

MEADOWS OF THE “GRANICA” COMPLEX IN THE KAMPINOS NATIONAL PARK (CENTRAL POLAND): GEOBOTANICAL CHARACTERISTICS AND PROTECTION PROPOSALS

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Abstract: Non-forest communities of the “Granica” meadow complex were investigated during the vegetation season of 1999. The studies resulted in finding the stations of six protected plant species (five strictly and one partially protected), including three species which are vulnerable in Poland, e.g. *Orchis militaris*. Twenty two non-forest communities were identified. Those considered to be most important – *Molinietum caeruleae* and *Caricetum diandrae* – were investigated using the Braun-Blanquet method. A total of 10 phytosociological relevés were made. In order to ensure adequate protection to all non-forest communities, the “Granica” meadow complex was divided into 24 ecochores. For each of them, conservation tasks relevant for the respective plant communities were planned.

Key words: meadows, protection, Kampinos National Park, central Poland.

INTRODUCTION

The “Granica” meadow complex which encompasses non-forest communities along the Olszowiec Canal, north of the Kampinos village, is one of the most valuable areas of this kind within the territory of the Kampinos National Park. It is characterised by a high patchiness of vegetation and rich flora. The largest area of the site is covered by sedge communities from the *Magnocaricion* alliance and wet meadows from the *Calthion* alliance. On the other hand, all kind of phytocoenoses on habitats with disturbed water conditions (e.g. phytocoenoses with *Calamagrostis canescens*) are much rarer and occupy a smaller area than in other parts of the park. The most valuable plant communities occurring in this area include the association with diandrous sedge *Caricetum diandrae* which was found only in this place and has not hitherto been reported from the territory of the Kampinos National Park and the association with purple moor-grass *Molinietum caeruleae*. This area is also most abundant in valuable meadow species (9 out of the 20 most valuable species of the western part of the park occur here). In the case of the rarest species – the soldier orchid *Orchis militaris* – “Granica” is its only station within the park, while in the case of the diandrous sedge *Carex diandra* – the only one in the western part of the park.

For the reasons given above, the conservation of the diversity of non-forest flora and vegetation of the “Granica” meadow complex should become one of the most important objectives of the park.

The aim of this study is to present a proposal for the active protection of non-forest communities of the “Granica” meadow complex divided into ecochores as well as to provide the characteristics of the plant cover on which the division is based.

THE STATE OF RESEARCH ON THE MEADOWS OF THE “GRANICA”

“Meadows” are defined in this study as including grass and herb communities from the *Molinio-Arrhenatheretea* class, rush communities from the *Phragmitetea* class, mires and fens from the *Scheuchzerio-Caricetea* class as well as grassland communities from the *Koelerio glaucae-Corynephoretea canescentis* and *Nardo-Callunetea* classes. The primary information source about the flora and vegetation of the “Granica” meadow complex, is the doctoral thesis entitled “Current state and directions of change non-forest vegetation of the Kampinos National Park” (Michal-

ska-Hejduk 2001). Other sources are the communications and notes in popular journals (Michalska-Hejduk 1995, 1998, 1999a, 1999b). These records were also the basis for the comparison and determination of changes which the meadows of the "Granica" have undergone during the last 5 years. During this time, most of the previously mown meadows have been abandoned due to the high level of ground water table (which persists till the beginning of August). Some earlier data pertaining to the described territory can be found in the work of Kobendza (1930), but they refer to meadow and sedge communities only to a certain degree (the author describes only six non-forest communities in all of the Kampinos Forest).

The most comprehensive study on the nature of the whole Kampinos National Park is the documentary part of the Conservation Plan for the Kampinos National Park dating from 1995. The field studies on the vegetation of the Park, especially on the non-forest communities of its western part, have been conducted, however, only during a single vegetation season. They were started in the beginning of August, which enabled only a general characterisation of meadow and sedge communities (although this was enough for the purposes of protection planning).

GENERAL CHARACTERISTICS OF THE AREA

The "Granica" meadow complex comprises communities from the following classes: *Molinio-Arrhenatheretea*, *Phragmitetea*, *Scheuchzerio-Caricetea*, *Koelerio glaucae-Corynephoretea canescentis* and *Nardo-Callunetea*, located on both sides of the Olszowiec Canal to the south of the village and of the "Granica" reserve (Fig. 1). It covers an area of ca. 96 ha. Its western and eastern borders run along paved roads, whereas the southern and northern borders run along forest edges. No permanent road runs through the meadow complex. In the south-western and north-eastern parts, there are weakly conspicuous roads leading to the meadows. A majority of meadows south of the Olszowiec Canal and a fragment in the north-eastern part of the meadow complex were still mown regularly several years ago. In the years 1995–1998 only meadows in the south-western part were mown. In 1999, due to the high level of water which stagnated in the meadows until the end of July, only a small fragment (ca. 1 ha) was mown in the north-western part of the meadow complex, in addition to a narrow belt on the hillock along the paved road, as well as small fragments in the south-western part.

