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Xerothermic grasslands within the area of the eastern margin of the Oder  
River valley in the vicinity of the town of Górzycza

Murawy kserotermiczne w obrębie wschodniej krawędzi doliny Odry w pobliżu Górzyczy

SUMMARY

On the basis of 49 phytosociological relevés taken in the area of the eastern edge of the Oder River valley in Owczary and the adjacent areas, four vegetation communities were distinguished. Within the *Festuco-Brometea* class, two associations occur – *Potentillo-Stipetum capillatae* and *Adonido-Brachypodietum pinnati*. The phytocoenoses of these syntaxa settle mainly on soils formed from light silty loam and heavy loamy sand of an alkaline reaction, containing CaCO<sub>3</sub>. Soils formed from loamy sand lying on loam, of an alkaline reaction with calcium carbonate are also settled by patches of the *Sileno otitis-Festucetum* association from the *Koelerio glaucae-Corynephoretea canescentis* class. It is the plant community of the psammophilous grasslands, related, to a significant extent, to xerothermic grasslands as far as the floristic composition is concerned. Within this community, a typical variant and the one with *Stipa capillata* were distinguished. The typical community of the psammophilous grasslands is *Diantho-Armerietum elongatae*. The phytocoenoses of this association are found on sandy soils of an acid and slightly acid reaction.

STRESZCZENIE

Na podstawie 49 zdjęć fitosocjologicznych wykonanych na terenie wschodniej krawędzi doliny Odry w Owczarach i obszarach przyległych wyróżniono cztery zbiorowiska roślinne. W obrębie klasy *Festuco-Brometea* występują dwa zespoły – *Potentillo-Stipetum capillatae* i *Adonido-Brachypodietum pinnati*. Fitocoenozy tych syntaksonów zasiedlają głównie gleby wytworzone z glin lekkich pylastych oraz piasków gliniastych mocnych o odczynie zasadowym, zawierających CaCO<sub>3</sub>.

Gleby wytworzone z piasków gliniastych naglinowych o odczynie zasadowym z węglanem wapnia zasiedlają również płaty zespołu *Sileno otitis-Festucetum* z klasy *Koelerio glaucae-Corynephoretea canescentis*. Jest to zbiorowisko roślinne muraw napiaskowych, nawiązujące w znacznym stopniu składem florystycznym do muraw kserotermicznych. W jego obrębie wyróżniono wariant typowy i ze *Stipa capillata*. Typowym zbiorowiskiem muraw napiaskowych jest *Diantho-Armerietum elongatae*. Fitocenozy tego zespołu występują na piaszczystych glebach o odczynie kwaśnym i lekko kwaśnym.

**Key words:** plant communities, xerothermic grasslands, psammophilous grasslands, *Potentillo-Stipetum capillatae*, *Adonido-Brychypodietum pinnati*, *Sileno otitis-Festucetum*, *Diantho-Armerietum elongatae*.

**Słowa kluczowe:** zbiorowiska roślinne, murawy kserotermiczne, murawy piaszkolubne, *Potentillo-Stipetum capillatae*, *Adonido-Brychypodietum pinnati*, *Sileno otitis-Festucetum*, *Diantho-Armerietum elongatae*.

## INTRODUCTION

In Poland xerothermic swards can be most frequently found in relatively small amounts on steep edges of river valleys and proglacial stream valleys, moraine hills, upland elevations, rock outcrops and sometimes on the slopes of anthropogenic origin. They usually settle on insolated southern, south-western and western slopes of calcareous subsoil. Xerothermic grasslands along with their unique flora and fauna belong to the most precious and at the same time the most endangered elements of the natural environment of Poland and Europe and therefore they were included in Annex I of the Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora). These are the habitats of a particular significance, subject to protection in all the countries of the European Union. Xerothermic grasslands were recognized as the ones of the floristically richest plant communities consisting of many protected and rare, often relict species of plants. In Poland they are recognized as habitats 6210, and in phytosociology they were classified to the *Festuco-Brometea* class. In the investigated area, a subtype of the habitat is mainly found, i.e. xerothermic flower grasslands, less frequently – stipa grasslands.

In Poland xerothermic grasslands can be found within the margin of the river valleys of the Oder, the Warta and the Noteć. They constitute a relict element of the plants in Western Pomerania. In the Oder River valley swards occur to the north of the Warta River mouth towards Szczecin. They were described many times: by Celiński and Filipek (5), Filipek (11, 12), Radomski and Jasnowska (38), Friedrich and Semczyszyn (13). These studies were carried out on the edges of the Oder River, on its eastern side from Boleszkowice to Widuchowa and on its western side from Pargowo to Ustowo, the latter situated just within the boundaries of Szczecin. Xerothermic grasslands found by the Oder to the south of the Warta River mouth were also acquainted with and described, mainly by members of the Naturalist's Club in Świebodzin (20, 28, 21, 2). Particular attention should be given to the swards occurring in the neighbourhood of Owczary (district of Górzycza) in the Lubuskie voivodeship.

The aim of the present study is to show ecological and phytosociological characteristics of communities of xerothermic and psammophilous grasslands in the district of Górzycza, which are famous for their riches and peculiarities of nature as well as to reveal their floristic differentiation.

## STUDY AREA

The commune of Górzycza is situated in the north western part of the Lubuskie voivodeship, in the district of Słubice. To the north it neighbours with the communes of Słońsk and Kostrzyn, to the north-east with the commune of Słońsk, to the south-east with the commune of Ośno Lubuskie, and to the south with the communes Rzepin and Słubice. The western border of the commune is constituted by the frontier of the country. The complex of xerothermic grasslands spreads on the edge of the Oder valley, occupying isolated, relatively small areas, surrounded mainly by arable fields, barren lands and also by thermophilous forests. The entirety is situated in the area of the Landscape Park “The Mouth of the Warta River”, located about 12 km from the Mouth of the Warta River National Park. This is the land classified to the area of Nature 2000 “the Mouth of the Warta River” of the number PLH 080001. These are “The Protected Owczary Area” (29.7 ha), and in its neighbourhood the site of ecological interest “Owczary I” (16.0 ha) and “Owczary II” (7.2 ha), whereas the nature reserve Pamięcin (11.8 ha), the site of ecological interest “Laski I” (2.9 ha) and “Laski II” (3.3 ha) are about 1.5 km away from it (Fig. 1). Kondracki (30) classified this area to the Great Poland Lakeland macroregion and to the Łagow Lakeland mesoregion. The area contains moraine soils formed as a result of the activity of the Scandinavian continental glacier and the

