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Ignacy KUTYNA, Katarzyna MALINOWSKA[1], Ryszard MALINOWSKI[2]

SOIL CONDITIONS AND PLANT COMMUNITIES ON THE SUMMIT, THE SLOPE AND THE DEPRESSION ON THE EDGE OF WEST ODER

WARUNKI GLEBOWE ORAZ ZBIOROWISKA ROŚLINNE WYSTĘPUJĄCE NA WIERZCHOWINIE, ZBOCZU I W OBNIŻENIU NA KRAWĘDZI ODRY ZACHODNIEJ

Department of Ecology, Envinronmental Protection and Development, West Pomeranian University of Technology, Szczecin, Poland
[1]Department of Plant Physiology and Biochemistry, West Pomeranian University of Technology Szczecin, Poland
[2]Department of Soil Science, Grassland and Environmental Chemistry, West Pomeranian University of Technology, Szczecin, Poland

Streszczenie. Na obszarze zachodniej krawędzi Odry Zachodniej, położonym między wsią Moczyły a przysiółkiem Kamionka, wykonano 37 zdjęć fitosocjologicznych. Badania geobotaniczne przeprowadzono w trzech elementach rzeźby terenu. Na płaskich wierzchowinach krawędzi w uprawie zbóż wykonano 17 zdjęć fitosocjologicznych, na zboczu o wystawach S i SE – w obrębie wieloletniego odłogu – 11, a w obniżeniu (w uprawie pszenżyta) – 7. Wzdłuż transektu wykonano 4 odkrywki; pobrano z nich próbki do oznaczenia podstawowych parametrów glebowych (składu granulometrycznego, pH i zawartości $CaCO_3$). Na wierzchowinie wyróżniono segetalny zespół *Lathyro-Melandrietum noctiflori*, wewnętrznie zróżnicowany na wariant typowy oraz z *Anthemis tinctoria* i *Melampyrum arvense*. Zbocze zasiedlają bardzo bogate florystycznie fitocenozy *Convolvulo arvensis-Agropyretum repentis.* Charakteryzuje się ono różnorodnością gatunkową wynikającą z procesu transformacji zbiorowiska, jaki zachodzi na zboczu siedliska w trakcie sukcesji wtórnej. U podnóża zbocza (w obniżeniu) charakteryzującego się odmiennymi warunkami ekologicznymi, w porównaniu ze zboczem i z wierzchowiną, wykształcają się fitocenozy *Poo-Tussilaginetum farfarae*. Wykorzystując właściwości fitoindykacyjne gatunków roślin i metodą Ellenberga, określono średnie wartości liczb stosunków termicznych siedliska (T), wilgotnościowych (W), odczynu gleby (R), ich zasobności w azot (N) i aktywności biologicznej gleby (G). Najcieplejsze są siedliska zbocza (T = 2,5) oraz wierzchowiny (T = 2,3), a bardzo chłodne – w obniżeniu (T = 1,8). Najsuchsze są gleby wierzchowiny i zbocza (W = 3,5), okresowo mokre (W = 2,4) w obniżeniu. Odczyn gleby na wierzchowinie i zboczu jest zasadowy (R = 4,2), w obniżeniu – obojętny (R = 3,8). Zawartość N w glebie na wierzchowinie i zboczu jest zbliżona (N = 2,8–3,3), nieco mniejsza na zboczu (N = 2,7), co wynika z ubytku próchnicy spowodowanego przez powierzchniową erozję wodną zachodzącą na stoku zbocza. Tą metodą uzyskane wyniki są bardzo zbliżone do wartości parametrów glebowych uzyskanych analitycznymi metodami gleboznawczymi.

Key words: *Convolvulo arvensis-Agropyretum repentis,* phytoindication habitats, *Lathyro-Melandrietum noctiflori,* Ellenberg's method, xerothermic grasslands, western Odra, Poland, *Poo--Tussilaginetum farfarae,* phytosociological stability, similarity coefficient, cover coefficient.

Słowa kluczowe: *Convolvulo arvensis-Agropyretum repentis,* fitoindykacja siedlisk, *Lathyro--Melandrietum noctiflori,* metoda Ellenberga, murawy kserotermiczne, Odra zachodnia, Polska, *Poo-Tussilaginetum farfarae,* stałość fitosocjologiczna, współczynnik podobieństwa, współczynnik pokrycia.

Corresponding author – Adres do korespondencji: Katarzyna Malinowska, Department of Plant Physiology and Biochemistry, West Pomeranian University of Technology, Szczecin, Juliusza Słowackiego 17, 71-434 Szczecin, Poland, e-mail: katarzyna.malinowska@zut.edu.pl

INTRODUCTION

The area of the study is located on the western edge of West Oder. On the Polish side it stretches from the village of Moczyły to the hamlet of Kamionka (Fig. 1). Geobotanical studies were conducted only on the summit, the slope and at its foot, without entering the valley of the Oder River.

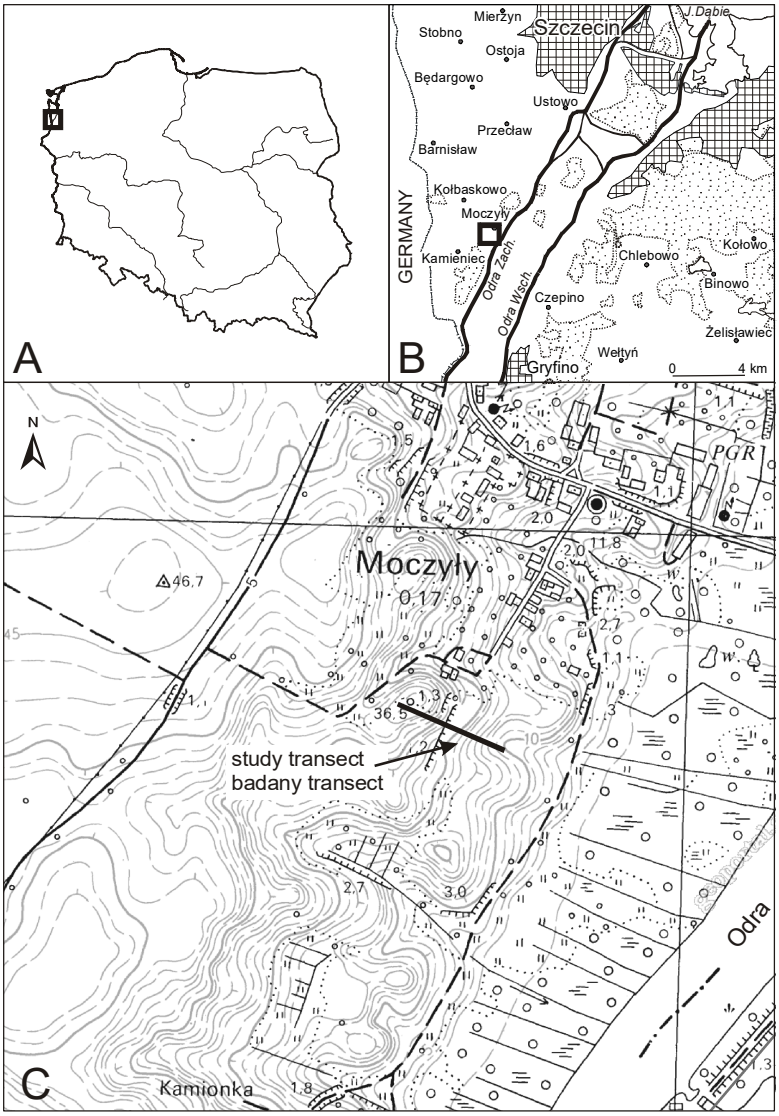

Fig. 1. Localization of study area on a background of Poland (A) and on Odra Valley slope (B) and location of transect with study soil profiles (C)
Rys. 1. Lokalizacja obszaru badań na tle Polski (A) i na zboczu doliny Odry (B) oraz położenie linii przekroju, wzdłuż której przeprowadzono badania glebowe (C)

The important factor determining the floristic composition of plant communities are soil conditions, their physical and chemical properties, the elements of terrain (summit, slope and its foot), as well as the type of habitat use (farmland, long-term fallow land, meadows, etc.). Among Polish works, there is a number of studies confirming the influence of the above

mentioned factors on the structure of phytocoenoses and their richness in species (Kutyna and Niedźwiecki 1996; Młynkowiak and Kutyna 1999, 2005a,b,c; Kutyna et al. 2004, 2006a,b,c,d, 2012a,b; Kutyna and Klera 2006).

The aim of the study is twofold. Firstly, it is to characterise soil conditions of the summit, the slope and the depression along the allotted transect. Secondly, it is to determine the type of plant communities occurring within these three elements of the terrain, taking into account the type of habitat use during the study. Cereals were cultivated on the summit (winter and spring wheat as well as spring barley), there was a long-term fallow on the slope, and in the depression at the footslope there were agriculturally neglected fields of triticale.

NATURAL CONDITIONS

Location of the study area

The village of Moczyły is located on the western edge of West Oder Valley. On the Polish side, the edge of the Oder River stretches from Pargowo, after 13 kilometres it reaches Szczecin Ustowo, and Skolwin after another 5 kilometres. The area belongs to Kołbaskowo municipality (Fig. 1). There are cropped lands in its western part with segetal communities developing within them. There can also be found patches of meadows with grassland phytocoenoses, as well as fallow lands and pastures inhabited by grassland and shrubland communities. In addition, enclaves of xerothermic and sandy grasslands can be found on the slopes. The north-western part of the edge in the vicinity of Moczyły, is characterised by patches of meadow steppe dominated by tor-grass (*Brachypodium pinnatum*). They undergo succession towards the communities of thermophilic forest edge species of *Trifolio-Geranietea sanguinei* class. The western part of the grassland, of mosaic character of stipeae steppe and thermophilic sandy grassland, is gradually plowed and its area decreases each year (Barańska et al. 2010). During the time of the study in the area, there were cropped lands, long-term fallow lands and xerothermic grasslands, partially covered with shrubs and occasionally with trees. Soil conditions of the selected terrain elements were determined within the allotted transect on the south-western slope by four soil outcrops – on the summit, on the slope in its upper and lower part, as well as in the depression at the footslope (Fig. 2).

Soil conditions

Detailed soil studies were performed on an elevated moraine, taking into account the summit, the slope and the footslope in the village of Moczyły (transect – Fig. 2).

According to Marcinek and Komisarek (2011), at the top of the hill there occur typical eutrophic brown soils (BEt) of genetic system levels Ap-Bw-Ck1-Ck2 (Fig. 3). They were formed of light loam rich in silt fraction (25–30%) and calcium carbonate, the content of which usually increases with the depth (from 2.1 to 10.2%). Calcium carbonate forms neutral or alkaline soil pH (pH in KCl is from 7.16 on the Ap level up to 7.40 in Ck2) – Table 1. There are lime concretions in soil profile (numerous loess dolls, columnar and prismatic, lime nodules) often of considerable size (outcrop 1).

