for the following reasons:

(a) All noda of our tables comprise many character taxa of the *Festuco-Brometea* and its subordinate units with high frequency (*Salvia pratensis, Stachys recta, Coronilla varia, Pimpinella saxifraga* and many others).

(b) In the course of our investigations we detected a positive correlation between the presence of the *Brachypodio-Geranion* and other *Festuco-Brometa* communities. In fact, we never observed a *Brachypodio-Geranion* stand outside the neighbourhood of other *Festuco-Brometea* communities or without any general character taxa of this class. On the other hand we have made many relevés without any characteristic arboreal or forb species (except those of the *Geranium* group species) of the *Quercetea pubescenti-petraeae*.

The establishment of the hierarchical relationship between the *Brachypodio-Geranion* and the *Cirsio-Brachypodion* (also in the *Brachypodietalia*: Korneck 1974) will be left to a future study program. The *Cynancho-Geranion* Tx. 60 apud Müll. 62 em. Dierschke 1974 is thought of as a provisory unit. It has been distinguished without relevé material of the major part of the "*Geranion*" distribution area. This unit can not be confirmed

as an alliance with our collection of data. Even a hierarchical status as subaliance seems undesirable.

5. DISTRIBUTION OF THE ALLIANCE

It is evident from this study that the distribution area of the *Brachypodio-Geranion* comprises the last "gap" in the eu-Medio-European forest province, i.e. its north eastern part. The distribution area thus at least comprises the eu-Medio-European, West and Central Submediterranean choria (van Gils 1977). The *Brachypodio-Geranion* may be further expected in the Euxinean chorium. This has been concluded from the older phytogeographical literature covering this region (Radde 1899; Rikli 1946) and from the Euxinean climate (van Gils 1977). In fact, Radde describes "Wiesen und Waldränder" (!) (Meadows and forest fringes) with e.g. *Geranium sanguineum, Dictamnus albus, Trifolium medium. Coronilla coronata, Filipendula vulgaris, Brachypodium pinnatum, Prunella vulgaris, Clinopodium vulgare.*

At least the *Inulo-Peucedanetum* and perhaps also other *Brachypodio-Geranion* associations may also be expected in the biogeographic continuation of the Lublin Higland: the Wolhynic Podolian Highland. This would imply a further extension of the *Brachypodio-Geranion* distribution area into the sub-Medio-European chorium.

6. SITE CONDITIONS OF THE ALLIANCE

6.1. Climate and substrate

The climatological conditions of the Polish *Brachypodio-Geranion* (Fig. 2) are markedly in accordance with those in the major part of its distribution area. The Polish *Brachypodio-Geranion* is only found on calcareous substrates. Under special climatic conditions, like those in Wallis (van Gils & Keysers 1977), the *Brachypodio-Geranion* may be found on both calcareous and silicateous soils.

Primary stands are, as in other places, found on unstable rock outcrops and screes. Semi-natural stands have also been observed on deeper soils. In some cases an organic layer occurs, in other cases it is absent; therefore it does not seem that it is an obligatory condition.

6.2. Relief

As in most parts of its distribution area, the Polish *Brachypodio-Geranion* is limited to xerophilous slopes in the two southern quadrants and therefore appears in highlands as a river valley element (German: "Stromtalelement"). Only in Illyrium we find *Branchypodio-Geranion* associations (*Cirsio-Clematidetum, Cirsio-Peucedanetum, Origano-Cnidietum*) on northerly exposed slopes. An, in alliance character taxa impoverished, subassociation: the *Geranio-Peucedanetum gentianetosum germanicae* Marst. 70 has been found in Thuringen on northern expositions.