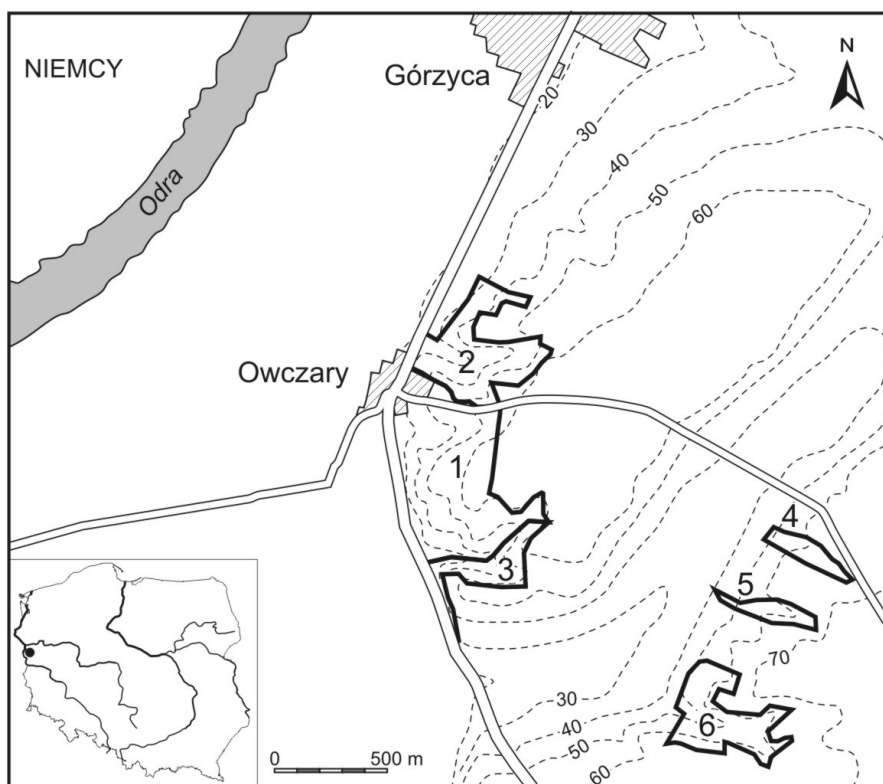


Fig. 1. Distribution of study areas. Explanations: 1 – Protected Area “Owczary”, 2 – Site of ecological interest “Owczary I”, 3 – Site of ecological interest “Owczary II”, 4 – Site of ecological interest “Laski I”, 5 – Site of ecological interest “Laski II”, 6 – Natural reserve “Pamięcin”

last Baltic ice-age in particular (Jermaczek, Maciantowicz 2005). These soils are mainly composed of loams and loamy sands, less rarely silts and clays fraction. They constitute proper brown soils containing calcium carbonate, characterised by a strongly alkaline and sometimes neutral reaction (Table 1).

Table 1. Some chemical properties and the granulometric composition of soils within the distinguished plant associations

Associations species	Number of relevés	Mechanical composition	pH		CaCO <sub>3</sub> in %
			in H <sub>2</sub> O	in 1MKCl	
<i>Potentillo-Stipetum capillatae</i>	2	glp	7.59	7.20	10.53
	21	glp	7.85	7.54	2.35
<i>Adonido-Brachypodietum pinnati</i>	9	glp	8.05	7.63	6.42
	14	glp	7.82	7.40	5.57
	18	pgmp	7.51	7.23	5.35
	22	glp	7.73	7.36	1.63
<i>Sileno otitis-Festucetum</i>	4	pgmp	7.62	7.02	2.17
	17	pglp	7.82	7.31	9.12
	37	pgmp	7.06	6.65	3.09
<i>Diantho-Armerietum elongatae</i>	27	ppl	5.67	4.47	–
	39	ppl	6.95	6.42	0.13
	42	ppl	6.36	5.79	–

gl – light loamy sand, pplp – silty light loamy sand, pgm – heavy loamy sand, pgmp – silty heavy loamy sand, glp – silty light loam

Xerothermic grasslands which occur in this area occupy the eastern margin of the Oder River valley. This area is situated in the direct catchment of the river. The angle of inclination of the slopes mostly ranges from 20 to 90°, which is favourable to quick discharging of rainfall water. The lay of the land and the structure of the subsoil (loams and sands) result in the lack of larger bodies of water in the discussed area. The only stable small bodies of water are found at spring outlets located in the south western part of the area. The springs flow out from the steep slope of about 50° inclination and of western exposure, spreading along the road no. 32 on the way from Kostrzyn to Ślubice.

The climatic conditions of the area are shaped by masses of polar and maritime and arctic air. Western winds are dominant. Precipitation during a year amounts on average from 500 to 550 mm. The largest precipitation occurs in July and August, the smallest from February to April. The mean annual temperature amounts to 8.4°C, and in summer months it reaches 17.1°C (25).

## MATERIAL AND METHODS

In the years 2008 to 2010, 49 relevés were taken on the studied surface (approximately 60 ha) by means of the commonly used by geobotanists Braun-Blanquet method. They were taken by E. Drewniak, a worker at the Owczary Field Station of the Naturalist's Club in Świebodzin. They

were made available and used for the purposes of this description. The terminology of syntaxa and the classification of characteristic species were mainly based on the description by Matuszkiewicz (32). The publications by Filipek (11, 12) concerning xerothermic vegetation of the lower Oder River region were also used in the phytosociological description. Also the phytosociological works by Friedrich and Senczyszyn (13) were taken into consideration, as well as those by Prajs (37). In the distinguished plant associations, the phytosociological stability (S) and cover coefficients (D) were calculated for particular species, using the methods shown in the descriptions by Dzwonko (9). The terminology of species were given according to Mirek et al. (33). In a part of patches, collective soil samples were taken from the depth of 0–20 cm. Reaction was determined in them by the potentiometric method and the granulometric composition by the organoleptic method, as well as the amount of calcium carbonate by the Scheibler method (29).

## RESULTS AND DISCUSSION

### *Potentillo-Stipetum capillatae*

*Stipa* grasslands are found in subxerothermic regions of Pomerania, Grand Poland and Kujavia. Phytocoenoses of the association are settled in extreme topoclimatic conditions of southern slopes of the Valley of the Lower Oder and the Lower Vistula and are found in Proglacial Toruń-Eberswalde Stream Valley (32). The community is often referred to as the Pomeranian *stipa* steppe. The grasslands are of a seminatural vegetation character. They grow in places particularly dry, insolated and hot. In the south of Poland they occur on the gypsum subsoil, on fine-grained soils of a shallow *pararendzina* or *rendzina* type, strongly skeletal, poor in humus, of alkalic reaction and of a considerable amount of sulphates. In the northern part of the country they are settled in morain areas characterised by a rich relief, on loamy soils and morainic sands rich in  $\text{CaCO}_3$ . Contrary to the grasslands from the south, these swards are markedly poorer floristically and characterised by a more mesophilic character (34).