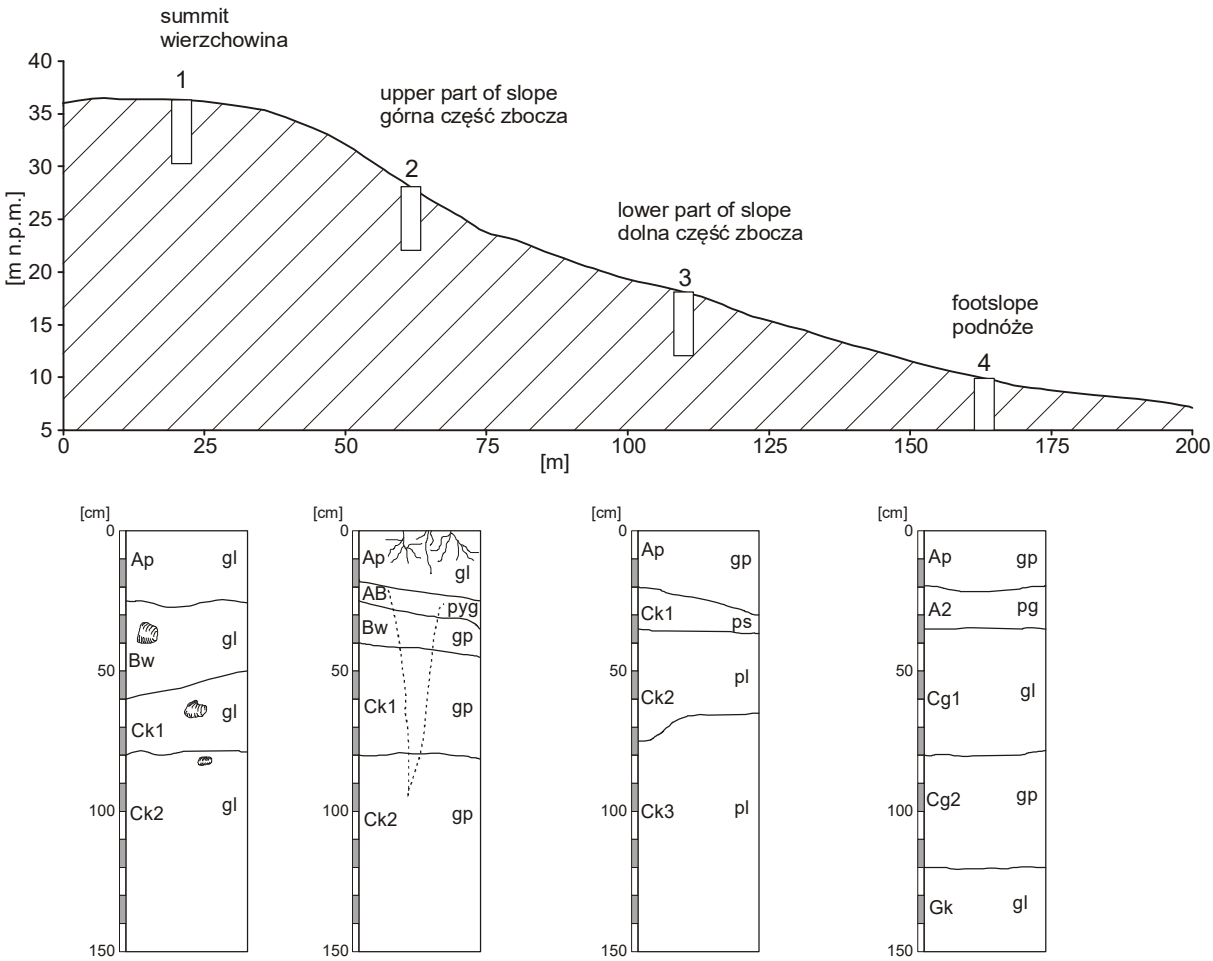

Fig. 2. Location of soil profiles along study transect. pl – loose sand, ps – slightly sands, pg – loamy sand, gp – sandy loam, gl – light loam, pyg – silt loam
Ryc. 2. Położenie odkrywek glebowych wzdłuż badanego transektu. pl – piasek luźny, ps – piasek słabogliniasty, pg – piasek gliniasty, gp – glina piaszczysta, gl – glina lekka, pyg – pył gliniasty

Fig. 3. Soil profile of typical eutrophic browin soil (BEt) – photo I. Kutyna
Ryc. 3. Profil gleby brunatnej eutroficznej typowej (BEt) – fot. I. Kutyna

Table 1. Mechanical composition and some chemical properties of soil
Tabela 1. Skład granulometryczny oraz niektóre właściwości chemiczne gleb

Plant communities Zbiorowiska roślinne	Soil horizons, depth Poziom genetyczny, miąższość [cm]	Percentage of fractions content Zawartość frakcji o określonych wymiarach [mm]			Group mechanical composition Grupa granulometryczna	pH		$CaCO_3$ [%]
		2–0.5	0.05–0.002	< 0.002		H_2O	1MK Cl	
	Summit – typical eutrophic brown soil (BEt) – soil pit No. 1 Wierzchowina – gleba brunatna eutroficzna typowa (BEt) – odkrywka nr 1							
Lathyro--Melandrietum noctiflori	Ap (0–25)	57	28	15	light loam glina lekka (gl)	7.93	7.16	2.9
	Bwk (25–60)	57	25	18	light loam glina lekka (gl)	8.24	7.19	2.1
	Ck1 (60–80)	57	30	13	light loam glina lekka (gl)	8.35	7.45	7.2
	Ck2 (80–150)	59	29	12	light loam glina lekka (gl)	8.34	7.40	10.2
	Upper part of slope – typical eutrophic brown soil (BEt) – soil pit No. 2 Górna część zbocza – gleba brunatna eutroficzna typowa (BEt) – odkrywka nr 2							
Convolvulo arvensis--Agropyretum repentis	Ap (0–25)	53	37	10	light loam glina lekka (gl)	7.97	7.40	8.4
	A/Bwk (25–35)	36	57	7	silt loam pył gliniasty (pyg)	7.60	7.44	3.9
	Bwk (35–45)	45	50	5	sandy loam glina piaszczysta (gp)	8.30	7.70	12.4
	Ck1 (45–80)	60	40	0	sandy loam glina piaszczysta (gp)	8.45	7.79	6.8
	Ck2 (80–150)	69	29	2	sandy loam glina piaszczysta (gp)	8.51	7.78	3.5
	Lower part of slope – soils poorly formed by erosion (SY) – soil pit No. 3 Dolna część zbocza – gleba słabo ukształtowana erozyjnie (SY) – odkrywka nr 3							
	Ap (0–25)	59	34	7	sandy loam glina piaszczysta (gp)	8.11	7.48	6.3
	Ck1 (25–35)	89	10	1	slightly sand piasek słabogliniasty (ps)	8.39	7.95	3.9
	Ck2 (35–75)	99	1	0	loose sand piasek luźny(pl)	8.46	8.03	2.4
	Ck3 (75–150)	97	3	0	loose sand piasek luźny (pl)	8.52	8.07	2.1
	Footslope – typical chernozem deluvial soil (CYt) – soil pit No. 4 Podnóże – gleba deluwialna czarnoziemna typowa (CYt) – odkrywka nr 4							
Poo--Tussilaginetum farfarae	A1 (0–20)	73	21	6	sandy loam glina piaszczysta (gp)	7.74	7.28	0.8
	A2 (20–35)	76	20	5	loamy sand piasek gliniasty (pg)	7.99	7.52	0.3
	Cg1 (35–80)	64	25	11	light loam glina lekka (gl)	8.01	6.74	0.1
	Cg2 (80–120)	68	21	11	sandy loam glina piaszczysta (gp)	8.06	6.99	0.1
	Gk (120–150)	55	34	11	light loam glina lekka (gl)	8.35	7.54	21.2

According to Marcinek and Komisarek (2011) typical eutrophic brown soils were formed by multispecies deciduous forests. They are characterised by good internal drainage conditions, the presence of free carbonates, a slightly acidic or neutral pH and a large proportion of alkaline cations.

Typical eutrophic brown soil (BEt) occur also in the upper part of the slope, of genetic system levels Ap-A/Bw-Bw-Ck1-Ck2 (outcrop 2). They are characterised by looser graining than similar soils occurring on the summit. At the top they are formed of light loam (Ap level) and silt loam (A/Bw level) and below 35 cm they are formed of sandy loam (Bw, Ck1 and Ck2 levels) rich in silt fraction. Presence of calcium carbonate and alkaline pH (pH in KCl from 7.40 to 7.79) were found in the whole profile (Table 1). At the ground Ap level, there are numerous dead root systems of grass. There are also humus stains and carbonate concretions such as loess dolls and lime nodules in the soil profile.

In the lower part of the slope, there were found incomplete shallow soils, which were weakly formed by erosion, of genetic levels layout Ap – Ck1 – Ck2 – Ck3 (outcrop No. 3). With the depth from the surface, grain size distribution was loosened, from sandy loam in humus level to loose sand in bedrock. Regardless of grain size distribution, calcium carbonate and alkaline pH (pH in KCl from 7.68 to 8.07) were observed in the whole soil profile – Table 1. The transitions between genetic levels in soil profile are mostly undulating, often weakly marked. They contain $CaCO_3$ dolls and numerous lime nodules (concentrated calcium carbonate).

According to the Soil Classification of Poland (Marcinek and Komisarek 2011) soils weakly formed by erosion occur on eroded areas used for agricultural purposes. The bedrock of these soils shows no distinct features of weathering soil-forming changes. The properties of cultivable level have been formed by cultivation.

At the footslope, in distinct depression, there were formed typical chernozem deluvial soils (CYt) of the genetic levels layout A1-A2-Cg1-Cg2-Gk (Soil Classification of Poland 2011) (outcrop No. 4) – Fig. 4.

Fig. 4. *Melampyrum arvense* – the characteristic species of *Adonido-Brachypodietum pinnati* – photo I. Kutyna
Ryc. 4. *Melampyrum arvense* – gatunek charakterystyczny *Adonido-Brachypodietum pinnati* – fot. I. Kutyna

They were mainly formed of sandy loam and light loam. They are characterised by a well-formed (35 cm) structural humus level and distinct soil-gleying process already at the depth of 35 cm, while the total gleying occurs at the depth of 120 cm. In contrast to soils in higher locations, the analysed soil contains insignificant amounts of calcium carbonate (0.1–0.8%) in the upper level, while its higher accumulation is observed in gley level (21.2%). The pH of soil ranges from neutral to alkaline (pH in KCl from 6.74 to 7.54). The soil is damp in the whole profile and its dampness increases with depth, the ground water occurs at 120 cm. Rust and blue coloured stains (compounds of Fe^{+2} and Fe^{+3}) occur in the whole profile, which is the evidence to top-down and bottom-up gleying. There is also a significant amount of dead plants roots. In the lower part of the profile, at the level of ground water, there are massive deposits of $CaCO_3$ and mineral components (Fig. 5).