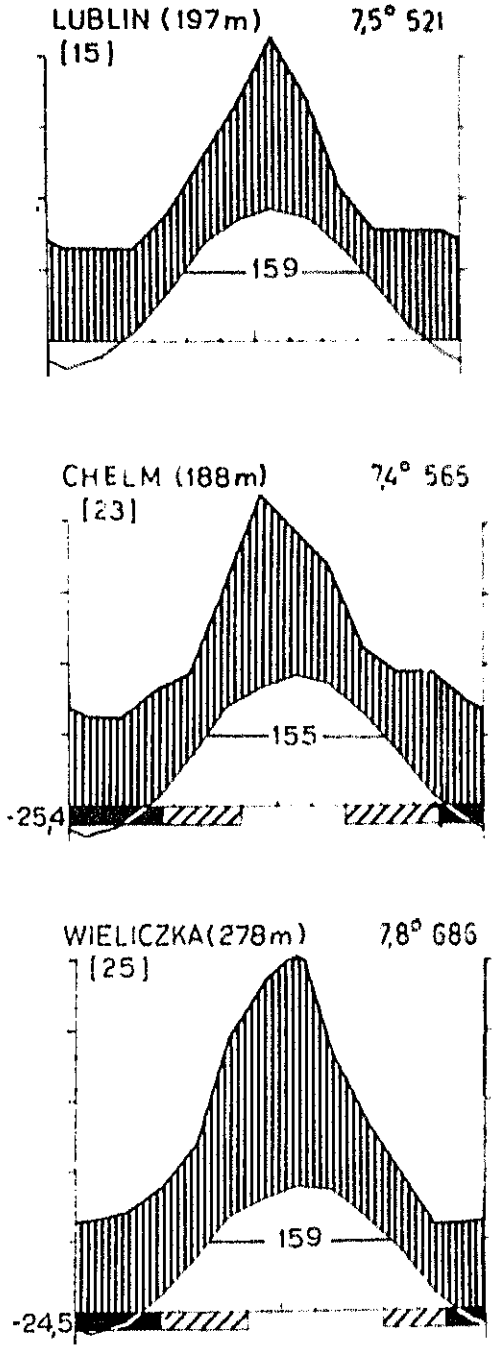

Fig. 2: Hydrothermic curves of the research area (Klimadiagrammen-Weltatlas: Walter & Lieth)

6.3. Biotic (including anthropogenic) factors

The *Brachypodio-Geranion* is not present on the grazed roadside verges and grazing lands, but is present on adjacent former pastures, where since recent grazing has been prohibited (e.g. the Rogów relevé locality). Only upon former grazing lands without neighbouring *Brachypodio-Geranion* stands, and thus consequently without diaspores of *Geranium sanguineum* and *Peucedanum cervaria*, such communities were not found. Leaf litter of various arboreous species (*Fagus*, *Pinus*) does not seem to prevent the persistence of the *Brachypodio-Geranion*.

6.4. Time

It is believed by the authors that all stands marked in table 1 with a degree of naturalness two or three (explanation: see table 1, foot-note), will certainly develop towards a woody vegetation, if there is no further anthropogenic interference. Of course such as succession can not be embodied during one field season. It has been concluded from the following observations:

(a) All conceivable transitions between pure forb meadow and closed shrub vegetation have been found in the area.

(b) The soils beneath the forblands and their adjacent vegetation differ in soil profile and colour, in individual transects. However all transects together do not show a significant correlative trend between soil profile colour and grassland/forbland/forests mosaics.
Even a detailed plant nutrient content analysis of soils in certain similar transects in France (van Althuis, van Gils & Keysers in prep.) could not help us in finding any discriminating soil factors.

(c) The microclimate may show some stable differences in some grassland/forbland/forest mosaics (Eysink & van Gils in prep.). When present, these differences are hardly to be considered a causal factor for the mosaic development. Indeed, the causal factor for the vegetational differences in many secundary grassland/forbland/forest transects may be the course of time, during which an anthropogenic factor (mowing, cutting, grazing, burning ceases to be of any influence.

7. NATURE MANAGEMENT

Natural *Brachypodio-Geranion* stands can be maintained by outward management sensu Westhoff 1976, i.e. prevention of pasturing, mowing, fertilising, treading, quarrying.

External management is not sufficient for the preservation of semi-natural *Brachypodio-Geranion* communities. For forb fringes alongside meadows, an internal management should at least include the continuation or creation of a mowing gradient, in combination with burning and chopping down the woody species invading the forbland. We would say

every 3–5 years. Inquiring into the best season for burning and experiments with mechanical disturbance seem necessary.

Forb meadows, that are in fact certain stages of abandoned grasslands, could be conservated as such, if desirable, by regularly chopping and burning down the woody invaders. However under such management a ruderalisation of the stands is conceived. Ceasing to graze and mow for many years in some small parts of relatively extensive seminatural grassland nature reserves seems to us a more reliable management. When the forbland, resulting from this regime, almost reaches the next successional stage (shrub or forest), another part of the nature reserve can be treated in the same way. A similar shrub or forest area can be cleared and this may be added to the pastures. We believe that such a dynamic management would cause an increase in species diversity, not only on behalf of the *Brachypodio-Geranion* species but also of several other stenotope and/or stenodynamic species (in the xerosere e.g.: *Inula conyza, Senecio umbrosus, S. erucifolius*).