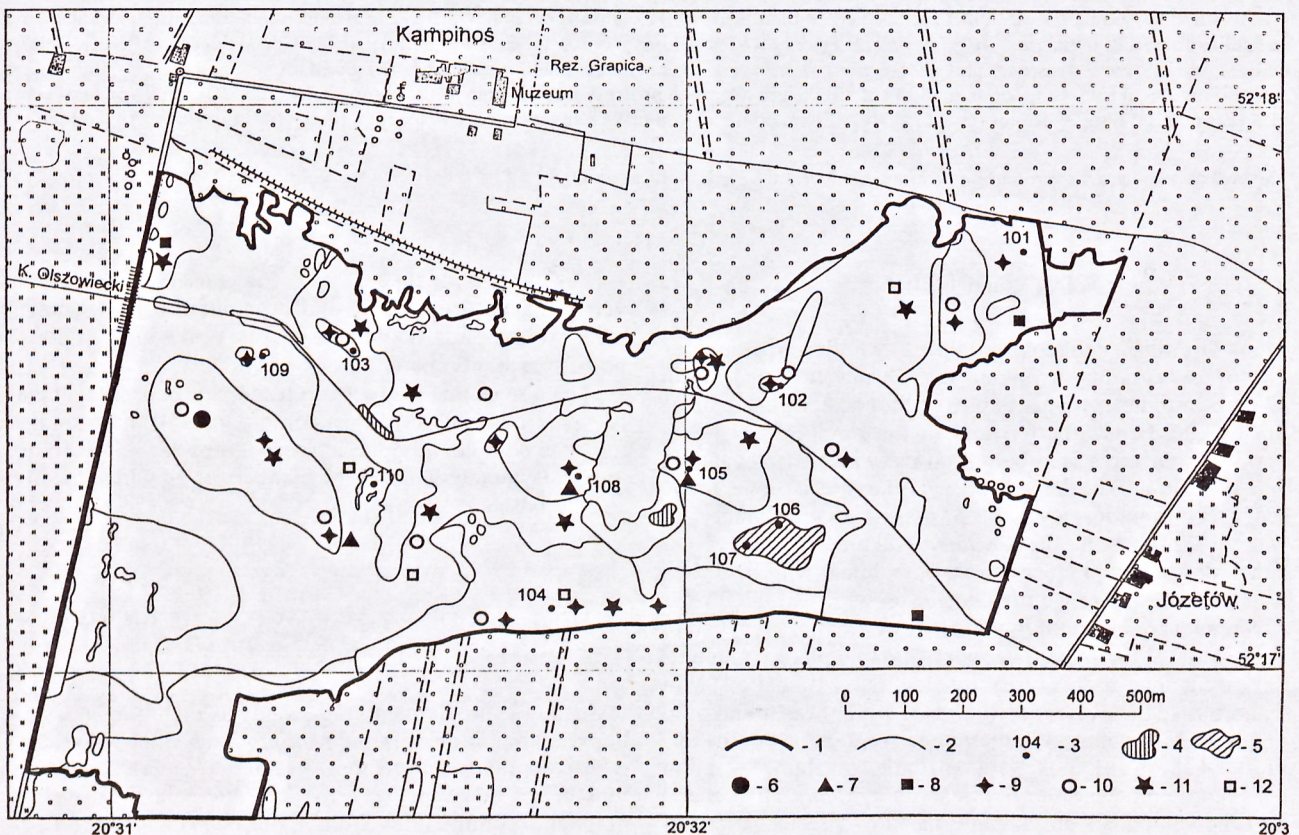


Fig. 1. Locality of relevés and distribution of the most valuable species in the Granica meadow complex. 1 – study area, 2 – borders of ecochores, 3 – field number of relevés, 4 – *Senecio paludosus*, 5 – *Carex diandra*, 6 – *Orchis militaris*, 7 – *Epipactis palustris*, 8 – *Centaurium erythraea subsp. erythraea*, 9 – *Dianthus superbus*, 10 – *Ophioglossum vulgatum*, 11 – *Dactylorhiza incarnata*, 12 – *Dactylorhiza majalis*.

METHODS OF RESEARCH

Field studies of the meadows and sedge communities of the "Granica" meadow complex were conducted at the turn of July and August 1999.

Floristic studies focused on interesting species, i.e. protected, threatened, locally rare species. Their abundance was noted, the localities were pinpointed on a map and photographic documentation was prepared. The distribution of selected species was shown on a topographic map in the scale 1:10,000. A nomenclature of species followed the *Checklist of vascular plants of Poland* (Mirek et al. 1995).

The most valuable plant communities – *Molinietum caeruleae* and *Caricetum diandrae* – were investigated using the commonly applied method of Braun-Blanquet including modifications by Pawłowski (1977) and Matuszkiewicz (2001). At arbitrarily selected points (Fig. 1), 10 phytosociological relevés were made. The syntaxonomic system and syntaxonomic affiliations of species were adopted after Matuszkiewicz (2001), Załuski (1995), Kucharski and Michalska-Hejduk (1994) and Balátova-Tuláčková (1963, 1978). The remaining communities, especially the communities from the *Phragmitetea* class which occupy very large surfaces in the investigated area, are discussed in a separate study (Michalska-Hejduk 2001).

As a basis for division of the meadow complex into ecochores and for distinguishing four types of protection regimes (see p. 64), a map of actual vegetation was used. It

also served for determination of dynamic vegetation tendencies; their knowledge allowed a more precise planning of conservation operations in the respective parts of the meadow complex. It was also used as the basis for calculating the approximate surface of biochores occupied by each community. The mapping of non-forest actual vegetation was conducted using a topographic map in the scale 1:10 000 and the topographic (transect) method (Faliński 1990).

RESULTS

SPECIES WHICH REQUIRE SPECIAL PROTECTION MEASURES

A majority of reported species are species characteristic for meadow communities and fens. However, scrub and forest species also appear among them, as a forecast of return of woodland to abandoned meadows.

Among the vascular plants of the investigated area, there are 5 species under strict species protection, 1 – under partial protection, and 3 species included in the red list of threatened plants (Zarzycki and Szelağ 1992). 11 species (except *Centaurium erythraea* ssp. *erythraea*) represent threatened species of wetland flora (Jasnowska and Jasnowski 1977). They are listed in Table 1 and their stations are presented in Figure 1. Most of them should be considered as species which require special protection measures.