Fig. 5. Limestones at a depth of 120 cm – photo I. Kutyna
Ryc. 5. Wapienie występujące na głębokości 120 cm – fot. I. Kutyna

According to the Soil Classification of Poland (Marcinek and Komisarek 2011), typical chernozem deluvial soils are formed at the footslopes in the process of sedimentation of eroded material. They are fed with rainwater, groundwater and additionally from surface runoff. Great humidity contributes to the accumulation of organic matter of turf origin.

Climatic conditions

Apart from soil conditions, growth and floristic structure of communities is significantly influenced, by climate. Especially, by microclimate formed on small surfaces. The study area is mainly affected by oceanic climate, and in some years parameters characteristic of continental climate can also be observed.

According to the division of Szczecin voivodeship into climate regions, the study area belongs to VII Goleniów-Pyrzyce land (Koźmiński 1983). It includes Szczecin Lowland and areas located to the west of the Oder. At its centre, there occurs the lowest rainfall, and apart from Szczecin region, the highest temperatures. The average temperature for the period 1956–1990 was 8.4°C, and for vegetation period (April – October) – 13.4°C. The average precipitation for the period was 528 mm, and for the vegetation period – 364 mm. The number of hot days (above 25°C) in the studied area reaches 25 a year. In March, the dry east winds prevail, which causes dryness of the soil. On average, there are 44 days with snow cover in the southern part of the area, and about 100 days with frost.

Extreme values of some climatic conditions are of great importance to the occurence of xerothermic communities in the area, especially repeated periodically years of exceptionally low average rainfall, often totaling in the area below 500 mm. This amount of rainfall is much smaller than the sum which delimits the occurrence of steppes in Eastern Europe. These dry years lead to drying out of a number of mesophilic species, which often successfully take place of xerothermic grasslands in the climatic zone of Pomerania. Then, the ability of grasslands to withstand drought allows the species to survive the critical period that eliminates their competitors. The impact of low rainfall is intensified by strings of days without precipitation, which can exceed 18 days and be repeated up to three times a year, and strings of 9 days can be repeated up to dozen or so times a year. Additionally, the periods of high temperatures, similarly to dry years, reduce the growth of mesophilic species. The influence of temperature is strengthened by winds, especially in spring and summer periods, when they influence southern and south-eastern slopes. Winds intensify evaporation of soil water and increase soil moisture deficiency, which is especially high in summer.

Apart from general climatic conditions on south-eastern and eastern slopes of the study area, a microclimate is formed mainly under the influence of strong insolation. It is characterised by even higher temperatures and higher moisture deficiency of soils, which makes the habitats drier and warmer, which is favourable to the growth of xerothermic plants. According to our study, the air temperature in the afternoon on the soil surface devoid of vegetation on the southern slope ranged from 42 to 51°C. While at the same time, on the western and northern slope it was much lower and ranged from 24–27°C.

MATERIAL AND METHODS

The study of plant communities and determining their floristic composition and structure were performed within three elements of terrain (flat and slightly undulating summit, slope and footslope) in the area located between the village of Moczyły and the hamlet of Kamionka (Fig. 1). In total, 37 relevés were made in June and July 2009 (17 on the flat summit, 13 on the slope and 7 at the footslope). The nomenclature of the distinguished syntaxa

and phytosociological classification of communities was based on the classification by Matuszkiewicz (2007). Phytosociological stability (S) and cover coefficients of species (D) were calculated in the distinguished associations with the use of methods described by Dzwonko (2007). The names of the species were given by Mirek et al. (2002). The following were calculated for each relevé with the use of Ellenberg's indicator values method (1950) – the average number of thermal relationships of habitat (T), soil moisture (M), pH of soil substrate (R), the abundance of nitrogen in soil (N) and the biological activity of soil (G). Then, for three distinguished communities of *Lathyro-Melandrietum noctiflori, Convolvulo arvensis-Agropyretum repentis* and *Poo-Tussilaginetum farfarae* the mean values of TWRNG were calculated using the average values for each relevé. On their basis, the habitats of phytocoenoses were characterised.

Four soil outcrops were made on one of the slopes within the transect (Fig. 1) on the flat summit, on the lower and upper part of the slope, and at its foot. Soil samples were taken from each genetic level of the profile. Their pH values were determined with potentiometric method, and soil pH was then determined on their basis. The content of $CaCO_3$ was determined with the use of Scheibler's method, and grain size distribution with the use of Casagrande's method modified by Prószyński (Koćmit et al. 1981). For each plant patch, grain size distribution to 25 cm in depth was established with the use of organoleptic method.

Mutual similarity coefficients of the distinguished communities were calculated using their phytosociological stability of species (S) and the Kluczyński's method described by Szafer and Zarzycki (1972).

RESULTS AND DISCUSSION

Three types of plant communities were distinguished in the study area. On the summit, within cultivation of winter and spring wheat and spring barley, there are agrophytocenoses of *Lathyro-Melandrietum noctiflori* segetal community. Fallow slopes on the southern and south--eastern side are inhabited by patches of *Convolvulo arvensis-Agropyretum repentis*, while the lower part of the slope is covered with phytocoenoses of *Poo-Tussilaginetum farfarae* growing in agriculturally neglected crops of triticale.

The community of *Lathyro-Melandrietum noctiflori* (Oberd. 1957) = *Euphorbio-Melandrietum* Müller 1964 (Table 3)

The community is mainly found in cereal crops on soils with neutral or alkaline pH, rich in $CaCO_3$. Significant content of facultatively calciphilous species is characteristic. The association takes intermediate position between *Vicietum tetraspermae* and *Caucalido-Scandicetum*. *Lathyro-Melandrietum noctiflori* community is an association not very widespread in Poland (Matuszkiewicz 2007).

The phytocoenoses of the association inhabit the flat, at some places slightly undulating, summit extending in the study area from the edge of the slope to the west. The area is used for agricultural purposes, and in 2009 there were crops of winter and spring wheat as well as spring barley. Their coverage is not too large (63.8% on average), so the spaces between individual crops are successfully inhabited by weeds, which reach the average coverage of

48.2% (Table 2). Within the habitat, there are typical eutrophic brown soil (BEt) formed of light clay, often silty. The soils are characterised by alkaline pH, and contain a significant content of $CaCO_3$ (Table 1). Mean values of R (4.0–4.4) calculated with Ellenberg's method confirm the occurrence of significant number of calciphilous species in the community (Table 3). The habitats of these soils are very warm (T = 2.3) and relatively dry (W = 3.5) – Table 2.

Table 2. Range of grades of stability in the particular syngenetic groups of *Lathyro-Melandrietum noctiflori* (a), *Convolvulo arvensis-Agropyretum repentis* (b) and *Poo-Tussilaginetum farfarae* (c)
Tabela 2. Rozkład stopni stałości w poszczególnych grupach syngenetycznych *Lathyro-Melandrietum noctiflori* (a), *Convolvulo arvensis-Agropyretum repentis* (b) i *Poo-Tussilaginetum farfarae* (c)

Phytosociological classes Klasy fitosocjologiczne		Grades of stability – Stopnie stałości					Total Razem
		V	IV	III	II	I	
		number of species – liczba gatunków					
Stellarietea mediae	a	10	8	5	10	10	43
	b	1	4	7	10	11	33
	c	6	6	9	4	2	27
Artemisietea vulgaris	a	1	2	3	–	3	9
	b	7	2	–	5	2	16
	c	1	1	2	2	1	7
Molinio-Arrhenatheretea	a	–	–	1	2	11	14
	b	3	3	5	9	7	27
	c	6	2	8	5	2	23
Festuco-Brometea	a	–	–	2	1	1	4
	b	3	3	6	2	3	17
	c	–	–	2	–	1	3
Trifolio-Geranietea sanguinei	a	–	–	–	–	–	–
	b	–	1	1	2	1	5
	c	–	–	–	–	–	–
Rhamno-Prunetea	a	–	–	–	–	–	–
	b	–	–	–	1	2	3
	c	–	–	–	–	–	–
Agropyretea intermedio-repentis	a	1	1	1	2	–	5
	b	3	–	–	1	–	4
	c	3	–	–	–	–	3
Koelerio glaucae-Corynephoretea canescentis	a	–	–	–	–	–	–
	b	–	–	2	3	1	6
	c	–	–	–	–	–	–
Nardo-Callunetea	a	–	–	–	–	1	1
	b	–	–	–	1	1	2
	c	1	–	–	–	–	1
Isoëto-Nanojuncetea	a	–	–	–	–	–	–
	b	–	–	–	–	–	–
	c	2	–	–	–	–	2
Accompanying species Gatunki towarzyszące	a	–	2	–	2	2	6
	b	1	1	1	4	3	10
	c	1	2	–	1	1	5
					Total Razem	a	82
						b	123
						c	71

The community is floristically rich. It consists of 82 species, of which half (43) belongs to *Stellarietea mediae* class (Table 2) and their number in individual patches ranges from 22 to 43, reaching 33 on average (Table 3).

Table. 3. Phytocenoses of *Lathyro-Melandrietum noctiflori* occurring in cereals on the summit, variant with *Anthemis tinctoria* and *Melampyrum arvense* (relevés 1–9), typical variant (relevés 10–17)
Tabela. 3. Fitocenozy *Lathyro-Melandrietum noctiflori* występujące w zbożach na wierzchowinie, wariant z *Anthemis tinctoria* i *Melampyrum arvense* (zdjęcia 1–9), wariant typowy (zdjęcia 10–17)

Successive No. Numer kolejny	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
Field No. of relevé Numer zdjęcia w terenie	6	32	2	4	3	5	31	1	37	7	8	9	10	26	27	28	29		
Patch area Powierzchnia płatu [m^2]	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	$\bar{x}$	
Cover of cultivated plants Pokrycie przez rośliny uprawne [%]	50	70	60	55	60	70	80	50	80	70	70	70	60	60	50	60	70	63.8	
Cover of weeds Pokrycie przez chwasty [%]	65	40	60	65	60	50	40	60	50	50	60	40	35	30	35	40	40	48.2	
Cultivated plants Rośliny uprawne	Winter wheat Pszenica ozima									Spring barley Jęczmień jary					Spring wheat Pszenica jara				
Mechanical composition of A horison of soil (0–20 cm) Gleba, skład granulometryczny, poziom A (0–20 cm)	gl	gl	gl	gl	gl	płi	gl	gl	gl	gl	płi	pgm	pgm	gl	gl	gl	gl		
Number of species in relevé Liczba gatunków w zdjęciu fitosocjologicznym	43	34	36	31	35	38	36	35	31	32	37	34	30	24	29	22	40	33	
Mean values Średnie wartości — thermic termiczne (T)	2.3	2.5	2.4	2.3	2.5	2.3	2.4	2.4	2.2	2.3	2.4	2.1	2.2	2.2	2.2	2.2	2.3	2.3	
moisture wilgotnościowe (W)	3.9	3.8	3.5	3.9	3.5	3.4	3.5	3.6	3.4	3.3	3.5	3.3	3.5	3.1	3.1	3.2	3.6	3.5	
reaction odczynu (R)	4.4	4.3	4.2	4.4	4.3	4.3	4.3	4.2	4.2	4.2	4.0	4.1	4.1	4.1	4.1	4.1	4.2	4.2	
nitrogen content zasobności w azot (N)	3.1	3.1	3.2	3.1	3.1	3.0	3.6	3.1	3.3	3.4	3.1	3.8	3.5	3.4	3.6	3.4	3.6	3.3	
biological activity aktywności biologicznej (G)	3.3	3.3	3.3	3.1	3.2	3.0	3.3	3.2	3.4	3.5	3.2	3.3	3.5	3.0	3.2	3.3	3.3	3.3	
																		S	D
ChAss.: *Lathyro-Melandrietum noctiflori*																			
Melandrium noctiflorum	**1.2**	**+**	**1.1**	**1.1**	**1.1**	**2.2**	**+**	**1.1**	**+**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**.**	**V**	**474**
Euphobia exigua	**1.1**	**1.1**	**1.2**	**1.1**	**1.1**	**1.1**	**+**	**1.1**	**.**	**+**	**1.1**	**.**	**+**	**1.1**	**1.1**	**1.1**	**1.1**	**V**	**371**
Lathyrus tuberosus	**.**	**1.2**	**1.2**	**.**	**+**	**1.1**	**.**	**1.1**	**+**	**.**	**+**	**.**	**.**	**1.1**	**+**	**.**	**.**	**III**	**171**