The *Potentillo-Stipetum capillatae* phytocoenoses in the studied area are mainly found on steep, warm, dry and open slopes (20–45°) and on the edges of hills as well as of gullies of southern and south-western exposure. The communities do not spread down to the gully depressions. The patches of the association situated along the open slopes do not occupy larger uniform surfaces. They are often surrounded by xerothermic scrub, the species of which penetrate the open surfaces of the swards. The *Potentillo-Stipetum capillatae* association is characterised by a distinctly poorer species composition as compared to other steppe communities of southern Poland. The structure of the sward is of a tussock character, often multi-layered, with a well developed layer of mosses.

The patches of the association were mainly formed on loamy soils of a brown type, characterised by an alkalic reaction and an amount of calcium carbonate varying from 2.35 to 10.53% (Table 1). The degree level of humus is low, but in many patches its thickness reaches up to 20 cm. A part of the surfaces is strongly

Table 2. *Potentillo-Stipetum capillatae*

Successive number of relevé	1	2	3	4	2009			2008			2009					$\bar{X}$
					2009	2008	2009	2009	2008	2009	2008	2009	2008	2009	2008	
Number of relevés within the area	26	27	2	41	28	7	43	29	6	45	31	33	30	38		
day	10.	25.	25.	02.	15.	02.	15.	04.	02.	02.	10.	25.	25.	25.		
month	06.	06.	05.	06.	06.	06.	05.	06.	06.	06.	06.	05.	05.	05.		
year	2009	2008	2008	2009	2008	2009	2009	2008	2009	2008	2009	2008	2009	2008		
Area of relevé (m <sup>2</sup> )	25	30	30	40	50	50	35	70	35	45	50	40	25	50		
Cover of herb layer (%)	90	100	90	90	95	70	90	100	100	70	85	80	90	90	88.6	
Exposition slope	S	SW	NW	S	S	SW	S	SW	NW	SW	S		S			
Gradient of slope (in degrees)	35	40	20	35	45	25	40	25	30	35	35		30			
Number of species	55	48	43	42	41	38	38	30	29	28	25	25	22	18	34	
<b>Ch.Ass. <i>Potentillo-Stipetum capillatae</i></b>																
<i>Stipa capillata</i>	3.3	3.2	1.2	3.3	3.3	1.1	3.3	4.4	1.1	3.3	1.2	2.3	3.3	1.1	V	2625
<i>Anthericum liliago</i> D	1.1	1.1	•	•	+	2.2	•	+	1.1	•	1.1	•	•	+	III	289
<i>Oxytropis pilosa</i>	1.1	•	+	•	+	1.1	•	1.1	1.1	+	1.1	•	•	+	III	207
<i>Alyssum montanum</i>	•	•	•	1.1	1.1	•	•	1.1	•	•	•	+	1.1	•	II	150
<b>I ChO. <i>Festucetalia valesiacae</i></b>																
<i>Potentilla arenaria</i>	2.2	2.2	+	+	1.2	1.1	+	2.2	1.1	2.2	+	1.1	2.2	1.1	V	832
<i>Achillea pannonica</i>	+	+	+	1.1	•	1.1	1.1	•	1.2	1.1	+	+	1.1	•	IV	250
<i>Thesium linophyllum</i>	1.2	2.2	+	•	•	2.2	•	•	+	•	1.1	•	•	•	III	336
<i>Eryngium campestre</i>	+	•	1.1	+	•	2.3	+	•	+	•	•	•	•	•	III	189
<i>Campanula sibirica</i>	1.1	1.1	+	•	+	+	•	1.1	•	•	•	•	•	+	III	136









Cont. Table 2

IX ChCl. <i>Rhamno-Prunetea</i>																						
<i>Crataegus monogyna</i> (juv.)	+2	•	+2	•	+	•	•	•	+	•	•	•	•	•	•	•	•	•	•	•	II	36
<i>Rosa canina</i> (juv.)	•	+	+	•	+2	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	II	29
<i>Prunus spinosa</i> (juv.)	•	+2	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	II	21
X Accompanying species																						
<i>Arenaria serpyllifolia</i>	+	•	+	•	+	1.1	+	+	+	•	•	•	•	•	•	•	•	•	•	•	IV	93
<i>Sanguisorba minor</i>	+	•	+	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	III	57
<i>Festuca trachyphylla</i>	•	•	•	•	1.1	•	•	1.1	•	•	•	•	•	•	•	•	•	•	•	•	II	397
<i>Ononis spinosa</i>	•	•	•	•	•	•	•	•	+	•	•	•	•	•	•	•	•	•	•	•	II	29
<i>Camelina microcarpa</i>	+	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	II	21

**Plant species occurring only in degree I of phytosociological constance in plant communities:** I: *Scorzonera purpurea* 2, 6 (+); II: *Anthyllis vulneraria* 1, 2 (1.1); *Campanula bononiensis* 9 (+); *Carex humilis* 2, 4 (+); *Helianthemum nummularium* 11 (1.1); III: *Medicago minima* 7, 11 (+); *Rumex acetosella* 3 (+); *Silene oites* 6, 10 (+); V: *Verbascum densiflorum* 10 (+); VII: *Briza media* 3 (2.2), 6 (+); *Festuca rubra* 11 (2.2); *Polygala comosa* 3 (1.1); *Taraxacum officinale* 2, 5 (+); VIII: *Cerastium arvense* 2 (+); X: *Pyrus pyrauster* (juv.) 1, 9 (+); Ch.Cl. *Stellarietea medinae*: *Vicia hirsuta* 1 (+); *V. tetrasperma* 1, 2 (+); ChCl. *Quercro-Fagetea*: *Ulmus minor* (juv.) 10 (+).

eroded and the soil-forming process is marked on them very weakly. The patches of association of stipa sward occur within the area of site of ecological interest "Owczary I", "Owczary II", "Laski II" and slightly less rarely in the nature reserve "Pamięcin". The composition of the xerothermic grasslands contains xero- and thermophilic species which reach the areas characterised by warm dry climate. Most of the species of the *Potentillo-Stipetum capillatae* community belong to the *Festucetalia valesiaca* order. A stable characteristic taxon of the association is *Stipa capillata*. It endures high temperatures prevailing on the slopes and it also needs full insolation. The structure of the association is also made up by characteristic species: *Anthericum liliago*, *Oxytropis pilosa* and *Alyssum montanum* (Table 2). They are observed rarely in other communities and achieve a slight cover.