Table 1. List of the most valuable species of the „Granica” meadow complex

Name of species	Number of stations in the meadow complex	Number of stations in western part of the KPN ^a	Legal protection	Categories of threat ^b
<i>Orchis militaris</i>	1	1	Ch	V
<i>Epipactis palustris</i>	3	8	Ch	V
<i>Dianthus superbus</i>	14	27	Ch	V
<i>Dactylorhiza majalis</i>	4	20	Ch	
<i>Dactylorhiza incarnata</i>	10	72	Ch	
<i>Centaurium erythraea</i>	3	8	cz. Ch	
<i>Carex diandra</i>	1	1		
<i>Senecio paludosus</i>	2	4		
<i>Parnassia palustris</i>	2	5*		
<i>Veronica longifolia</i>	3*	8*		
<i>Carex flava</i>	2*	11		
<i>Ophioglossum vulgatum</i>	10	68		

Explanations: ^a – according to Michalska-Hejduk 2001; ^b – according to Zarzycki, Szelağ (1992); Ch – species covered by strict protection; cz. Ch – species partially protected; * not mapped species, number of stations according to frequency in phytosociological relevés.

PLANT COMMUNITIES

In the "Granica" meadow complex, 21 non-forest plant communities were found:

Class: *Phragmitetea* R. Tx. et Prsg. 1942

Order: *Phragmitetalia* Koch 1926

Alliance: *Phragmition* Koch 1926

1. *Phragmitetum australis* (Gams 1927) Schmale 1939

Order: *Magnocaricetalia elatae* (Koch 1926) Bal.-Tul. 1963

2. Community with *Calamagrostis canescens*

Alliance: *Caricion rostratae* Bal.-Tul. 1963

3. *Caricetum appropinquatae* (Koch 1926) Sos 1938

4. *Caricetum acutiformis* Sauer 1937

Alliance: *Caricion gracilis* Bal.-Tul. (1960) 1963

5. *Caricetum ripariae* Sos 1928

6. *Caricetum gracilis* (Graeb. et Hueck 1931) R. Tx. 1937

Alliance: *Sparganio-Glycerion fluitantis* Br.-Bl. et Siss. in Boer 1942

7. *Sparganio-Glycerietum fluitantis* Br.-Bl. 1925 n.n.

Class: *Koelerio glaucae-Corynephoretea canescentis* Klika in Klika et Novak 1941

Order: *Corynephorotalia canescentis* R. Tx. 1937 em. Krausch 1962

Alliance: *Corynephorion canescentis* Klika 1931

8. *Spergulo morisonii-Corynephoretum canescentis* R. Tx. ex K. Czyżewska 1992

Class: *Molinio-Arrhenatheretea* R. Tx. 1937

Order: *Molinietalia* Koch 1929

Alliance: *Filipendulion ulmariae* Segal. 1966

9. *Filipendulo-Geraniumetum* Koch 1926

10. *Valeriano-Filipenduletum* Siss. in Westh. et al. 1946

Alliance: *Molinion* Koch 1926

11. *Molinietum caeruleae* Koch 1926

Subassociation: *Molinietum c. sanguisorbetosum officinalis* Grynia 1968

Alliance: *Calthion* R. Tx. 1936 em. Oberd. 1957

12. *Angelico-Cirsietum oleracei* R. Tx. 1937 em. Oberd. 1967

13. *Scirpetum sylvatici* Knapp 1946

14. *Stellario-Deschampsietum* Freitag 1957

15. *Deschampsietum caespitosae* (Horvati 1930) Grynia 1961

16. Community with *Caltha palustris* i *Geum rivale*

Order: *Arrhenatheretalia* Paw3. 1928

Alliance: *Arrhenatherion* (Br.-Bl. 1925) Koch 1926

17. *Arrhenatheretum elatioris* Br.-Bl. ex Scherr. 1925

Alliance: *Cynosurion* R. Tx. 1947

18. *Lolio-Cynosuretum* R. Tx. 1937

Class: *Scheuchzerio-Caricetea* (Nordh. 1937) R. Tx. 1937

Order: *Scheuchzerietalia palustris* Nordh. 1937

Alliance: *Caricion lasiocarpae* Vanden Bergh. ap. Lebrun et al. 1949

19. *Caricetum diandrae* Jon. 1932 em. Oberd. 1957

Order: *Caricetalia nigrae* Koch em. Nordh. 1926

Alliance: *Caricion nigrae* Koch 1926 em. Klika 1934

20. *Carici canescentis-Agrostietum caninae* R. Tx. 1937

Class: *Nardo-Callunetea* Prsg 1949

Order: *Nardetalia* Prsg 1949

Alliance: *Violion caninae* Schwick. 1944

21. *Polygalo-Nardetum* Prsg 1953

Apart from the above-mentioned non-forest communities, willow scrubs (mainly *Salix cinerea* and *Salix rosmarinifolia*) also occur in the site but they have not been subject to detailed investigation.

TALL-HERB, MEADOW, PASTURE,
AND OTHER GRASSLAND COMMUNITIES

These communities occupy nearly 45 ha, i.e. over 47% of the area of the meadow complex. Wet meadows from the *Molinietalia* order dominate among them. Communities of sand and mat-grass grasslands, on the other hand, occupy less than 2% of the area of the meadow complex and occur on ground with the highest elevation. The most valuable community in the meadow complex is *Molinietum caeruleae*.

Molinietum caeruleae Koch 1926

[*Molinietum medioeuropaeum* Koch 1926] (Tab. 2)

The purple moor-grass meadows is one of the best-known meadow communities in Poland, although they are becoming increasingly rare (Grynia 1968; Kucharski and Michalska-Hejduk 1994).