Table. 3. Phytocenoses of *Lathyro-Melandrietum noctiflori* occurring in cereals on the summit, variant with *Anthemis tinctoria* and *Melampyrum arvense* (relevés 1–9), typical variant (relevés 10–17) (cont.)
Tabela. 3. Fitocenozy *Lathyro-Melandrietum noctiflori* występujące w zbożach na wierzchowinie, wariant z *Anthemis tinctoria* i *Melampyrum arvense* (zdjęcia 1–9), wariant typowy (zdjęcia 10–17) (cd.)

I ChO.: *Centauretalia cyani*																			
Centaurea cyanus	**3.3**	**2.2**	**3.3**	**3.3**	**1.3**	**3.3**	**1.2**	**3.3**	**2.2**	**2.3**	**2.3**	**2.2**	1.3	**1.3**	**1.1**	**+**	**1.2**	**V**	**1697**
Consolida regalis	**1.2**	**2.2**	**2.3**	**2.3**	**2.3**	**2.3**	**1.2**	**1.2**	**2.2**	**+**	**1.1**	**1.1**	+	**+**	**+**	**1.1**	**2.3**	**V**	**921**
Papaver rhoeas	+	**2.2**	**+**	**+**	+	**+**	**1.1**	**+**	**+**	**+**	+	**+**	+	**+**	**+**	**+**	**+**	**V**	**221**
Avena fatua	**1.1**	**1.1**	**+**	**+**	**.**	**2.3**	**+**	**.**	**1.1**	**3.4**	**3.3**	**2.3**	1.3	**1.1**	**1.3**	**.**	**.**	**IV**	**841**
Lithospermum arvense	**1.3**	+	**.**	**2.3**	**+**	**1.3**	**+**	**1.2**	**+**	**1.3**	**1.1**	**.**	1.1	**.**	**.**	**.**	**.**	**IV**	**302**
Vicia sativa	**.**	+	**+**	**+**	**+**	+	**+**	+	**.**	**.**	**+**	**.**	.	**.**	**.**	**.**	**.**	**III**	**47**
Vicia villosa	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	.	**.**	**+**	**1.3**	+	**.**	**.**	**.**	**+**	**II**	**47**
II ChO.: *Polygono-Chenopodietalia*																			
Chenopodium album	**+**	**.**	+	**+**	**+**	**+**	**.**	**+**	**+**	**1.1**	**1.1**	**1.1**	1.3	**.**	**+**	**.**	**1.1**	**IV**	**194**
Polygonum aviculare	**+**	**+**	**.**	**.**	**+**	**+**	**+**	**.**	**.**	**+**	**.**	**+**	.	**.**	**.**	**.**	**+**	**III**	**47**
Atriplex patula	**+**	**.**	**+**	**.**	**.**	**+**	**.**	**.**	**+**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**1.3**	**II**	**53**
Capsella bursa-pastoris D	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**+**	**.**	**.**	**.**	**+**	+	**+**	**.**	**.**	**+**	**II**	**29**
III ChCl.: *Stellarietea mediae*																			
Apera spica-venti	**1.3**	**+**	**1.2**	**1.2**	**1.3**	**1.1**	**+**	**2.3**	**.**	**+**	**+**	**1.1**	+	**2.3**	**2.3**	**+**	**.**	**V**	**521**
Matricaria maritima subsp. *inodora*	**1.3**	**+**	**1.1**	**1.2**	**1.2**	**1.2**	**+**	**1.3**	**1.1**	**1.1**	**+**	**+**	1.3	**1.3**	**+**	**+**	**1.3**	**V**	**359**
Viola arvensis	**+**	**1.1**	**+**	**+**	**1.1**	**+**	**1.1**	**+**	**1.1**	**1.1**	**+**	**1.1**	1.1	**1.1**	**+**	**1.1**	**+**	**V**	**312**
Fallopia convolvulus	**1.1**	**+**	**+**	**1.1**	**1.1**	**+**	+	**+**	**+**	**+**	**+**	**1.1**	1.1	**+**	**+**	**1.1**	**1.1**	**V**	**265**
Euphorbia helioscopia	**1.1**	**+**	**+**	**1.1**	**+**	**+**	+	**+**	**+**	**+**	**1.1**	**+**	**+**	**+**	**+**	**+**	**+**	**V**	**171**
Stellaria media	**+**	**2.2**	**+**	**.**	**+**	**.**	**1.1**	**+**	**+**	**+**	**.**	**1.1**	+	**+**	**.**	**.**	**+**	**IV**	**215**
Anagallis arvensis	**+**	**.**	**.**	**+**	**+**	**+**	**.**	**+**	**.**	**1.1**	**1.1**	**1.1**	+	**.**	**1.1**	**+**	**.**	**IV**	**159**
Myosotis arvensis	**+**	**+**	**+**	**.**	**.**	**.**	**+**	**+**	**+**	**+**	**.**	**+**	1.1	**+**	**1.1**	**+**	**.**	**IV**	**118**
Veronica polita	**+**	**+**	**+**	**.**	**+**	**.**	**+**	**+**	**.**	**+**	**+**	**+**	+	**.**	**+**	**+**	**+**	**IV**	**77**
Sinapis arvensis	**+**	**.**	**+**	**+**	**+**	**+**	**.**	**.**	**+**	**.**	**+**	**+**	**+**	**.**	**+**	**+**	**+**	**IV**	**71**
Veronica persica	**+**	**.**	**+**	**.**	**.**	**.**	**.**	**.**	**+**	**1.1**	**.**	**+**	.	**1.1**	**1.1**	**1.1**	**.**	**III**	**141**
Lamium amplexicaule	**.**	**+**	**.**	**.**	**.**	**.**	**+**	**.**	**+**	**1.1**	**+**	**1.1**	+	**.**	**.**	**+**	**.**	**III**	**94**
Chaenorhinum minus	**.**	**+**	**1.1**	**.**	**1.1**	**.**	**+**	**.**	**.**	.	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**II**	**71**
Anchusa arvensis	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	.	**.**	**+**	**+**	**+**	**+**	**+**	**.**	**.**	**II**	**29**
Vicia hirsuta	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**+**	.	**+**	**+**	**+**	**.**	**.**	**.**	**.**	**+**	**II**	**29**
Anagallis sfr. *foemina*	**+**	**.**	**+**	**.**	**.**	**+**	**.**	**.**	**.**	**+**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**II**	**24**
Papaver argemone	**.**	**+**	**.**	.	**.**	**.**	**+**	**.**	**.**	**.**	**.**	**.**	**+**	**.**	**.**	**.**	**+**	**II**	**24**
Papaver dubium	**.**	**+**	**+**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**+**	**.**	.	**.**	**.**	**+**	**.**	**II**	**24**
Thlaspi arvense	**.**	**.**	**.**	**+**	**.**	**.**	**.**	**.**	.	**+**	**.**	**+**	**+**	**.**	.	**.**	**.**	**II**	**24**
IV ChCl.*: Festuco-Brometea*																			
Anthemis tinctoria	**1.3**	**1.1**	**1.2**	**1.1**	**1.3**	**.**	**+**	**+**	**+**	**.**	**.**	**.**	.	**.**	**.**	**.**	**.**	**III**	**165**
Melampyrum arvense	**1.1**	**1.1**	**1.1**	**+**	**+**	**1.1**	**+**	**+**	**.**	**.**	**.**	**.**	.	**.**	**.**	**.**	**.**	**III**	**141**
Centaurea scabiosa	**+**	**+**	**.**	**.**	**+**	**1.2**	**+**	**.**	**.**	**.**	**.**	**.**	.	**.**	**.**	**.**	**.**	**II**	**53**

Table. 3. Phytocenoses of *Lathyro-Melandrietum noctiflori* occurring in cereals on the summit, variant with *Anthemis tinctoria* and *Melampyrum arvense* (relevés 1–9), typical variant (relevés 10–17) (cont.)
Tabela. 3. Fitocenozy *Lathyro-Melandrietum noctiflori* występujące w zbożach na wierzchowinie, wariant z *Anthemis tinctoria* i *Melampyrum arvense* (zdjęcia 1–9), wariant typowy (zdjęcia 10–17) (cd.)