A considerable contribution in the structure of the association have also characteristic species of the *Festucetalia valesiaca* order: *Potentilla arenaria*, *Achillea pannonica*, *Thesium linophyllum*, *Eryngium campestre*, *Campanula sibirica* and *Asparagus officinalis*. They all reach the 3rd degree of stability and slightly lower coefficients of cover (from 114 to 336). Very often (S=V) and in numerous amounts (D varies from 493 to 675), characteristic species of the *Festuco-Brometea* class: *Salvia pratensis*, *Artemisia campestris*, *Euphorbia cyparissias* and *Dianthus carthusianorum* were observed. Slightly less frequently, but in larger amounts *Phleum phleoides* were recorded. In smaller quantities, but frequently (S=IV) in the patches, *Centaurea stoebe* and *C. scabiosa* were noticed (Table 2). There are no trees or bushes in the phytocenoses of the association. Scarce, single individuals of: *Crataegus monogyna*, *Rosa canina* and *Prunus spinosa* do not grow above the herb layer plants. They all reach the juvenile stage and only the 2nd degree of stability and a slight cover. Within the *Potentillo-Stipetum capillatae* association, a part of patches (relevés 6, 7, 26, 29, 31) can be classified to the subassociation with woolly milk-vetch (*Oxytropis pilosa*) – Table 2. The remaining relevés constitute a typical subassociation (34).

The patches of the *Potentillo-Stipetum capillatae* associations are also settled by species from the remaining phytosociological classes. Of the *Koelerio glaucae-Corynephoretea canescentis* class, *Sedum acre* and *Thymus pulegioides* were often, but not observed in large amounts. They are found on the surfaces of lesser density of the vegetation and the soils are a little lighter (light or heavy loamy sand). The most frequently recorded of the *Artemisietea vulgaris* class, was *Echium vulgare*, and of *Trifolio-Geranietea sanguinei* – *Galium verum*.

The phytocenoses of the association are floristically rich and the number of species in particular patches varied from 18 to 55 (on average in a relevé 34 taxa were noticed). The structure of the association is composed of 90 species. It is characterised by a tussock structure and layered distribution of the species. Stipa plants form tussocks on the slopes and the spaces between them are settled

by other plants, mainly dicotyledonous, most frequently – perennial plants. The vegetation cover in the phytocenoses is large (70–100%, on average 88.6%) – Table 2. The largest number of the species (39) falls on the *Festuco-Brometea* class (Table 2).

Considerable richness (72 species within 5 plant patches) is characteristic of the association distinguished by Prajs (37) within the area of the nature reserve “Stary Przylep” and “Brodogóry”, on the Pyrzyce-Stargard Plain. In the structure of this community, the most numerous (36 taxa) was the share of characteristic species from the *Festuco-Brometea* class. Like on the edge of the Oder River valley in Owczary, on the edge of the Płonia River valley in the vicinity of Miedwie lake, *Stipa capillata* is dominant in the association. Two characteristic species of the association are also frequently observed. These are *Oxytropis pilosa* and *Alyssum montanum*. Whereas the *Anthericum liliago* species which reaches  $S=V$  and  $D=289$  within the margin of the Oder River in the vicinity of Owczary, is not present on these surfaces. This species was recorded earlier by Libbert (31). In both discussed areas, *Salvia pratensis*, *Achillea pannonica*, *Veronica spicata* and *Centaurea stoebe* occur in the association frequently and in large amounts. Research work carried out by Gamrat (14) in the area of the site of ecological interest “Owczary I” confirmed that capillary needlegrass (*Stipa capillata*) is quite often observed in the *Potentillo-Stipetum capillatae* association. Friedrich and Senczyszyn (13) described the *Potentillo-Stipetum capillatae* association on the basis of 15 sociological relevés taken on the edge of the Oder River, north of the mouth of the Warta River (in the localities of: Kamieniec, Moczyły and Cedynia). *Stipa capillata* is dominant in them. In the community, 111 taxa were found, of which 56 were from the *Festuco-Brometea* class. In the patches of association there were also and in large amounts: *Phleum phleoides*, *Potentilla arenaria* and *Artemisia campestris*. In the patches of this association, *Anthericum liliago*, which was very often observed in the *Linosyridi-Stipetum pullcherimae* association distinguished by them, did not occur.

An interesting example of the formation of *Potentillo-Stipetum capillatae* phytocoenoses on anthropogenic habitats, intensively transformed by man in the course of several thousand years, is the natural reserve “Góra św. Wawrzyńca”, including the town and adjacent to it remains of the slope of a small valley. The present state of the patches of this xerothermic grasslands, according to Kamiński (24), shows that phytocenoses can undergo changes. Due to the spread, over this area, of scrub and forest species with the dominance of *Prunus* sp., *Acer* sp., *Robinia pseudoacacia*, *Quercus robur*, *Ulmus laevis* and *Populus alba*, most of the species characteristic of the association can extinct.

Heise (18) distinguished the *Potentillo-Stipetum capillatae* association on the slopes of the valley of the Bydgoszcz canal (the natural reserve “Skarpy

Ślesińskie”). In the patches of the association, *Stipa capillata*, *S. joannis*, *Adonis vernalis* and *Scorzonera purpurea* were found. The number of distinguished species is not numerous. Only *Stipa joannis* was found to be more numerous.

#### *Adonido-Brachypodietum pinnati*

The *Adonido-Brachypodietum pinnati* community is floristically poorer than regionally corresponding *Thalictro-Salvietum*. As compared to *Potentillo-Stipetum* occurring in the investigated area, it occupies less extreme habitats with regard to the microclimate. The phytocenoses of the association are composed of dense swards with the dominance of grass. The share of dicotyledonous perennial plants to them is also high. The grasslands of the *Cirsio-Brachypodion* alliance are mainly seminatural communities existing due to extensive grazing. They change gradually into scrub and forest communities after the grazing is ceased. The *Adonido-Brachypodietum pinnati* association has a graminous, sodded meadow character, due to the dominance of tor-grass (*Brachypodium pinnatum*) – Table 3. It is the most mesophillous community of xerothermic grasslands in the valley of the Oder River. It is found on the slopes of different exposure and angle of inclination (from 20 to 35°), on more fertile soils than the *Potentillo-Stipetum capillatae* patches. Loamy soils and silty soils are characterised by a well-formed humus level, alkaline reaction (pH in 1 M KCl varies from 7.23 to 7.63) and the content of CaCO<sub>3</sub> varies from 1.63 to 6.42% (Table 1). The community is floristically rich (altogether, 78 taxa were recorded). On average, 28 species were observed in the relevé, and their number in individual patches ranged from 19 to 36. It is characterised by a high density. On average, it reaches the cover of 89.3%. The largest number of characteristic species belong to the *Festuco-Brometea* class (32 taxa) – Table 3. It is a slightly lower number as compared to the *Potentillo-Stipetum capillatae* phytocenoses (39 taxa) – Table 2. The number of the species from the *Koelerio glaucae-Corynephoretea canescentis* class is also lower, only 6 taxa (Table 3), as compared to *Potentillo-Stipetum capillatae* (10 taxa) – Table 2. Whereas there are more species of the *Quercu-Fagetea* class. They penetrate into these phytocenoses from scrub and forest communities. The characteristic species of the association and reaching a high degree level of stability, apart from *Brachypodium pinnatum*, are *Galium verum*, *Salvia pratensis* and *Prunella grandiflora*. Frequent species in the community are also *Centaurea scabiosa*, *Dianthus carthusianorum* and *Euphorbia cyparissias*. Moreover, permanent components of the phytocenoses are *Fragaria viridis* and *Coronilla varia* of the *Trifolio-Geranietea sanguinei* class, as well as *Arrhenatherum elatius* and *Dactylis glomerata* of the *Molinio-Arrhenathereta* class. In the tor-grass