In the Conservation Plan for the Kampinos National Park (Solon 1995), small patches of *Molinietum caeruleae* are mentioned from the south-western part of the park. Furthermore, there are mentioned numerous poorly developed communities with the participation of *Molinia caerulea*, which are, however, dominated by such species as *Deschampsia caespitosa* or *Cirsium arvense* or show absolute domination by the purple moor-grass itself. The best-preserved phytocoenoses of *Molinietum caeruleae* in the western part of the park can be found precisely within the "Granica" meadow complex. They have been formed as a result of the special type of management of these meadows in the past. Nowadays, after mowing has ceased, most of the species characteristic for the association are withdrawing. The improvement in the overall water regime during the last 5 years has, however, stopped succession and resulted in a (probably temporary) increase in the proportion of species characteristic for the association and for the alliance.

The phytocoenoses with purple moor-grass which occur currently in the "Granica" meadow complex have been classified among the *Molinietum caeruleae* association and the subassociation *M.c. sanguisorbetosum officinalis*. It is characterised by relatively considerable floristic richness (on average 25 species per relevé) and by a high participation of species characteristic for the class. In these phytocoenoses there were found two differentiating species of this community – *Sanguisorba officinalis* and *Galium verum*, while *Medicago lupulina* and *Plantago media* were

Table 2. *Molinietum caeruleae* Koch 1926

Successive number	1	2	3	4	5	6	7	8	Constancy
Field number of relevé	102	103	109	101	108	104	105	110	
Date	18.07. 1999	18.07. 1999	21.07. 1999	18.07. 1999	20.07. 1999	18.07. 1999	20.07. 1999	21.07. 1999	
Area of relevé [m ²]	25	20	25	25	25	25	25	25	
Cover of herb layer [%] c	100	100	100	100	100	100	100	100	
Cover of bryophyte layer [%] d	-	-	-	-	-	40	30	-	
Number of species in relevé	24	21	24	31	23	29	29	19	
Ch.Ass. <i>Molinietum caeruleae</i> , Ch. et D. All. <i>Molinion</i>									
<i>Molinia caerulea</i>	2	2	3	3	2	.	3	2	V
<i>Dianthus superbus</i>	2	1	1	1	1	1	1	.	V
D. <i>Potentilla erecta</i>	1	.	.	2	2	1	2	.	IV
D. <i>Briza media</i>	.	.	1	2	1	1	1	1	IV
<i>Succisa pratensis</i>	.	.	+	.	2	1	1	2	IV
<i>Selinum carvifolia</i>	2	2	.	.	.	.	2	1	III
D. <i>Salix rosmarinifolia</i> c	.	2	3	.	.	1	.	2	III
<i>Ophioglossum vulgatum</i>	.	1	+	.	.	.	+	.	II
D. <i>Carex panicea</i>	.	.	.	1	1	+	.	.	II
D. <i>Carex flava</i>	.	.	+	.	.	.	.	.	I
D. <i>Parnassia palustris</i>	.	.	.	+	.	.	.	.	I
Ch.subass.									
<i>M.c.sanguisorbetosum</i>									
<i>Galium verum</i>	1	1	1	+	2	2	2	1	V
<i>Sanguisorba officinalis</i>	.	.	.	.	.	.	.	1	I
Ch.All. <i>Filipendulion ulmariae</i>									
<i>Valeriana officinalis</i>	1	1	+	.	1	1	1	1	V
<i>Lythrum salicaria</i>	1	.	+	+	.	.	2	1	V
<i>Hypericum tetrapterum</i>	.	.	.	+	.	.	+	.	II
<i>Filipendula ulmaria</i>	.	.	.	.	.	.	1	1	II
<i>Stachys palustris</i>	.	1	.	.	.	.	.	.	I
Ch.O. <i>Molinietalia</i>									
<i>Deschampsia caespitosa</i>	1	1	2	1	2	3	1	2	V
<i>Geum rivale</i>	3	2	.	.	1	2	2	1	IV
<i>Cirsium palustre</i>	1	1	.	.	1	2	2	.	IV
<i>Cirsium oleraceum</i>	.	.	+	.	.	.	.	3	II
<i>Galium uliginosum</i>	.	.	+	.	.	1	.	.	II
<i>Climacium dendroides</i> d	.	.	.	.	.	3	1	.	II
<i>Equisetum palustre</i>	.	.	.	.	.	.	+	.	I
Ch.Cl. <i>Molinio-Arrhenatheretea</i>									
<i>Plantago lanceolata</i>	1	2	1	2	2	2	1	.	V
<i>Holcus lanatus</i>	.	2	1	1	1	1	1	+	V
<i>Ranunculus acris</i>	1	1	1	2	1	2	.	.	IV
<i>Poa pratensis</i>	.	1	1	2	2	.	.	1	IV
<i>Festuca pratensis</i>	1	2	+	.	2	.	.	.	III
<i>Achillea millefolium</i>	1	.	.	.	1	1	.	.	II
<i>Leucanthemum vulgare</i>	+	.	.	+	.	.	1	.	II

Table 2 cont.