V ChCl.*: Molinio-Arrhenatheretea*																			
Daucus carota	+	.	.	+	+	.	.	+	+	+	+	+	.	.	.	.	+	III	53
Cerastium holosteoides	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	II	24
Trifolium repens	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	+	II	24
VI ChCl.: *Agropyretea intermedio-repentis*																			
Elymus repens	2.3	.	1.3	1.2	2.3	1.2	.	1.2	+	1.3	1.3	2.3	2.3	2.3	1.3	2.3	2.3	V	932
Convolvulus arvensis	+	+	1.3	1.2	1.3	+	+	+	1.1	+	+	.	.	.	.	.	+	IV	165
Falcaria vulgaris	1.2	+	+	+	+	+	+	+	+	.	+	.	.	.	.	.	.	III	82
Equisetum arvense	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	+	II	29
Cerastium arvense	.	.	.	.	.	+	.	.	+	+	.	.	.	+	.	.	.	II	24
VII ChCl.: *Artemisietea vulgaris*																			
Cirsium arvense	+	+	1.2	1.2	+	+	+	1.2	+	+	1.3	+	.	.	.	1.3	1.3	V	224
Artemisia vulgaris	+	+	.	+	.	1.2	+	1.2	+	.	.	+	+	+	.	.	+	IV	112
Galium aparine	+	+	+	.	+	+	+	+	.	.	.	.	.	+	+	1.1	+	IV	88
Medicago lupulina	+	.	.	+	+	1.1	.	+	.	.	1.1	1.1	1.1	.	.	.	+	III	147
Rubus cfr. *caesius*	1.3	+	+	+	.	+	+	.	.	.	1.3	.	.	.	.	.	+	III	94
Melilotus officinalis	1.3	.	+	+	+	+	.	+	.	.	.	.	.	.	+	.	1.2	III	94
VIII Accompanying species – Gatunki towarzyszące																			
Camelina microcarpa	2.3	1.1	2.3	2.3	2.3	2.2	1.1	2.3	1.1	+	.	.	.	+	.	.	.	IV	718
Arenaria serpyllifolia	+	1.1	1.1	.	+	1.1	+	+	+	+	+	.	.	.	.	+	.	IV	135
Veronica arvensis	.	.	.	.	.	.	.	.	+	+	.	+	.	+	+	.	+	II	35
Brassica napus v. *oleifera*	+	.	.	+	+	+	.	.	.	.	.	+	.	.	.	.	+	II	35

Plant species occurring only in I degree (S) of relevé constance in plant communities. After a name of species the number of the relevé in which species occurred is given and in brackets the quantity degrees and sociability.
Gatunki roślin występujące w zbiorowisku wyłącznie w I stopniu stałości (S). Po nazwie gatunku podano numery zdjęć fitosocjologicznych, w których wystąpił gatunek, w nawiasach – stopnie ilościowości i towarzyskości.
Explanations – Objaśnienia: S – phytosociological stability – stałość fitosocjologiczna, D – cover coefficient – współczynnik pokrycia, $\bar{x}$ – medium value – wartości średnie.
Soil species – Gatunki gleb: gl – light loam – glina lekka, płi – clayey silt – pył ilasty, pgm – heavy loamy sand – piasek gliniasty mocny.
I: *Valerianella dentata* 10,14(+); **II:** *Geranium pussilum* 12,13(+); *Sonchus arvensis* D11(1.3); **III:** *Bromus sterilis* 7(+); *B. tectorum* 7(+); *Descurainia sophia* 17(+); *Fumaria officinalis* 17(+); *Lamium purpureum,* 12(1.1),13(+); *Sonchus asper* 6,11(+); *Vicia angustifolia* 9,13(+); **IV:** *Centaurea stoebe* 7(+); **V:** *Achillea millefolium* 11(+); *Alopecurus pratensis* 17(+); *Avenula pubescens* 5(+); *Festuca rubra* 15(+); *Knautia arvensis* 11(1.2),1(+); *Lolium perenne* 2,7(+); *Phleum pratense* 1(+); *Plantago maior* 17(+); *Poa pratensis* 17(+); *Taraxacum officinale* agg. 17(+); *Trifolium pratense* 15(+); **VII:** *Hypericum perforatum* 8(+); *Medicago sativa* 6,8,17(+); *Picris hieracioides* 1,3,6(+); **VIII:** *Erodium cicutarium* 17(+); *Hordeum sativum* 15(+); **ChCl.: *Nardo-Callunetea***: *Agrostis capillaris* 11(1.3), 15(+).

The agrophytocoenoses of the association were divided. Relevés 1–9 were included in the variant of *Anthemis tinctoria* and *Melampyrum arvense* (Fig. 6) and *Camelina microcarpa* due to their occurrence exclusively in the plant patches of winter wheat. Other relevés (10–17) were classified as a variant of typical association. *Lathyro-Melandrietum noctiflori* phytocoenon is characterised by the dominance of two characteristic species of the association – *Melandrium noctiflorum* (S = V, D = 474) and *Euphorbia exigua* (S = V, D = 371). *Lathyrus tuberosus* is less frequent (S = III) and less numerous (D = 171). Many species of segetal communities both of *Centauretalia cyani* and *Stellarietea mediae* also dominate in the structure of the association. Particularly frequent and numerous are: *Centaurea cyanus* (S = V, D = 1697), *Consolida regalis* (S = V, D = 921), *Papaver rhoeas* (S = V, D = 221) and *Avena fatua* (S = IV, D = 841). The latter species is particularly frequent in communities of spring cereals (Table 3). *Stellarietea mediae* is most often (S = V) represented by, among others, *Apera spica-venti* (D = 521), *Matricaria maritima* subsp. *inodora* (D = 359), *Viola arvensis* (D = 312), *Fallopia convolvulus* (D = 265) and *Euphorbia helioscopia* (D = 171) – Table 3. The participation of species of other phytosociological classes in the structure of the association is varied. The most common are the species of seminatural communities of *Molinio-Arrhenatheretea* (14) – Table 3, and xerothermic grasslands of *Festuco-Brometea* as well as ruderal phytocoenoses of *Artemisietea vulgaris*. More often and more frequently observed is also *Elymus repens* (S = V, D = 932) of *Agropyretea intermedio-repentis* and *Cirsium arvense* (S = V, D = 224) as well as *Artemisia vulgaris* (S = IV, D = 112) of *Artemisietea vulgaris*. *Camelina microcarpa* (S = V, D = 718), a species which is not included in any of the phytosociological classes, has also its significant share in the structure of the association.

Fig. 6. Soil profile of typical chernozem deluvial soil (CYt) – photo I. Kutyna
Ryc. 6. Profil gleby deluwialnej czarnoziemnej typowej (CYt) – fot. I. Kutyna

The phytocoenoses of *Lathyro-Melandrietum noctiflori* occur mainly on the summit and are visibly floristically different from the patches of communities located on the slope and in the depression. Hence, they reveal little similarity (46.1%) to the communities on the slope 51.1% and the phytocoenoses of *Poo-Tussilaginetum farfarae* found in the depression.

The structure of *Lathyro-Melandrietum noctiflori* association has been identified and characterised by a number of geobotanist. Among others, Kutyna and Malinowska (2015) distinguished the association on the ridge area (crown of excavation) of "Piotrawin" quarry, on the basis of more numerous presence of two characteristic species - *Melandrium noctiflorum* (S = V, D = 433) and *Lathyrus tuberosus* (S = V, D = 433). The structure of the association is formed by 119 species. Species of *Stellarietea mediae* have the largest share in it. There are 26 of them, while the dominant role is played by 11 which are stable components of the association (S = V) and they reach varied values of coverage coefficients. To this group belong both characteristic species – *Melandrium noctiflorum* and *Lathyrus tuberosus* as well as *Papaver rhoeas* (S = V, D = 1058), *Consolida regalis* (S = V, D = 283), *Anagallis arvensis* (S = IV, D = 300), *Stachys annua* (S = IV, D = 300) and *Sinapis arvensis* (S = V, D = 233). In the community there is also a significant share of thermophilic xerothermic grassland species of *Festuco-Brometea* (19) as well as ruderal communities of *Artemisietea vulgaris* (22), meadow species communities of *Molinio-Arrhenatheretea* (15) and to a lesser extent thermophilic forest edge communities of *Trifolio-Geranietea sanguinei* (8 species).

The association of *Lathyro-Melandrietum noctiflori* was also distinguished by Kutyna (1988) in the area of the western part of Gorzów Basin (Kotlina Gorzowska) within the areas directly adjacent to it. The phytocoenoses are relatively rare in this area. Their presence is limited only to very warm and dry southern slopes of glacial hills and the northern edge of the river Warta. The communities inhabit exclusively soils of alkaline pH formed of silty deposits, mainly of loamy substrate, less frequently observed within clay soils (average indicator value (R) given by Ellenberg is 4.1) – Kutyna (1988).

The characteristic species of the association are stable components of the community (S = V), and their coverage coefficients are varied. *Lathyrus tuberosus* reaches D = 952, and *Melandrium noctiflorum* D = 194. The structure of the association is formed by numerous species of *Caucalidion lappulae* alliance. The most numerous among them are: *Consolida regalis* (S = V, D = 742), *Euphorbia exiqua* (S = IV, D = 131) and *Avena fatua* (S = III, D = 203). The phytocoenon is formed of 80 species, and individual plant patches are floristically rich. The number of species in 20 relevés ranges from 29 to 38, and equals on average 33.

The association of *Lathyro-Melandrietum* was also distinguished by Trzcińska-Tacik (2000). The phytocoenoses are found in cereals on the soils of organic and conventional farms in the village of Tempoczów – Rędziny. The floristic composition of patches of organic and conventional farms was to a large extent similar. Trzcińska-Tacik (2000) included them to the association of *Lathyro-Melandrietum*, but noted that the floristic composition also gravitates towards *Vicietum tetraspermae*. Among characteristic species, the most numerous was *Lathyrus tuberosus* (S = III in organic farms and S = IV in conventional farms). The coefficients calculated by the authors of this paper are respectively D = 254 and D = 357. Other characteristic species of the association are very rarely found in conventional farms, and they slightly more often inhabit plant patches in organic farms. The community of *Lathyro-Melandrietum*

is floristicall rich, characterised by the presence of 153 species, and is significantly poorer on the fields of conventional farms where it is formed of 80 species. The average number of species in the community is 31 and 25 taxa respectively. The association develops on soils with a significant amount of calcium carbonate and organic matter, usually on warm and dry slopes.

The association of *Lathyro-Melandrietum* was also distinguished by Anioł-Kwiatkowska (1990) in the area of Dalkowskie Hills (Wzgórza Dalkowskie) and Trzebnickie Hills (Wzgórza Trzebnickie). Phytocoenoses inhabit mainly winter grains, and the author noted them most often in wheat. Two characteristic species *Lathyrus tuberosus* and *Melandrium noctiflorum* occur in the *Lathyro-Melandrietum* association. *Lathyrus tuberosus* is a stable component of the community (S = IV–V) both in phytocoenoses on Dalkowskie Hills and on Trzebnickie Hills. It reaches there significant coverage coefficients, D = 1105 and D = 2950 respectively. *Melandrium noctiflorum* is less frequently found. In the communities of Dalkowskie Hills, it is found occasionally (S = I, D = 326), and slightly more often on Trzebnickie Hills (S = III, D = 452). In the structure of this phytocoenosis, there are also characteristic species of *Caucalidion lappulae*. The most common and most numerous among them were *Euphorbia exiqua* and *Avena fatua*. *Lathyro-Melandrietum* is a floristically rich association of cereal crops, on average there are from 16 species per one relevé (on Dalkowskie Hill) and up to 24 (on Trzebnickie Hill), while in 17 patches of the association (Dalkowskie Hill) 81 were found. Phytocoenoses develop on compacted soils formed of medium silty loam and alkaline loess deposits, mainly on southern, warm and dry slopes of glacial hills.

The association of *Lathyro-Melandrietum noctiflori* is also referred to in Poland as *Euphorbio-Melandrietum* – Müller 1964. The community is found mainly on black loamy soils of Pleistocene ice-marginal lake in the area of Pyrzyce Lowland (Nizina Pyrzycka) and on Myśliborskie Lakeland (Pojezierze Myśliborskie) and is defined as a form of *Melandrium noctiflorum* and *Euphorbia exigua* within the subassociation of *Aphano-Matricarietum delphinietosum* (Borowiec et al. 1975). The association of *Euphorbio-Melandrietum* is also found on rich in calcium carbonate black soils of Wrocław (Matuszkiewicz 2007).