Table 3. *Adonido-Brachypodietum pinnati*

Successive number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	$\bar{x}$	
	2009			2008			2009											
Number of relevés within the area	1	3	5	8	9	10	11	14	15	22	18	20	19	24	25	21		
day	25.	25.	02.	02.	15.	15.	15.	02.	02.	25.	25.	25.	25.	25.	25.	02.		
month	05.	05.	06.	06.	05.	05.	05.	06.	06.	05.	05.	05.	05.	05.	05.	06.		
Date																		
year	2009			2008			2009											
Area of relevé	25	30	25	25	30	25	40	25	35	35	40	25	35	25	25	35		
Cover of herb layer (%)	90	100	90	90	90	80	90	90	90	90	80	80	80	90	90	100	89.3	
Exposition slope	NW	NW	W	SE	N	S	S	SW	S	SW	S	SW	SW	SW	SW	SW		
Gradient of slope (in degrees)	20	25	30	30	35	20	30	25	30	30	30	35	35	25	25	35		
Number of species	34	30	24	22	27	27	30	26	28	31	36	24	33	24	19	38	28	
<b>Ch.Ass. <i>Adonido-Brachypodietum pinnati</i></b>																	S D	
<i>Brachypodium pinnatum</i>	4.4	3.3	4.4	4.4	3.3	3.3	4.4	3.3	4.4	3.3	3.3	3.3	3.3	2.2	4.4	3.3	V 4563	
<i>Galium verum</i>	1.1	1.1	1.1	1.1	+	2.2	2.2	2.2	2.2	1.1	1.1	1.1	1.1	1.1	1.1	3.3	V 991	
<i>Salvia pratensis</i>	+	+	+	1.1	2.2	1.1	1.1	1.1	1.1	1.1	1.1	+	1.1	+	+	•	V 631	
<i>Prunella grandiflora</i>	+	1.1	+	1.1	2.2	1.1	+	1.1	+	•	•	•	•	1.1	•	•	IV 288	
<i>Trifolium montanum</i>	•	+	•	•	•	+	•	+	•	+	+	+	•	•	•	•	III 172	
<i>Medicago falcata</i>	1.2	1.1	1.1	+	•	+	+	+	+	•	•	•	•	•	•	•	III 125	
<i>Campanula sibirica</i>	•	•	•	•	•	+	•	+	•	•	•	•	•	+	•	+	II 25	
<b>I ChO. <i>Festucetalia valesiacae</i></b>																		
<i>Stipa joannis</i>	•	•	•	•	•	+	•	+	•	2.2	2.2	1.1	2.2	•	•	3.3	III 606	
<i>Potentilla arenaria</i>	•	1.1	•	•	+	•	+	•	+	1.1	+	•	1.1	•	•	3.3	III 228	



Cont. Table 3

<i>Sedum acre</i>	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	1.1	II	50	
<b>IV ChCl. Artemistetea vulgaris</b>																							
<i>Hypericum perforatum</i>	•	•	•	+	•	•	•	•	+	•	+	•	+	•	•	+	•	•	•	3.3	II	278	
<i>Artemisia vulgaris</i>	•	•	•	•	•	•	•	•	+	•	•	•	•	•	•	•	•	•	•	1.1	II	56	
<b>V ChCl. Trifolio-Gerantetea sanguinei</b>																							
<i>Fragaria viridis</i>	+	2.2	•	+	1.1	+	+	1.1	+	1.1	1.1	1.1	1.1	1.1	+	1.1	+	+	+	3.3	V	569	
<i>Coronilla varia</i>	+	+	1.1	1.1	•	+	+	+	+	+	+	+	+	+	+	+	+	+	+	1.1	V	397	
<i>Agrimonia eupatoria</i>	1.1	1.1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	•	•	III	106	
<i>Viola hirta</i>	+	•	•	•	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	1.1	III	75	
<b>VI ChCl. Molinio-Arrhenatheretea</b>																							
<i>Arrhenatherum elatius</i>	+	•	1.1	1.1	•	1.1	•	1.1	•	1.1	1.1	1.1	1.1	1.1	•	1.1	1.1	1.1	2.2	1.1	V	663	
<i>Dactylis glomerata</i>	1.1	•	+	•	+	+	+	1.1	+	1.1	1.1	1.1	1.1	1.1	+	1.1	1.1	1.1	+	2.2	V	594	
<i>Pimpinella saxifraga</i>	+	+	+	•	+	+	+	+	•	+	•	•	•	•	•	•	•	•	•	•	•	III	50
<i>Briza media</i>	+	1.1	+	•	1.1	+	•	+	•	•	+	•	•	•	•	•	•	•	•	•	•	II	88
<i>Knautia arvensis</i>	+	•	+	•	•	•	•	•	•	•	•	•	•	•	+	+	•	•	•	+	1.1	II	50
<i>Galium mollugo</i>	+	•	•	•	•	•	•	•	•	+	+	+	+	+	•	•	•	•	•	•	•	II	31
<i>Polygala comosa</i>	+	+	•	•	+	•	•	+	•	•	•	•	•	•	•	•	•	•	•	•	•	II	25
<b>VII ChCl. Agropyretea intermedio-repentis</b>																							
<i>Falcaria vulgaris</i>	+	•	+	+	•	•	•	•	•	•	•	•	•	•	+	+	+	+	+	+	2.2	IV	166
<i>Cerastium arvense</i>	+	•	•	•	•	•	•	•	•	•	•	•	•	•	•	+	+	+	•	•	2.2	III	147
<i>Poa angustifolia</i>	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	3.3	II	303
<i>Convolutus arvensis</i>	+	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	+	1.1	II	56





(*Brachypodium pinnatum*) association, scrubs are often observed. According to Filipek (12), this association represents an intermediate stage of a gradual change leading to the formation of scrub and then a forest. In the studied phytocoenoses, a share of species from the *Rhamno-Prunetea* class is observed, above all: *Crataegus monogyna*, *Prunus spinosa* and *Rosa canina* (Table 3). Waldon and Rapacka-Gackowska (42) also confirmed the penetration of the scrub species into this community. They report that in the “Zbocza Płutowskie” in the Valley of the Vistula River considerable changes in the floristic composition of the grasslands have taken place since 1963, when the agricultural use of this area was stopped. 20% of the xerothermic species have disappeared from it, and the total surface of the patches of swards decreased six times due to the invasion of scrub from the *Rhamno-Prunetea* class. The dominant patches of *Potentillo-Stipetum capillatae* and *Adonido-Brachypodietum pinnati* form now not large enclaves on the slopes that have not been overgrown with shrubs yet.