Successive number	1	2	3	4	5	6	7	8	Con- stancy
<i>Rumex acetosa</i>	.	1	.	1	.	1	.	.	II
<i>Lychnis flos-cuculi</i>	.	+	+	.	.	1	.	.	II
<i>Potentilla anserina</i>	2	.	1	.	.	.	.	.	II
<i>Centaurea jacea</i>	1	.	.	.	2	.	.	.	II
<i>Rhinanthus minor</i>	+	.	.	.	.	+	.	.	II
<i>Arrhenatherum elatius</i>	+	.	+	.	.	.	.	.	II
<i>Trifolium repens</i>	.	.	.	1	.	+	.	.	II
<i>Heracleum sphondylium</i>	.	.	.	+	.	1	.	.	II
<i>Lotus corniculatus</i>	.	.	.	1	.	1	.	.	II
<i>Ranunculus repens</i>	.	.	.	.	.	1	1	.	II
Sporadic species: <i>Cerastium holosteoides</i> 101 (1), <i>Leontodon autumnalis</i> 101 (1), <i>Phleum pratensis</i> 102 (+), <i>Prunella vulgaris</i> 108 (1).									
Accompanying species:									
Ch.Cl. <i>Scheuchzerio-Caricetea</i>									
<i>Epilobium palustre</i>	.	.	.	+	1	2	2	.	III
<i>Epipactis palustris</i>	.	.	.	.	1	.	2	.	II
Sporadic species: <i>Carex diandra</i> 105 (+), <i>Carex nigra</i> 101(+), <i>Dactylorhiza majalis</i> 104(+), <i>Juncus articulatus</i> 101(1).									
Others:									
<i>Veronica chamaedrys</i>	2	2	.	2	.	.	.	.	II
<i>Galium palustre</i>	.	.	+	1	.	.	.	1	II
<i>Valeriana dioica</i>	.	.	.	.	2	.	+	2	II
<i>Carex acutiformis</i>	.	.	.	.	.	+	+	+	II
<i>Mentha arvensis</i>	1	.	.	.	1	.	.	.	II
<i>Epilobium parviflorum</i>	1	.	.	.	.	.	.	1	II
<i>Anthoxanthum odoratum</i>	.	.	1	2	.	.	.	.	II
<i>Festuca rubra</i>	.	.	.	.	.	2	2	.	II
Sporadic species: <i>Carex appropinquata</i> 105 (1), <i>Carex leporina</i> 101 (+), <i>Centaureum erythraea ssp. erythraea</i> 101(+), <i>Cirsium arvense</i> 103 (+), <i>Danthonia decumbens</i> 101(1), <i>Galium mollugo</i> 103 (1), <i>Luzula campestris</i> 101(1), <i>Plantago media</i> 104 (1), <i>Salix cinerea</i> c 108 (1), <i>Senecio jacobaea</i> 102 (1), <i>Thuidium philibertii</i> d 105 (2).									

absent. Just as in the subassociation described by Grynia (1968) from the Katowice province, some species have a higher participation in *M.c. sanguisorbetosum officinalis* than in other subassociations. These are *Achillea millefolium*, *Ranunculus acris* and *Centaurea jacea*, as well as other species (not listed by Grynia) occurring mainly on moist meadows, such as *Leucanthemum vulgare*. The presence of this species in relevés 101, 102 and 105 is probably due to the location of these patches on sandy mid-marsh hillocks called *grondziki*. During the last 5 years, a decrease in the participation of differentiating species of this subassociation has been noted due to secondary swamping of the area.

REED AND LARGE-SEDGE BEDS, TRANSITION MIRES AND FENS

These communities occupy a total area of 44 ha, i.e. over 45% of the area of the meadow complex. They include six plant associations and one community from the *Phragmitetea* class as well as two associations from the *Scheuchzerio-Caricetea* class. Most widely distributed are

the associations with the lesser pond-sedge and the tufted sedge as well as reed beds. The association with the diandrous sedge – *Caricetea diandrae* – should be treated as the most valuable one.

Caricetum diandrae Jon. 1932 em Oberd. 1957 (Tab. 3)

This association has been reported from the territory of the Kampinos National Park for the first time by Michalska-Hejduk (2001). It occurs only within the “Granica” meadow complex as a small patch to the south of the Olszowiec Canal. In its phytocoenoses, meadow species play a major role, while species from the *Scheuchzerio-Caricetea nigrae* class are less important. They are also characterised by the presence of the common sedge *Carex nigra*, but from the phytocoenoses of *Carici-Agrostietum caninae* (variant with *Carex nigra*) differ in that they have the participation of *Eriophorum angustifolium* and a higher coverage of *Drepanocladus aduncus*. Just as in the phytocoenoses of this association described by Noryśkiewicz (1978), the *Caricion lasiocarpae* alliance is represented only by *Carex diandra*.

Table 3. *Caricetum diandrae* Jon. 1932 em Oberd. 1957

Successive number	1	2
Field number of relevé	106	107
Date	20.07.1999	21.07.1999
Area of relevé [m ²]	50	25
Cover of herb layer % c	80	90
Cover of bryophyte layer % d	60	40
Number of species in relevé	17	14
Ch.Ass. <i>Caricetum diandrae</i>		
<i>Carex diandra</i>	2	3
Ch.Cl. <i>Scheuchzerio-Caricetea</i>		
<i>Drepanocladus aduncus</i> d	4	3
<i>Eriophorum angustifolium</i>	3	2
<i>Carex nigra</i>	2	3
<i>Stellaria palustris</i>	1	1
<i>Veronica scutellata</i>	+	.
Accompanying species:		
Ch.Cl. <i>Phragmitetea</i>		
<i>Galium palustre</i>	1	2
<i>Carex rostrata</i>	1	1
<i>Equisetum fluitans</i>	+	1
<i>Phalaris arundinacea</i>	.	+
Ch.Cl. <i>Molinio-Arrhenatheretea</i>		
<i>Caltha palustris</i>	2	2
<i>Ranunculus repens</i>	2	3
<i>Equisetum palustre</i>	2	1
<i>Lythrum salicaria</i>	1	1
<i>Myosotis palustris</i>	+	1
<i>Deschampsia caespitosa</i>	1	.
Others:		
<i>Calamagrostis canescens</i>	+	.
<i>Dactylorhiza incarnata</i>	+	.