Succession, spontaneous or caused by nature conservationists, has a preservational aspect yet to be mentioned. It may lead to supression (e.g. *Carlina onopordiifolia* in relevé 5 of table 1) and subsequent extinction of certain pasture plants.

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APPENDIX

Incidental species of table 1:
1: Plantago lanceolata (+), Potentilla recta (+); 2: Agrostis tenuis (+); 3: Lolium perenne (+), Festuca gigantea (+), Astragalus glycyphyllus (+), Cichorium intybus (+), Linaria vulgaris (+); 4: Berberis vulgaris (+), Hepatica nobilis (+), Epipactis helleborine (+), Viola reichenbachiana (+), Festuca gigantea (+), Asarum europeum (+), Lathyrus pratensis (+); 6: Carex sp. (+), Salix sp. (+); 7: Falcaria vulgaris (+), Stipa capillata (+), Festuca valesiaca (+), Potentilla argentea (+); 8: Lathyrus tuberosus (+); 9: Festuca rubra (+); 10: Onosis spinosa (+), Pseudolysimachion spicatum (+), Scabiosa columbaria (+), Lotus corniculatus (+), Lathyrus latifolius (+); Pseudolysimachion spicatum (+), Verbascum lychnitis (+); 12: Dorycnium germanicum (r), Onosis spinosa (+); 13: Betula pendula (+), Salix caprea (+), Carex flacca (+), Rubus sp. (+); 14: Quercus petraea (+), Berberis vulgaris (+), Eryngium campestre (+), Bromus sp. (+°), Viola sp. (+°), Orobanche elatior (+); 15: Calamagrostis epigejos (+); 18: Cichorium intybus (+), Campanula trachelium (+), Hepatica nobilis (+), Epipactis helleborine (+), Lathyrus vernus (+); 20: Salix sp. (+); 21: Pyrus communis (+), Astragalus glycyphyllus (+), Carex flacca (+), Anthyllis vulneraria (+); 22: Potentilla argentea (+), Trifolium pratense (+),

Euphorbia sp. (+); 23: Asarum europeum (+), Viola reichenbachiana (+), Rhinanthus serotinus (+°), Festuca rubra (+); 24: Rhinanthus serotinus (+°), Linum catharticum (+); 25: Cerasus avium (1), Peucedanum oreoselinum (+), Carex flacca (+), Genista tinctoria (+), Picea abies introd. (+), Rhinanthus serotinus (r°); 26: Cotoneaster melanocarpa (+), Medicago lupulina (+), Linum catharticum (+), Lotus corniculatus (+), Scabiosa columbaria (+°), Carex digitata (+), Melica transsilvanica (+), Lamium galeobdolon (+), Solidago virgaurea (+), Potentilla argentea (+); 27: Solidago virgaurea (+); 28: Carex flacca (+), Quercus petraea (+), Convallaria majalis (+), Lathyrus vernus (+), Carex digitata (+), Solidago virgaurea (+), Hypericum perforatum (+), Calamintha acinos (+); 29: Cotoneaster melanocarpa (+); 30: Malus sp. (+), Silene nutans (+), Festuca pratensis (+), Sedum sexangulare (+), Allium sphaerocephalon (+); 31: Geranium pratense (+), Silene nutans (+), Allium montanum (+), Melica ciliata (+), Cirsium arvense (+); 32: Fraxinus excelsior (+), Silene nutans (+), Allium montanum (+), Potentilla heptaphylla (+), Echium vulgare (+), Convolvulus arvensis (+), Cytisus supinus (+), Melica transsilvanica (+); 33: Peucedanum oreoselinum (+), Festuca rubra (+), Bromus inermis (4); 34: Hypochoeris maculata (+), Cytisus ruthenicus (+); 35: Poa nemoralis (+), Solidago virgaurea (+), Hypochoeris maculata (+), Cytisus ruthenicus (+); 36: Artemisia vulgaris (+), Cytisus ruthenicus (+), Festuca rubra (+), Rubus idaeus (+), Erigeron acer (+).