The *Adonido-Brachypodietum pinnati* association is quite frequently recorded in Poland. In the Płaskowyż Twardowicki (Silesian Uplands) it was distinguished by Babczyńska-Sendek (1) in the rank of three subassociations: *A.-B. phleetosum*, *A.-B. typicum*, and *A.-B. anthericetosum*. In the nature reserve “Brodogóry” this association was also distinguished by Prajs (37), who was in possession of relevés of the year 2000 and she also had Filipek’s material of 1974. Comparing her own relevés with Filipek’s material, she observed that within this span of time no larger changes in the floristic composition of the community took place. Whereas a part of its patches is characterised by a more numerous presence of scrub species from *Rhamno-Prunetea*. Strong expansion of the species of meadow communities and of *Rubus caesius* and *Calamagrostis epigejos* was also noticed. In the *Adonido-Brachypodietum pinnati* community within this nature reserve, numerous populations of *Anthericum liliago* occurred, as well as *Asperula tinctoria*, *Stachys recta*, *Bromus inermis*, and *Achillea pannonica* which are disappearing in Pomerania (36). This association was also characterised by Heise (18) within the area of xerothermic swards in the nature reserve “Skarpy Ślesieńskie”. It is endangered within this area due to building works carried out in the vicinity of the Nature Reserve. This community was also distinguished by Waldon (42) in the wildlife reserve “Ostnicowe Parowy Gruczna”, and the one in the Lower Oder Valley was described by Friedrich and Semczyszyn (13). They recorded 135 species altogether, in 40 patches of the community, of which 45 taxa reached only the 1st degree of stability (sporadic species). The number of the species in the relevé varied from 21 to 65, on average 39. The phytocoenoses in this area are more rich floristically than the community from the vicinity of Górzycyca. It can be the result of a larger number of phytosociological relevés they have gathered. *Brachypodium pinnatum* and *Prunella grandiflora* were the

dominant species. The permanent components of the association were also the species from the *Festuco-Brometea* class: *Galium verum*, *Medicago falcata* and *Salvia pratensis*. In the dense grasslands of *Adonido-Brachypodietum pinnati* in the area of Owczary, Czyż et al. (7) observed the domination of *Brachypodium pinnatum*, *Festuca rubra* and *Stipa joannis*. *Stipa capillata*, *Centaurea stoebe*, *Achillea pannonica*, *Thesium linophyllum*, *Thymus pulegioides*, *Potentilla arenaria* and *Ononis spinosa* were also frequently (S=IV) found, but they reached only low degrees of cover.

#### *Sileno otitis-Festucetum*

The psammophilous grasslands with Spanish catchfly (*Silene otites*) is not very demanding as far as the soil is concerned, and it develops, in the studied area, on sandy soils and sandy loam soils of alkaline and neutral reaction (pH in 1 M KCl ranges from 6.65 to 7.31), containing calcium carbonate (2.17–9.12%) – Table 1. The humus level of these soils is relatively thin, slender or sometimes there is no humus on freshly exposed and eroded slopes. This can be a result of small production of the phytomass or a loose character of the community. The phytocoenoses of the association are found on flat surfaces and on steep S, SW and SE slopes of the inclination angle varying from 30 to 45°.

The *Sileno otitis-Festucetum* association is a community of a relatively low vegetation density (the average cover in patches amounts to 68%), and of a loose tussock vegetation structure of quite a uniform floristic composition. Most of the patches are at an initial growth stage. The community is composed of 50 taxa and the phytocoenoses are characterised by a differentiated number of species (from 15 to 32), on average 23. Dominating in the structure are the species characteristic of the association: *Phleum phleoides*, *Silene otites*, *Centaurea stoebe* and *Dianthus carthusianorum* (Table 4). The patches of this community are also found in the vicinity of Szczecin. Radomski and Jasnowska (65) described them as “the grasslands of Boehmer’s cats-tail” (*Phleum phleoides*). It shows the fertile facies with *Phleum boehmeri*. *Sileno otitis-Festucetum* also represents the richest psammophilic community on Wolin island (35). This association was also distinguished and described, in the area of Wielkopolska, by other researchers, including Celiński (3), Filipek (10), Staniewska (40) and Celiński and Balcerkiewicz (4), and in the region of the lower Vistula by Kępczyński (26) and Ceynowa (6). *Sileno otitis-Festucetum* from the areas of Wielkopolska and the lower Vistula has a richer floristic composition than that from the Oder River, which is expressed, above all, by the occurrence of the species of more fertile soils and a higher share of continental taxa. A considerable share in the association in

Table 4. *Sileno otitis-Festucetum*, typical variant (relevés 2-6), variant in *Stipa capillata* (relevés 7-10)

Successive number of relevé	1	2	3	4	5	6	7	8	9	10	
	16	17	4	23	32	36	40	35	34	37	
Number of relevés within the area	20.	15.	27.	15.	07.	01.	28.	27.	26.	03.	
day	07.	06.	05.	06.	06.	06.	06.	05.	05.	06.	
Date	2009										
year	2008										
Area of relevé (m <sup>2</sup> )	50	40	50	35	40	30	35	25	40	45	$\bar{x}$
Cover of herb layer (%)	100	50	60	100	80	90	50	70	40	40	68.0
Exposition slope	SW	SW	S	SW	SW		SE				
Gradient of slope (in degrees)	30	45	35	30	30		40				
Number of species	32	28	29	27	20	16	27	17	17	15	23
<b>ChAss. <i>Sileno otitis-Festucetum</i></b>											
<i>Phleum phleoides</i>	2.2	1.1	1.1	2.2	2.2	·	1.1	1.1	1.1	+	S
<i>Silene otites</i>	1.1	1.1	1.1	+	1.1	2.2	1.1	1.1	+	1.1	D
<i>Centaurea stoebe</i>	+	1.1	+	+	+	1.1	1.1	+	1.1	1.1	V
<i>Dianthus carthusianorum</i>	1.1	+	·	+	+	·	+	·	1.1	+	V
<b>I ChCl. <i>Koeleria glaucae-Corynephoretea canescentis</i></b>											
<i>Sedum acre</i>	2.2	+	1.1	·	+	+	1.1	2.2	+	1.1	V
<i>Helichrysum arenarium</i>	1.1	1.1	+	+	1.1	·	·	+	+	1.1	IV
<i>Festuca ovina</i>	2.2	2.3	1.1	3.3	2.2	·	·	·	+	·	III
<i>Thymus pulegioides</i>	2.3	·	·	2.2	+	·	·	·	+	+	III
<i>Corynephorus canescens</i>	1.1	+	·	+	2.3	·	·	·	·	·	II
<i>Cerastium semidecandrum</i>	1.2	+	·	·	2.2	·	·	·	·	·	II