SPATIAL DIVISION INTO ECOCHOSES AND
RECOMMENDATIONS FOR PROTECTION

In order to preserve in the territory of the "Granica" meadow complex the present diversity of vegetation, **active protection** is needed. Therefore, the area was divided into types of protection (diversified as to the intensity of protection measures) and ecochores in which various types of conservation measures were suggested for action. In the spatial division of the meadow complex into ecochores, dynamic diversity of the vegetation was adopted as a basis. Distinct spatial units – ecochores (Fig. 2) – are spaces occupied by a specific patch or patches of vegetation (phytocoenosis/phytocoenoses) where a particular dynamic process is taking place. The limits of ecochores are arbitrary. They are not always apparent in the field, since the transition from one phytocoenosis to another one is vague; moreover, some of these borders may

change in the process of succession. Table 4 presents a description of the ecochores.

Altogether 24 ecochores have been distinguished in the investigated area. They will be subject to four types of protection regime (Fig. 2):

I – preservative protection will encompass ecochores (2, 3a, 4a, 14, 17 and 18) which will be excluded from exploitation. They comprise scrub communities and reed beds. The goal of protection is either the conservation of rushes or to allow the spontaneous process of regeneration of riverine forest communities. A condition of preservation of rushes is a high groundwater level – water should stagnate until the end of July or longer; therefore the control of the water level is the only protective recommendation in the described ecochores.

II – stabilising active protection encompasses meadow and rush communities. Its aim is the preservation of the existing state of communities, mainly by stopping succession processes. The following ecochores are included in this type of protection: 1a, 1b, 3b, 4b, 4c, 5a, 5d, 6a, 6b, 7a, 7b, 10a, 10c, 11, 12, 13, 16b, 16c, 19a, 19b, 20, 21, 22, 23 and 24. Conservation measures taken within the frame of this type of protection will include the periodical (as the need arises) removal of shrubs and mowing of meadow communities. The purple moor-grass meadows should be mown in late summer (at the end of August or at the beginning of September) every 2–3 years. The small reed beds and large-sedge beds should also be mown every 2–3 years, while the ground water table should be maintained at the current level. Fresh and wet meadows from the *Calthion* alliance should, on the other hand, be mown once a year at the end of July. In all cases the hay should be removed.

III – intensive active protection (renaturalisation) encompasses ecochores 3c, 5b, 5c, 10b, 15 and 16a. They include fragments of meadows (mainly with the purple moor-grass) where the succession process has already started – willow scrub has appeared. This type of protection aims at the restoration of the previous state (earlier stages of succession). Conservation measures will comprise the removal of shrubs and subsequent extensive mowing in late summer – every 2–3 years on purple moor-grass meadows and each year on wet meadows.

IV – agricultural land. It encompasses ecochores 8 and 9. This area may be left in agricultural use as a poor pasture or left to natural succession.

CONCLUSIONS

The "Granica" meadow complex is one of the most valuable non-forest areas of the Kampinos National Park. It is of major significance as a site of many valuable plant species, the most valuable of which are *Orchis militaris*, *Epipactis palustris* and *Dianthus superbus*. On an area of 96 ha, 21 non-forest communities were identified, including the association of the purple moor-grass *Molinietum caeruleae*, which is endangered on the national scale as well as the association of diandrous sedge *Caricetum diandrae*, which does not occur in other parts of the park. Thanks to the exist-