According to Matuszkiewicz (2007) the information of the occurrence of this association on Lublin Upland (Wyżna Lubelska) is a misunderstanding, as it regards poorer or anthropogenically impoverished forms of *Caucalido-Scandicetum* on poorer by nature or secondarily degraded Jurassic and cretaceous rendzinas.

The community of *Convolvulo arvensis-Agropyretum repentis* Felföldy 1943 (Table 4)

The phytocoenoses of the community are found on southern, south-eastern and south--western slopes of the edge of the Oder valley within cropped land abandoned a few years ago. They are characterised by varied inclination from 8 to 20 degrees (Table 4). Surface soil substrate is mainly composed of light loam. Sandy loam is deeper (Table 1). Surfaces of the slope are eroded. Organic matter from upper layers has been transported and deposited in the depression. There are eutrophic brown soils (BEt) in the upper part of the slope, and in the lower part there are soils poorly formed by erosion (SY). The surface layer is composed of sandy loam transforming into slightly loamy and loose sand. Plants density is significant and on average equals 87%. The habitat is very warm, which is confirmed by mean thermal numbers T = 2.5, soils are desiccated (W = 3.5), alkaline, with calcium carbonate (R = 4.2), poorer in nitrogen compounds (N = 2.6) and biologically less active (G = 2.7) – Table 3.

Table. 4. *Convolvulo arvensis-Agropyretum repentis* community occurring on slopes of fallow lands
Tabela. 4. Zbiorowisko *Convolvulo arvensis-Agropyretum repentis* występujące na zboczach odłogów

Successive No. Numer kolejny	1	2	3	4	5	6	7	8	9	10	11	12	13		
Field No. of relevé Numer zdjęcia w terenie	34	36	35	33	11	12	13	14	15	16	17	18	30		
Patch area Powierzchnia zdjęcia [m^2]	100	100	100	100	80	100	80	90	100	100	80	90	70		$\bar{x}$
Cover of herb layer Pokrycie powierzchni zdjęcia przez rośliny [%]	50	75	60	70	90	100	100	100	90	100	100	100	100		87
Mechanical composition of A horison of soil Gleba skład granulometryczny, poziom A (0–20 cm)	płi – clayey silt – pył iłowy														
Exposition Wystawa	SE	SE	S	S	S	SE	S	S	SW	S	SW	SE	SW		
Gradient of stope in degree Nachylenie zbocza w stopniach	15	15	10	15	15	20	8	8	10	8	8	10	8		
Number of species in relevé Liczba gatunków w zdjęciu fitosocjologicznym	53	56	41	56	56	55	56	58	46	47	49	50	32		48
Mean values Średnie wartości															
thermic termiczne (T)	2.5	2.4	2.4	2.5	2.2	2.4	2.5	2.3	2.4	2.9	2.8	2.4	2.8		2.5
moisture wilgotnościowe (W)	3.4	3.6	3.4	3.5	3.3	3.4	3.6	3.3	3.4	3.3	3.8	3.8	4.0		3.5
reaction odczynu (R)	4.2	4.2	4.0	4.1	4.1	4.1	4.2	4.1	4.2	4.3	4.5	4.3	4.4		4.2
nitrogen content zasobności w azot (N)	2.9	3.0	2.8	2.8	3.0	3.0	2.7	2.8	3.1	2.6	2.3	3.4	2.9		2.6
biological activity aktywności biologicznej (G)	3.1	3.1	3.0	2.9	3.1	3.2	2.9	2.8	3.0	2.3	2.6	2.8	3.3		2.7
														S	D
ChAss.: *Convolvulo arvensis-Agropyretum repentis*															
Elymus repens	**1.2**	**2.2**	**2.2**	**2.2**	**1.3**	**1.3**	**2.3**	**2.3**	**2.3**	**.**	**.**	**1.2**	**1.1**	**V**	**1000**
Convolvulus arvensis	**+**	**2.2**	**+**	**+**	**2.3**	**1.3**	**1.3**	**2.3**	**.**	**1.2**	**+**	**1.3**	**.**	**V**	**588**
I ChCl.: *Agropyretea intermedio-repentis*															
Falcaria vulgaris	**+**	**1.1**	**.**	**+**	**+**	**+**	**+**	**2.2**	**.**	**1.2**	**1.2**	**1.3**	1.3	**V**	**365**
Cerastium arvense	**+**	**+**	**+**	**+**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	.	**II**	**31**
II ChCl.: *Stellarietea mediae*															
Papaver rhoeas	**1.2**	**+**	**+**	2.2	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**.**	.	**V**	**242**
Consolida regalis	**+**	**1.1**	**.**	**+**	**2.3**	**1.3**	**1.2**	**1.1**	**+**	**1.2**	**.**	**.**	.	**IV**	**350**
Conyza canadensis	**.**	**+**	.	**.**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**.**	**+**	**+**	1.1	**IV**	**277**
Matricaria maritima ssp. *inodora*	**+**	**+**	**+**	**+**	**+**	**1.2**	**.**	**+**	**+**	**+**	**.**	**.**	.	**IV**	**100**
Centaurea cyanus	**+**	.	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**.**	**.**	.	**IV**	**69**
Anagallis arvensis	**1.1**	.	**+**	**1.1**	**+**	**+**	**+**	**.**	+	**.**	**.**	**.**	.	**III**	**115**
Chenopodium album	**.**	**+**	**.**	**.**	**1.2**	1.2	**+**	**+**	**.**	**.**	**.**	**.**	+	**III**	**108**
Vicia sativa	**.**	**+**	**.**	**.**	**+**	**+**	**+**	**+**	**+**	**+**	**.**	**.**	.	**III**	**54**
Euphorbia helioscopia	**.**	**+**	**+**	**.**	**.**	**+**	**+**	**+**	**+**	**.**	**.**	**.**	.	**III**	**46**
Papaver argemone	**+**	**+**	**+**	**+**	**.**	**+**	**+**	**.**	**.**	**.**	.	**.**	**.**	**III**	**46**
Capsella bursa-pastoris	**+**	**+**	**.**	**+**	**+**	**+**	**+**	**.**	**.**	**.**	.	**.**	**.**	**III**	**46**
Viola arvensis	**.**	**+**	**+**	**.**	**+**	**+**	**+**	**+**	**.**	**.**	**.**	.	**.**	**III**	**46**
Apera spica-venti	**.**	**.**	.	**.**	**1.3**	**1.1**	**.**	**1.2**	**+**	**.**	**.**	**.**	+	**II**	**123**
Chamomilla recutita	**.**	**.**	**.**	**1.1**	**.**	**.**	**.**	**1.1**	**.**	**1.1**	**.**	**.**	.	**II**	**115**
Lactuca serriola	**.**	**.**	**.**	.	**.**	**+**	**1.3**	**1.3**	**.**	**.**	.	**.**	**.**	**II**	**85**
Sinapis arvensis	**+**	**+**	**+**	**+**	**.**	**+**	**.**	**.**	**.**	.	**.**	**.**	.	**II**	**38**
Myosotis arvensis	**+**	**.**	**.**	**+**	**+**	**.**	**.**	**.**	.	**.**	**.**	**+**	.	**II**	**31**
Anagallis cfr. *foemina*	**+**	**.**	**.**	**+**	.	**.**	**.**	**+**	**.**	.	**.**	**.**	.	**II**	**23**
Vicia angustifolia	**+**	**.**	**.**	**+**	.	**.**	**.**	**.**	.	**.**	**.**	**+**	.	**II**	**23**
Geranium pusillum	**+**	**.**	**.**	**+**	.	**.**	**.**	**.**	.	**.**	**.**	**+**	.	**II**	**23**
Melandrium noctiflorum	**+**	**.**	**.**	**+**	**+**	**.**	**.**	**.**	.	**.**	**.**	**.**	.	**II**	**23**
Polygonum aviculare	**.**	**+**	**.**	**.**	**+**	**.**	**+**	.	**.**	**.**	**.**	.	**.**	**II**	**23**

Table. 4. *Convolvulo arvensis-Agropyretum repentis* community occurring on slopes of fallow lands (cont.)
Tabela. 4. Zbiorowisko *Convolvulo arvensis-Agropyretum repentis* występujące na zboczach odłogów (cd.)