Cont. Table 4

<b>V ChCl. Molinio-Arrhenatheretea</b>												
<i>Dactylis glomerata</i>	+	+	•	+	+	•	•	+	•	•	III	50
<i>Arrhenatherum elatius</i>	•	•	•	•	•	1.1	1.1	+	1.1	1.1	II	160
<i>Achillea millefolium</i>	•	+	•	+	1.1	•	•	•	•	•	II	70
<i>Pimpinella saxifraga</i>	+	•	+	•	•	•	•	+	•	•	II	30
<b>VI ChCl. Agropyretea intermedio-repentis</b>												
<i>Falcaria vulgaris</i>	•	•	+	+	+	+	+	+	+	+	IV	70
<b>VII ChCl. Trifolio-Geranietea sanguinei</b>												
<i>Agrimonia eupatoria</i>	1.1	1.1	1.2	2.2	2.2	1.1	•	•	•	•	III	550
<i>Galium verum</i>	+	+	•	1.2	•	•	•	+	•	•	II	80
<b>VIII Accompanying species</b>												
<i>Arenaria serpyllifolia</i>	1.2	+	•	1.2	2.3	•	•	•	•	•	II	285

**Plant species occurring only in degree I of phytosociological constance in plant: I:** *Thymus serpyllum* 5 (2.3); **II:** *Campanula sibirica* 8, 9 (+); *Carlina vulgaris* 3, 7 (+); *Eryngium campestre* 3 (+); *Petrorhagia prolifera* 3, 7 (+); *Plantago media* 3, 7 (+); **III:** *Luzula campestris* 3, 7 (+); **IV:** *Verbascum densiflorum* 3, 7 (+); **VI:** *Cerastium arvense* 3, 7 (+); *Convolvulus arvensis* 8, 10 (+); **VII:** *Fragaria viridis* 8 (+); **ChCl. Stellarietea mediae:** *Vicia hirsuta* 3, 7 (+).

the investigated area also have characteristic species of the *Koelerio glaucae-Corynephoretea canescentis* class. The most frequent and the most numerous among them are *Sedum acre*, *Helichrysum arenarium*, *Festuca ovina* and *Thymus pulegioides* (Table 4). In the patches of the sward a significant role is played by characteristic species of the *Festuco-Brometea* class. Particularly often and plentifully occur: *Potentilla arenaria*, *Euphorbia cyparissias*, and also *Artemisia campestris* (Table 4). The phytocoenoses of patches from 2 to 6 were classified to the typical variant with the domination of *Salvia pratensis*, and patches from 7 to 10, to the less frequent variant with *Stipa capillata*. In the structure of the association a considerable contribution is also characteristic of *Agrimonia eupatoria*, a taxon of wooded forest border communities of the *Trifolio-Geranietea sanguinei* class. The phytocoenoses of the association found on the edge of the Oder River valley are of a very approximate floristic composition (13).

#### *Diantho-Armerietum elongatae*

The patches of triangle pink (*Dianthus deltoides*) and sea pink (*Armeria maritima* ssp. *elongata*) are found in a major part of Poland, mainly on the lowlands. This community is the most common association of the *Vicio lathyroidis-Potentillion argenteae* alliance. These are low mesophilic psammophilous grasslands of a distinctly west central European type, i.e. without any significant contribution of sub-Atlantic or subcontinental species (32). *Diantho-Armerietum elongatae* is found on poor sandy soils, sometimes on sandy loam. For this reason, depending on the habitat conditions, it belongs to a dynamic circle of a fresh forest, a mixed forest or the *Quercetea robori-petraeae* class. It forms widespread strongly dense swards on old fallows, dry extensive pastures and on road and railway shoulders. Their range and surface coverage have increased recently due to the human's activity, leading to deforestation (8, 22). The association is of a seminatural character, shows large variability of the local habitat and creates, apart from a typical form, different deviations from this type, towards clubawn grass (*Corynephorion*) grasslands or moorlands and *Nardo-Callunetea* grasslands, typical meadow communities of the *Arrhenatheretalia* order, the latter are particularly observed forms (32). These phytocoenoses are floristically richer and settle in slightly moister and also more fertile habitats as compared to the communities of the *Corynephorion* alliance.

In the studied area the phytocoenoses are not rich floristically; 43 taxa were recorded in the community. The number of the species in individual patches varies from 15 to 23 taxa, on average 19 species were observed (Table 5). The community mainly occurs on light loamy sand (pgl) of an acid reaction and a slightly acid reaction (pH in KCl varies from 4.47 to 6.42) – Table 1.

Table 5. *Diantho-Armerietum elongatae*

Successive number of relevé	2008			2010						$\bar{x}$
	1	2	3	4	5	6	7	8	9	
Number of relevés within the area	12	13	39	42	44	47	46	49	48	
day	04.	04.	01.	01.	01.	01.	01.	01.	01.	
month	06.	06.	07.	07.	07.	07.	07.	07.	07.	
Date										
year	2010									
Area of relevé (m <sup>2</sup> )	50	40	45	25	25	35	45	45	30	
Cover of herb layer (%)	100	100	90	80	90	90	100	90	90	92.2
Exposition slope	S	S				S				
Gradient of slope (in degrees)	30	20				20				
Number of species	23	22	21	17	14	18	18	18	15	19
<b>Ch.Ass. <i>Diantho-Armerietum elongatae</i></b>										<b>S D</b>
<i>Armeria maritima</i> ssp. <i>elongata</i>	2.3	2.3	2.3	1.1	2.2	2.2	1.1	1.1	2.2	V 1333
<i>Cerastium arvense</i>	1.2	1.2	1.1	+	+	•	•	•	•	III 189
<b>I ChCl. <i>Koeleria glaucae-Corynephoretea canescens</i></b>										
<i>Thymus serpyllum</i>	3.3	3.3	1.1	•	•	2.2	•	2.2	•	III 1277
<i>Helichrysum arenarium</i>	2.2	1.1	1.2	1.1	+	•	•	•	•	III 372
<i>Rumex acetosella</i>	•	•	+	1.2	1.1	•	•	•	1.2	III 178
<i>Anthoxanthum odoratum</i>	1.1	+	1.1	•	•	1.1	•	•	•	III 178
<i>Sedum acre</i>	2.2	1.2	•	•	•	•	•	•	•	II 250
<i>Koeleria glauca</i>	2.2	1.2	•	•	•	•	•	•	•	II 250
<i>Medicago minima</i>	2.2	+	•	•	•	+	•	•	•	II 217
<i>Scleranthus perennis</i>	1.1	1.1	•	•	•	•	•	•	•	II 111
<i>Thymus pulegioides</i>	•	•	•	•	•	1.1	1.1	•	•	II 111