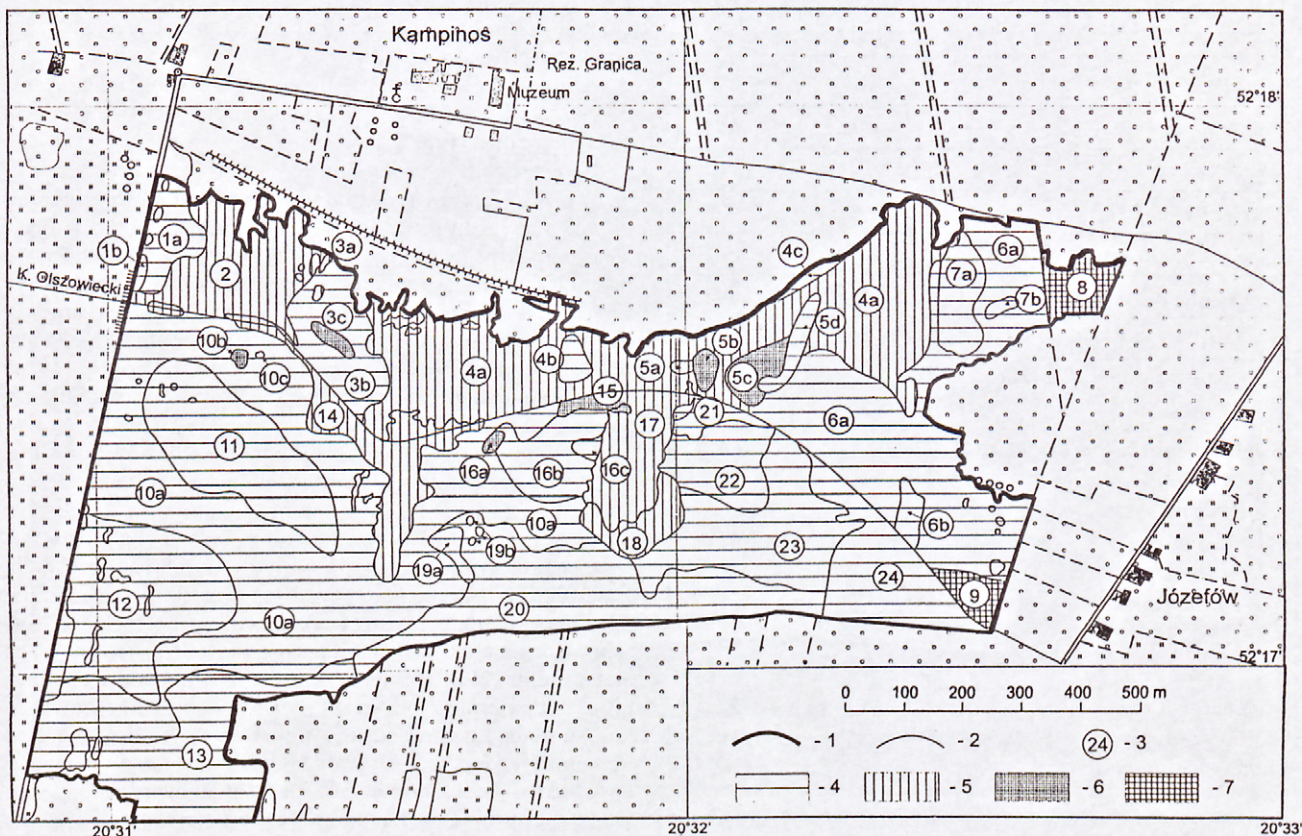


Fig. 2. Division of Granica meadow complex into ecochores and types of protection. 1 – study area, 2 – borders of ecochores, 3 – number of ecochore, 4 – stabilising protection (II), 5 – preservative protection (I), 6 – intensive protection (III), 7 – arable land (IV).

Table 4. Characteristics of ecochores

No of ecochore	Area of ecochore [ha]	Type of protection	Dynamic tendency*	Actual state of phytocoenosis
1	2	3	4	5
1a	1.11	II	fluct. in anthr. comm./ regeneration	Mown mesophilous meadow from the <i>Arrhenatheretalia</i> order; a small patch of moist meadow with domination of <i>Juncus effusus</i> ; a dried-out patch of meadow from the <i>Calthion</i> alliance with the following dominant species: <i>Deschampsia caespitosa</i> and <i>Calamagrostis canescens</i> .
1b	0.10	II	fluct. in anthr. comm.	Phytocoenosis of <i>Glycerietum fluitantis</i> .
2	3.74	I	fluct. in natur. comm./degeneration	Phytocoenosis of <i>Phragmitetum australis</i> forming a belt along the Olszowiec Canal and filling spaces between willow scrubs in the northern part of the ecochore. Large-sedge beds (<i>Magnocaricetalia</i>), mainly with <i>Carex gracilis</i> and <i>C. acutiformis</i> .
3a	0.11	I	recreative sec. succ.	A small clump of <i>Salix cinerea</i> .
3b	2.26	II	regeneration	Dried-out meadow from the <i>Calthion</i> alliance with a domination of <i>Deschampsia caespitosa</i> .

Table 4. cont.

1	2	3	4	5
3c	0.27	III	recreative sec. succ.	A patch of <i>Molinietum caeruleae</i> overgrowing with high perennials and willow. The western part of the ecochore is a dried-out meadow from the <i>Calthion</i> alliance with a domination of <i>Deschampsia caespitosa</i> also overgrowing with willow.
4a	11.86	I	fluct. in natur. comm./de-generation	Phytocoenosis of <i>Phragmitetum australis</i> forming a belt along the Olszowiec Canal and filling spaces between willow scrubs in the northern part of the ecochore. Large-sedge beds (<i>Magnocaricetalia</i>), mainly with <i>Carex gracilis</i> and <i>C. acutiformis</i> , locally also with <i>Carex appropinquata</i> . In some spaces, between willow thickets, a tall-herb community from the <i>Filipendulion ulmariae</i> alliance.
4b	0.33	II	regeneration	Moist meadow from the <i>Calthion</i> alliance, to a large degree overgrown. A herb community from the <i>Filipendulion ulmariae</i> alliance is developing here.
4c	0.27	II	regeneration	Dried-out meadow from the <i>Calthion</i> alliance with a domination of <i>Deschampsia caespitosa</i> .
5a	0.11	II	regeneration	Purple moor-grass meadow <i>Molinietum caeruleae</i> .
5b	0.22	III	recreative sec. succ.	A fragment of <i>Molinietum caeruleae</i> overgrowing with high perennials and willow.
5c	0.66	III	recreative sec. succ.	A fragment of <i>Molinietum caeruleae</i> overgrowing with high perennials and willow.
5d	0.51	II	regeneration	Purple moor-grass meadow <i>Molinietum caeruleae</i> .
6a	9.8	II	fluct. in anthr. comm./de-generation/regeneration	Meadows from the <i>Molinio-Arrhenatheretea</i> class: <i>Scirpetum sylvatici</i> , drying meadow from the <i>Calthion</i> alliance with a domination of <i>Deschampsia caespitosa</i> , moist meadows from the <i>Arrhenatherion</i> alliance, locally with a domination of <i>Deschampsia caespitosa</i> , small fragments of herb communities from the <i>Filipendulion ulmariae</i> alliance. On conspicuous sandy hillocks – <i>Polygalo-Nardetum</i> .
6b	0.33	II	fluct. in anthr. comm.	Large-sedge beds (<i>Magnocaricetalia</i>), mainly with <i>Carex acutiformis</i> .
7a	1.13	II	fluct. in anthr. comm.	Purple moor-grass meadow <i>Molinietum caeruleae</i> .
7b	0.11	II	fluct. in anthr. comm.	Purple moor-grass meadow <i>Molinietum caeruleae</i> .
8 and 9	0.930.66	IV	recreative sec. succ.	Periodically arable ground. In 1999 fallow ground.
10a	21.1	II	fluct. in natur. comm.	Large-sedge beds (<i>Magnocaricetalia</i>), mainly with <i>Carex gracilis</i> and <i>C. acutiformis</i> , locally also tussocks of <i>Carex appropinquata</i> . A small part of the ecochore (the southern fragment reaching the paved road) is occupied by a moist meadow from the <i>Calthion</i> alliance.
10b	0.11	III	recreative sec. succ.	A patch of <i>Molinietum caeruleae</i> overgrowing with high perennials and willow.
10c	0.11	II	regeneration	A small patch of <i>Angelico-Cirsietum oleracei</i> on a hillock among sedge rushes.
11	4.92	II	regeneration	<i>Molinietum caeruleae</i> growing on small hillocks among large-sedge beds (<i>Magnocaricetalia</i>).