III ChCl.: *Artemisietea vulgaris*															
Rubus cfr. *caesius*	**1.2**	**2.3**	3.3	**1.1**	**3.3**	**2.3**	**+**	**2.3**	**2.3**	**1.2**	**1.3**	**1.3**	**.**	**V**	**1315**
Picris hieracioides	**+**	**2.3**	**2.3**	+	**2.3**	**2.3**	**2.3**	**2.3**	**.**	**+**	**+**	**+**	.	**V**	**846**
Melilotus officinalis	**1.1**	+	**2.2**	**1.1**	**+**	**+**	**+**	**2.3**	**1.2**	**+**	1.1	**2.2**	.	**V**	**604**
Hypericum perforatum	**+**	**+**	**+**	**+**	**2.3**	**1.3**	**1.3**	**2.3**	**1.2**	**1.2**	**1.3**	**.**	1.3	**V**	**531**
Melilotus alba	**.**	**+**	**+**	**1.1**	**1.2**	**+**	**2.2**	**+**	**1.1**	**+**	**+**	**+**	1.1	**V**	**342**
Medicago lupulina	**1.1**	**+**	**1.1**	**1.1**	**1.3**	**+**	**+**	**1.2**	**+**	**.**	**+**	**+**	.	**V**	**238**
Melandrium album	**+**	**+**	**.**	**+**	**+**	**1.3**	**+**	**+**	**+**	**.**	**+**	**+**	**1.2**	**V**	**146**
Artemisia vulgaris	**+**	**+**	**+**	**1.1**	**1.3**	**1.3**	**1.3**	**1.2**	**1.2**	**.**	**+**	**.**	.	**IV**	**262**
Echium vulgare	**.**	**+**	**.**	**+**	**.**	**1.1**	**.**	**1.1**	**+**	**1.1**	**+**	**.**	1.1	**IV**	**185**
Erigeron ramosus	**.**	.	**.**	**.**	.	**+**	**.**	**+**	**+**	**1.1**	**.**	**+**	**.**	**II**	**69**
Anchusa officinalis	**.**	**.**	.	**.**	**.**	**.**	**.**	**+**	**+**	**.**	**.**	**.**	1.3	**II**	**54**
Cirsium arvense	**.**	.	**.**	**.**	**+**	**.**	**.**	**+**	**1.2**	**.**	**.**	**.**	.	**II**	**54**
Medicago sativa	**+**	**.**	**+**	**+**	**.**	**.**	**.**	**.**	**+**	**.**	**.**	**+**	.	**II**	**38**
Cynoglossum officinale	**.**	**.**	.	**.**	**.**	**+**	**.**	**.**	**.**	**+**	**+**	**.**	**.**	**II**	**23**
IV ChCl.: *Molinio-Arrhenatheretea*															
Festuca rubra	**+**	**.**	**1.3**	**+**	**1.3**	**1.3**	**1.2**	**1.2**	**1.3**	**4.4**	**2.3**	**2.2**	**3.4**	**V**	**1285**
Dactylis glomerata	**1.1**	+	**.**	**2.2**	**+**	**1.3**	**+**	**1.3**	**1.2**	**1.1**	**2.3**	**1.3**	1.3	**V**	**562**
Vicia cracca	**+**	**+**	**+**	**+**	**1.3**	**+**	**1.3**	**1.2**	**+**	**1.3**	**1.2**	**.**	.	**V**	**238**
Daucus carota	**+**	+	**1.1**	**1.1**	**1.2**	**1.3**	**1.3**	**1.2**	**1.2**	**.**	**+**	**.**	.	**IV**	**292**
Bromus hordeaceus	**+**	**+**	**.**	**.**	**.**	**+**	**+**	**.**	**+**	**.**	**+**	**1.1**	1.2	**IV**	**123**
Taraxacum officinale agg.	**+**	**+**	**+**	**+**	**+**	**+**	**1.3**	**+**	**.**	**+**	**+**	**.**	**.**	**IV**	**108**
Phleum pratense	**+**	.	**.**	**1.1**	**+**	**1.2**	**1.1**	**1.2**	**.**	**.**	**.**	**1.2**	.	**III**	**200**
Festuca pratensis	**.**	.	**.**	**.**	**+**	**1.3**	**1.2**	**1.2**	**1.2**	**.**	**1.2**	**.**	.	**III**	**200**
Plantago lanceolata	**+**	**+**	**+**	**+**	**.**	**.**	**.**	.	**1.1**	**+**	**+**	**.**	**.**	**III**	**85**
Tragopogon pratensis	**.**	**+**	**.**	**.**	**.**	**.**	**+**	**+**	**.**	**+**	**1.2**	**+**	.	**III**	**77**
Rumex crispus	**+**	**+**	**.**	**+**	**+**	**+**	**+**	**+**	**.**	**.**	.	**.**	.	**III**	**54**
Arrhenatherum elatius	**.**	.	**.**	**.**	**.**	**.**	.	**.**	**.**	**1.3**	**2.3**	**3.3**	**.**	**II**	**462**
Galium mollugo	**.**	.	**.**	**.**	**.**	**.**	.	**.**	**1.3**	**1.2**	**1.3**	**1.3**	**1.3**	**II**	**192**
Knautia arvensis	**.**	**+**	.	**.**	**.**	.	**.**	**+**	**.**	**1.3**	**.**	**+**	.	**II**	**62**
Poa annua	**+**	**.**	**.**	**1.1**	**+**	**.**	**.**	.	**.**	**.**	.	**.**	.	**II**	**54**
Achillea millefolium	**.**	**+**	**+**	**.**	**.**	.	**.**	.	**+**	**+**	**.**	**+**	.	**II**	**38**
Rumex acetosa	**.**	**+**	**.**	**.**	**+**	**.**	**.**	.	**.**	**+**	**.**	**+**	.	**II**	**31**
Poa pratensis	**.**	**+**	**+**	**.**	**.**	**+**	.	**.**	**.**	.	**.**	**.**	**+**	**II**	**31**
Cerastium holosteoides	.	**.**	**.**	.	**+**	**+**	**.**	**+**	.	**.**	**.**	**+**	**.**	**II**	**31**
Lolium perenne	**+**	**.**	**.**	**+**	**.**	**+**	.	**.**	**.**	.	**.**	**.**	**.**	**II**	**23**
V ChCl.: *Koelerio glaucae-Corynephoretea canescentis*															
Sedum acre	**+**	**+**	**.**	**+**	**1.3**	**.**	**.**	**.**	**.**	.	**+**	**.**	2.3	**III**	**204**
Senecio vernalis	**+**	**+**	**+**	**+**	**.**	**+**	**+**	**.**	**.**	.	**+**	**.**	**.**	**III**	**54**
Festuca cfr. *ovina*	**.**	**.**	.	**.**	**.**	.	**.**	**.**	+	**1.3**	**1.3**	**2.3**	**1.3**	**II**	**258**
Helichrysum arenarium	**.**	**.**	.	**.**	**.**	.	**.**	**.**	**.**	**+**	**+**	**+**	**1.3**	**II**	**62**
Potentilla argentea	**.**	**.**	.	**.**	**.**	.	**+**	**.**	**.**	**.**	**+**	**+**	**.**	**II**	**23**
VI ChCl.: *Festuco-Brometea*															
Anthemis tinctoria	**+**	2.2	**+**	**+**	**2.3**	**2.3**	2.3	**2.3**	**2.3**	1.3	**1.3**	**1.3**	**.**	**V**	**946**
Melampyrum arvense	**2.2**	+	**1.1**	**2.2**	**.**	**1.3**	**+**	1.2	**+**	**1.2**	2.3	**1.3**	**.**	**V**	**485**
Artemisia campestris	**+**	.	**+**	**+**	**+**	**1.3**	**1.3**	1.2	**+**	**1.3**	1.3	**1.3**	**2.3**	**V**	**404**
Centaurea stoebe	**+**	.	**+**	**.**	**+**	**.**	1.3	**.**	**1.3**	1.3	**1.3**	**1.3**	**3.4**	**IV**	**427**
Centaurea scabiosa	**+**	**+**	**+**	**+**	**.**	**.**	**1.3**	**1.2**	+	**1.3**	**1.3**	**1.3**	**.**	**IV**	**231**
Poa compressa	**+**	**+**	**+**	**.**	**1.1**	**.**	**+**	**.**	1.3	**1.3**	**1.2**	**.**	**.**	**IV**	**185**
Acinos arvensis	**1.1**	**2.2**	+	**2.2**	.	**3.4**	**2.3**	**2.3**	**.**	**.**	**.**	**.**	.	**III**	**873**
Phleum phleoides	**.**	**.**	.	**1.1**	**.**	**+**	**.**	**.**	**+**	**2.3**	**2.3**	**.**	**1.3**	**III**	**362**
Hieracium echioides	**.**	**+**	**.**	.	**+**	**.**	**.**	**2.3**	**1.2**	**.**	**1.2**	**+**	.	**III**	**235**
Dianthus carthusianorum	**.**	.	**.**	**.**	**1.1**	**.**	**1.1**	**+**	**.**	**.**	+	**+**	2.3	**III**	**227**
Sanguisorba minor	**.**	**.**	**+**	**+**	**.**	**.**	**1.1**	**+**	**+**	**.**	**1.1**	.	**1.1**	**III**	**146**
Plantago media	**+**	**+**	**+**	**+**	**.**	**.**	**+**	**.**	**.**	**1.2**	**1.3**	**.**	.	**III**	**115**
Petrorhagia prolifera	**.**	**.**	**1.1**	**.**	**1.1**	**.**	**+**	**.**	**.**	**1.1**	**.**	**+**	**.**	**II**	**131**
Asparagus officinalis	**.**	**.**	.	**.**	**.**	**.**	**+**	**.**	**.**	**.**	**+**	**1.3**	1.3	**II**	**92**
VII ChCl.: *Trifolio-Geranietea sanguinei*															
Agrimonia eupatoria	**+**	**.**	**.**	**+**	**+**	**+**	**1.3**	**+**	**+**	**1.2**	**2.3**	**1.2**	**.**	**IV**	**296**
Medicago falcata	**.**	.	**.**	**.**	**+**	**.**	1.1	**+**	**.**	2.3	**1.3**	**.**	**1.3**	**III**	**265**
Fragaria viridis	**.**	**.**	.	**.**	**.**	.	+	**.**	**.**	3.3	**2.3**	**.**	**.**	**II**	**431**
Verbascum lychnitis	**.**	**.**	**.**	.	**.**	**.**	.	+	**.**	**.**	**1.3**	**+**	**.**	**II**	**54**
VIII ChCl.: *Nardo-Callunetea*															
Agrostis capillaris	**.**	+	**.**	**.**	**.**	**.**	**.**	**1.2**	**+**	**1.3**	**.**	**.**	.	**II**	**92**
IX ChCl.: *Rhamno-Prunetea*															
Rosa canina b	**.**	**.**	.	**.**	**.**	.	**.**	**+**	**.**	**1.2**	**.**	**1.3**	.	**II**	**85**

Table. 4. *Convolvulo arvensis-Agropyretum repentis* community occurring on slopes of fallow lands (cont.)
Tabela. 4. Zbiorowisko *Convolvulo arvensis-Agropyretum repentis* występujące na zboczach odłogów (cd.)

X Accompanying species – Gatunki towarzyszące															
Arenaria serpyllifolia	+	+	+	+	1.1	2.2	1.2	1.2	.	.	+	+	1.1	V	358
Camelina microcarpa	+	+	+	+	1.1	+	+	1.1	.	.	+	.	+	IV	138
Senecio jacobaea	.	.	.	.	+	+	+	+	1.2	.	.	.	+	III	77
Ranunculus bulbosus	+	+	+	+	.	+	.	.	.	.	.	.	.	II	38
Veronica arvensis	+	+	.	+	+	.	.	.	.	.	.	.	.	II	31
Cerasus vulgaris (juv.)	.	.	.	.	+	+	+	.	.	.	.	+	.	II	31
Holosteum umbellatum	+	+	.	+	.	.	.	.	.	.	.	.	.	II	23

Plant species occurring only in I degree (S) of relevé constance in plant communities. After a name of species the number of the relevé in which species occurred is given and in brackets the quantity degrees and sociability.
Gatunki roślin występujące w zbiorowisku wyłącznie w I stopniu stałości (S). Po nazwie gatunku podano numery zdjęć fitosocjologicznych, w których wystąpił gatunek, w nawiasach – stopnie ilościowości i towarzyskości.
Explanations – Objaśnienia: S – phytosociological stability – stałość fitosocjologiczna, D – cover coefficient – współczynnik pokrycia, $\bar{x}$ – medium value – wartości średnie.
II: *Bromus sterilis* 2(+); *B. tectorum* 4(+); *Fallopia convolvulus* 5(+); *Lamium amplexicaule* 5(+); *Setaria viridis* 5,6(+); *Silene vulgaris* 4(+); *Sonchus arvensis* 2(+); *S. asper* 5,6(+); *Stellaria media* 2,9(+); *Vicia hirsuta* 7,12(+); *V. tetrasperma* 8(+); **III:** *Berteroa incana* 12(2.3); *Lamium* sp. 12(+); **IV:** *Alopecurus pratensis* 2(+); *Avenula pubescens* 8(+), 12(1.3); *Carex hirta* 13(1.2); *Leontodon autumnalis* 13(+); *Potentilla anserina* 10(+); *Prunella vulgaris* 8(+); *Trifolium repens* 1,8(+); **V:** *Trifolium campestre* 12(+); **VI:** *Allium oleraceum* 12,13(1.2); *Bromus inermis* 3(+); **VII:** *Campanula rapunculoides* 11(+); **VIII:** *Hieracium pilosella* 10(+); **IX:** *Crataegus monogyna* b 10(1.2); *Prunus spinosa* b 12(1.3); **X:** *Erodium cicutarium* 13(+); *Malus domestica* 10(+); *Sinapis alba* 9(+).