Cont. Table 5

<b>VI ChCl. Molinio-Arrhenatheretea</b>											
<i>Festuca rubra</i>	1.2	2.2	2.3	•	2.2	+	1.2	•	1.1	IV	761
<i>Arrhenatherum elatius</i>	•	•	+	1.1	2.2	•	+	1.1	3.3	IV	744
<i>Dactylis glomerata</i>	•	•	•	+	1.1	•	+	1.1	1.1	III	189
<i>Taraxacum officinale</i>	•	•	+	•	+	1.1	1.2	•	•	III	133
<i>Galium mollugo</i>	•	•	+	+	•	+	+	•	•	III	44
<i>Pimpinella saxifraga</i>	•	•	+	•	•	•	2.2	1.1	•	II	261
<b>VII ChCl. Agropyretea intermedio-repentis</b>											
<i>Falcaria vulgaris</i>	•	•	•	•	+	+	•	+	+	III	44
<b>VIII ChCl. Stellarietea mediae</b>											
<i>Vicia hirsuta</i>	•	•	1.1	•	+	2.2	2.2	+	+	IV	478
<i>Vicia tetrasperma</i>	•	•	+	+	+	+	1.1	1.1	+	IV	167
<b>IX Accompanying species</b>											
<i>Arenaria serpyllifolia</i>	1.2	1.2	•	•	•	•	•	•	•	II	111

**Plant species occurring only in degree I of phytosociological constance in plant communities: II: *Asparagus officinalis* 1 (+); VI: *Achillea millefolium* 2 (+); *Plantago lanceolata* 8 (2.2).**

In the structure of the association the species of the *Koelerio glaucae-Corynephoretea canescentis* class are prevailing, and the characteristic species *Armeria maritima* ssp. *elongata* is dominant in them. Another characteristic taxon *Cerastium arvense* was also frequently observed. Among 11 characteristic species of the class, the most often occur: *Thymus serpyllum*, *Helichrysum arenarium*, *Rumex acetosella* and *Anthoxanthum odoratum*. In the patches there are also species of the *Festuco-Brometea* class (11 taxa). Some of them reach the 3rd degree of stability and a slight cover: *Euphorbia cyparissias*, *Eryngium campestre*, *Phleum phleoides* and *Centaurea scabiosa*. Beside them, two species of the *Nardo-Callunetea* class dominate in the community: *Hieracium pilosella* and *Agrostis capillaris*. It should be believed that the *Diantho-Armerietum elongatae* association in the investigated area is a form related to moorlands and the *Nardo-Callunetea* swards. Moreover, in a part of the patches a considerable share of *Festuca rubra* and *Arrhenatherum elatius*, related to the meadow communities of the *Arrhenatheretalia* order, is observed. In the phytocoenoses there are also species of the wooded forest border communities of *Galium verum* and *Coronilla varia*, as well as the segetal communities, mainly – *Vicia hirsuta*.

The studies carried out by Głowacki (16) show that the *Diantho-Armerietum elongatae* association is rarely observed in Masurian Lakeland. Juśkiewicz and Endler (23) distinguished it in Masurian Plain, in the area of a former military training ground. Its phytocoenoses settled on sandy soils of a very acid reaction. 85 taxa were recorded in them, on average 26 species in a relevé.

The *Diantho-Armerietum elongatae* grasslands occur throughout Poland. In the Cracow Jurassic area they were distinguished by Kornaś (27), in the neighbourhood of Poznań – by Celiński (3), in the western part of the Trzebnickie Hills – by Głowacki (15), on the Wysoczyzna Siedlecka – by Głowacki (16). Juśkiewicz and Endler (23) distinguished, within the association, the *D.-A. corynephoretosum* subassociation and also a typical form of the association. In the community, *Armeria maritima* ssp. *elongata* and *Dianthus deltooides* prevailed. Frequently and plentifully the patches are settled by *Festuca ovina* and other species of the class *Koelerio glaucae-Corynephoretea canescentis*: *Potentilla argentea*, *Rumex acetosella*, and *Jasione montana*. *Sarothamnus scoparius* dominated in shrub layer of the community. The *Diantho-Armerietum elongatae* phytocoenoses were also distinguished by Ratyńska (39). They are the most common sward syntaxon in the Warta river valley, occurring on a humus sandy subsoil within the hills and on alluvia. The phytocoenoses are relatively rich. The number of species in the relevés varied from 17 to 28, on average it amounted to 26. The characteristic species of the association do not reach, apart from *Armeria maritima* ssp. *elongata*, higher degrees of stability. Grzelak et al. (17) noticed the *Diantho-Armerietum elongatae* community on the site of a mine within the

area of barren lands, planned for obtaining gravel. It settled on slightly moister places (small depressions). The patches of vegetation were poor floristically (from 10 to 19 taxa). The characteristic species of the association was not frequently observed in phytocenoses, whereas *Thymus serpyllum* was dominant. Moreover, in the community numerously occurred: *Festuca ovina*, *F. rubra* and *Sedum acre*.

#### CONCLUSIONS

1. In the studied area four plant communities were distinguished within the xerothermic grasslands (*Festuco-Brometea*) and on sand (*Koelerio glaucae-Corynephoretea canescentis*).

2. The phytocenoses of the *Potentillo-Stipetum capillatae* association are found on the S and SW slopes, mainly on soils formed from light loam of an alkaline reaction, containing calcium carbonate.

3. The prevailing community of the xerothermic grasslands in this area is *Adonido-Brachypodietum pinnati*. The patches of this association settle on slopes and their tops, on loamy soils and sandy loam of an alkaline reaction.

4. The community of the grasslands on sand, *Sileno otitis-Festucetum*, is mainly found on lighter (sandy), alkaline soils, of the floristic composition related, to a considerable extent, to the *Festuco-Brometea* class.

5. The sandy soils of an acid and slightly acid reaction are settled by phytocenoses of the association of psammophilous grasslands – *Diantho-Armerietum elongatae*.

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