Table 4. cont.

1	2	3	4	5
12	5.69	II	fluct. in anthr. comm./degeneration	Phytocenoses of mesophilous meadows from the <i>Arrhenatheretalia</i> order, partially mown. Large fragments with a domination of <i>Deschampsia caespitosa</i> . On places with highest elevation <i>Spergulo-Corynephorretum</i> .
13	3.52	II	fluct. in anthr. comm.	Phytocenoses of mesophilous meadows from the <i>Arrhenatherion</i> order, partially mown.
14	2.58	I	fluct. in natur. comm./recreative sec. succ.	Phytocoenosis of <i>Phragmitetum australis</i> forming a belt along the Olszowiec Canal and filling spaces between willow thickets. Willow thickets (mainly with <i>Salix cinerea</i>) with patches of initial stages of swamp forest.
15	0.26	III	sec. succ.	Dried-out meadow from the <i>Calthion alliance</i> with a domination of <i>Deschampsia caespitosa</i> , overgrowing with willows.
16a	0.09	III	regeneration	A patch of <i>Molinietum caeruleae</i> overgrowing with high perennials and willow.
16b	1.76	II	regeneration	Purple moor-grass meadow <i>Molinietum caeruleae</i> .
16c	0.11	II	regeneration	Large-sedge beds (<i>Magnocaricetalia</i>), mainly with <i>Carex gracilis</i> and <i>C. acutiformis</i> .
17	2.36	I	sec. succ./regeneration	Phytocoenosis of <i>Phragmitetum australis</i> forming a belt along the Olszowiec Canal and filling spaces between willow thickets. Willow thickets (mainly with <i>Salix cinerea</i>) with fragments of initial stages of swamp forest.
18	1.1	I	fluct. in natur. comm.	Phytocoenosis of <i>Phragmitetum australis</i> forming a broad belt to the south of willow thicket in ecochore 17.
19a	0.33	II	regeneration	Purple moor-grass meadow <i>Molinietum caeruleae</i> .
19b	0.13	II	regeneration	Purple moor-grass meadow <i>Molinietum caeruleae</i> .
20	6.34	II	regeneration	A complex of wet meadow communities (from the <i>Calthion alliance</i>) and large-sedge beds (<i>Magnocaricetalia</i>), locally with developed phytocoenoses of <i>Filipendulion ulmariae</i> .
21	0.46	II	fluct. in natur. comm.	High-sedge rushes (<i>Magnocaricetalia</i>), mainly with <i>Carex gracilis</i> and <i>C. acutiformis</i> , locally also tussocks of <i>Carex appropinquata</i> . In southern part of the ecochore a small patch of <i>Phragmitetum australis</i> .
22	1.87	II	regeneration	A patch of <i>Molinietum caeruleae</i> overgrowing with high perennials. In northern part of the ecochore also patches of large-sedge beds (<i>Magnocaricetalia</i>).
23	4.62	II	fluct. in natur. comm.	Large-sedge beds (<i>Magnocaricetalia</i>), mainly with <i>Carex gracilis</i> and <i>C. acutiformis</i> , locally also tussocks of <i>Carex appropinquata</i> . In central part a <i>Caricetum diandrae</i> quaking mire.
24	3.27	II	fluct. in anthr. comm.	Communities of mesophilous meadows from the <i>Arrhenatherion alliance</i> ; on highest elevated fragments of the site – <i>Arrhenatheretum elatioris</i> . In depressions – large-sedge beds (<i>Magnocaricetalia</i>).

Explanation: *dominant process is underlined; sec. succ. – secondary succession; fluct. in natur. comm. – fluctuation in natural communities; fluct. in anthr. comm. – fluctuation in anthropogenic communities.

tence of these communities, many animal species which are rare on the national scale may occur in the meadow complex, mainly birds, e.g. the corncrake *Crex crex*. This globally endangered species (Tucker and Heath et al. 1994) prefers open areas of the KNP with a mosaic of overgrowing and still mown meadows which include both scrubby patches (important in the breeding season as a hiding-place) and late-mown patches (mown after hatching, i.e. after mid-July) (Juszczak and Olech 1997). Any terrain with these properties should be maintained in areas where the corncrake appears, according to the exigencies of the conservation plan for this bird in Europe (Williams 1995). Non-forest communities in the territory of Kampinos Forest should also be preserved for historical, cultural and landscape reasons, since they often provide picturesque vantage points from where one may observe the moose – the symbol of the KNP.

The preservation of non-forest communities in the "Granica" meadow complex is not, however, an easy task. A decline in the interest in meadow management due to its low profitability and due to the difficult access to meadows located far from paved roads (made still more difficult the rise in the groundwater level) has already led to overgrowing of large areas by willow scrubs. However, the contribution of non-forest communities to the biological diversity of the park obliges us to protect them at any cost.

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