The association is floristically rich and it counts 122 plant species (Table 2). The individual plant patches are characterised by a significant presence of species from different phytosociological classes. Their number ranges from 32 to 58, and equals 48 on average (Table 4). A significant share of *Stellarietea mediae* species (33) is observed in the phytocoenoses – which is the remains of segetal communities - *Molinio-Arrhenatheretea* (27), *Artemisietea vulgaris* (16), as well as *Festuco-Brometea* (17) – Table 2. Such a large floristic diversity caused problems in their phytosociological classification, specifying the type and the name of phytocoenon in the rank of the association. After careful analysis of the floristic composition of communities and taking into account S and D values of individual species, 13 plant patches were classified as *Convolvulo arvensis-Agropyretum repentis.* Both characteristic species of phytocoenon – *Elymus repens* and *Convolvulus arvensis* – are stable components of phytocoenosis (S = V) and have significant coverage coefficients – D = 1000 and D = 588 respectively (Table 4). As mentioned above, characteristic species of *Stellarietea mediae* have a significant share in the structure of the association. It is a remnant of the fact that the habitat had been previously used agriculturally. The species of seminatural communities and xerothermic grasslands, which are entering the area, have not yet managed to eliminate the taxa of segetal communities although they are mostly therophytes. Some of them: *Papaver rhoeas, Consolida regalis, Matricaria maritima* subsp. *inodora* and *Centaurea cyanus* reach the stability degree of IV and V, but their number (coverage) is insignificant (Table 4).

Ruderal species of *Artemisietea vulgaris* play significantly greater role in the community. Stable components of the phytocoenosis (S = V) are: *Rubus caesius, Picris hieracioides, Melilotus alba, M. officinalis, Hypericum perforatum, Medicago lupulina* and *Melandrium album*. Their coverage is varied. The highest values of D are obtained by *Rubus caesius* (1315) and *Picris hieracioides* (846). The rest of the mentioned species are characterised by lower

values – from 146 to 604 (Table 4). Three species of *Molinio-Arrhenatheretea* have a significant share in the composition of phytocoenosis: *Festuca rubra* (S = V, D = 1285), *Dactylis glomerata* (S = V, D = 562) and *Vicia cracca* (S = V, D = 238) – Table 4.

Habitat conditions – dry and warm slope, alkaline soil with significant content of $CaCO_3$ benefit the development of a number of thermocalciphilous grass species. Due to the lack of characteristic species for the associations of *Festuco-Brometea*, there were no basis to distinguish them. Stable components of the phytocoenoses (S = V) are: *Anthemis tinctoria, Melampyrum arvense* (Fig. 6) and *Artemisia campestris.* Very common (S = IV) are also *Centaurea scabiosa, C. stoebe* and *Poa compressa.* Their D values range from 185 (*Poa compressa*) to 946 (*Anthemis tinctoria*). Species of other phytosociological classes are less common. More common are also species of *Trifolio-Geranietea sanguinei*. The most frequently noted was *Agrimonia eupatoria* (S = IV, D = 296). Stable components of the community are also *Arenaria serpyllifolia* (S = V) and *Camelina microcarpa* (S = IV) which do not belong to any of the phytosociological classes. These species are found often and in large numbers also in *Lathyro-Melandrietum noctiflori* (Table 3). Microareas within the slope are also characterised by lighter soil substrate. There are loamy, slightly loamy and loose sands. Species of thermophilic sandy grasslands of *Koelerio glaucae-Corynephoretea canescentis* are also found in these areas. The most common are *Sedum acre* and *Senecio vernalis* (Table 4). Due to the considerable variety in the species composition and the structure of the community, it reveals the smallest similarity to the communities in the depression (42.3%) and on the summit (46.05%).

The association is often noted in Poland and is described by many authors. The plant community of *Convolvulo arvensis-Agropyretum repentis* has been distinguished by Kutyna et al. (2012 b) on the slope and the summit of long-term fallow located in the vicinity of Szczecin. Its floristic composition is dominated by characteristic species of *Elymus repens* (S = V, D = 4456) and *Convolvulus arvensis* (S = V, D = 589). The structure of the community is made of 70 species, on average there were 32 observed in each relevé. Two grass variants were distinguished in the community. Four plant patches, apart from the mentioned above, are dominated by meadow community species of *Arrhenatherum elatius* (S = III, D = 1372) of *Molinio-Arrhenatheretea.* A significant share of an expansive species of *Calamagrostis epigejos* (S = III, D = 555) of *Epilobietea angustifolii* was observed in five patches. Stable components of the phytocoenoses on the summit and the hill are also ruderal species of *Artemisietea vulgaris*: *Cirsium arvense* (S = V, D = 1233), *Picris hieracioides* (S = V, D = 600), *Epilobium montanum* (S = V, D = 278) and *Artemisia vulgaris* (S = IV, D = 256). There are slightly less species of *Stellarietea mediae*, some of them are quite common (S = IV, V), but their coverage is low. The most common are: *Matricaria maritima* subsp. *inodora* (S = V, D = 278), *Apera spica-venti* (S = V, D = 550), *Vicia villosa* (S = V, D = 189) and *Myosotis arvensis* (S = IV, D = 78). There are much more species of seminatural communities. The most commonly observed were: *Taraxacum officinale* (S = V, D = 406), *Holcus lanatus* (S = IV, D = 572) and *Rumex crispus* (S = IV, D = 122). The characteristic feature of the community after 15 years is the appearance in its structure of shrub communities inhabiting c layer and composing the b layer of the community. Among them, the most common are: *Rosa canina* (S = IV, D = 156) and *Crataegus monogyna* (S = III, D = 317). Apart from shrub species, the phytocoenoses are inhabited by seedlings and juvenile specimens of *Fraxinus excelsior* (S = III, D = 594), which

are most common and most numerous in b layer. The road adjacent to the study area is planted on the sides with European ash and the seeds of the species are moved anemochorically on cropped lands abandoned years ago.

The association of *Convolvulo arvensis-Agropyretum repentis* is almost exclusively of anthropogenic origin. According to Brzeg and Wojterska (1996) it is a synanthropic ruderal, most common syntaxon representing *Convolvulo-Agropyrion*. It is characterized by stable and very large share of couch grass (*Elymus repens*) and field bindweed (*Convolvulus arvensis*). It is commonly found in Wielkoposka, it is expansive but does not show geographical determinism in the scale of the region. *Elymus repens* is an expansive species and phytocoenoses composed of it are quite stable and tend to spread. The phytocoenoses of the association are found in varied habitats: on fallow lands, field borders, roadsides, slopes of excavations, embankments and other wastelands. The soils of these habitats are characterised by significant content of potassium and phosphorus and slightly smaller content of nitrogen (Wysocki and Sikorski 2002; Matuszkiewicz 2007).

Ratyńska (2001) distinguished the association of *Convolvulo arvensis-Agropyretum repentis* in the area of Poznań's Warta Gorge (Poznański Przełom Warty) in different habitats, mainly within loamy soils. It is found in places where natural vegetation had been destroyed, on sunny slopes, sometimes in fields. The association is of heterogeneous character. For 69 species, as many as 41 (ie. 60%) were recorded only once. The number of species is relatively small and it ranges from 5 to 14, with average of 10. Only the association edificators are present in all of the relevés (n = 14). Both species have the same degree of stability (S = V), however their coverage coefficients are significantly different. *Convolvulus arvensis* is dominating (D = 4061), the coefficient of *Elymus repens* was smaller by half (D = 2325). Species of *Stellarietea mediae* and *Molinio-Arrhenatheretea* are also present in the habitats. The association in the area of our country have been also documented and described by Rostański and Gutte (1971), Misiewicz (1976) and Czaplewska (1981).

Wróbel (2004) distinguished the association of *Convolvulo arvensis-Agropyretum repentis* on the roadsides of paved roads going through agricultural lands in the area of Szczecin Lowland with stable and massive presence of *Convolvulus arvensis* and *Elymus repens*. The community is also present in shallow roadside ditches, within roadsides and on their edges. *Elymus repens* often reaches S = V and D = 4600, and *Convolvulus arvensis* reaches S = V and D = 1850. The community is floristically poor – 38 species, with the average number of 13 per relevé. The phytocoenoses are also very often (S = IV) and numerously (D = 750) inhabited by *Cirsium arvense* and *Equisetum arvensis* (S = V, D = 1000). The association of *Convolvulo arvensis-Agropyretum repentis* was also distinguished by Ziarnek (2003) in the area of Szczecin in the vicinity of residential houses and blocks of flats, allotment gardens, and on storage yards with building materials. The communities are characterised by a small number of species (from 3 to 23). The average number of species per relevé is 12. The phytocoenoses are dominated by characteristic species of *Elymus repens* (S = V and D = 5173) and *Convolvulus arvensis* (S = IV and D = 877). The structure of the association is composed by the largest number of species of *Molinio-Arrhenatheretea* (23) and *Artemisietea vulgaris* (21). Most of the species in the community are rarely found and their coverage is small. The association have been also distinguished by Błońska et al. (2003) in the area of a gravel pit

after backfill sand excavation. Moreover, the association have been distinguished by Kutyna et al. (2013) within the excavation of "Krzynka". The phytocoenoses of the community develop mainly on more compact deposits (strong loamy sand). The pH of the soil is alkaline (pH per 1 M KCl ranges from 7.4 to 7.6). The structure of the association is composed of 38 species. In this relatively not very floristically varied community two characteristic species are dominant – *Elymus repens* (S = V, D = 1136) and *Convolvulus arvensis* (S = IV, D = 1659). Other species of *Agropyretea intermedio-repentis* are very common, mainly *Equisetum arvense* and *Tussilago farfara*. The phytocoenoses of the association are characterised by considerable density (75.5% on average), hence the small number of species. Their number per relevé ranges from 11 to 2 (16 on average).

The patches of *Convolvulo arvensis-Agropyretum repentis* have also been distinguished by Balcerkiewicz and Pawlak (1990) on post-mining dumping grounds Pątnów-Jóźwin. They occupy fairly large areas, mainly on slopes of large mounds. The community is characterised by very high density in the undergrowth (over 80%). It is dominated by occurring in facies *Elymus repens*, while *Convolvulus arvensis* was observed very rarely. The phytocoenoses are floristically poor. The number of species per relevé varies from 10 to 15.

The community of *Convolvulo arvensis-Agropyretum repentis* is the most common in the alliance of *Convolvulo-Agropyrion* and it has no characteristic species. It is characterised by stable and very abundant share of *Convolvulus arvensis*, which supports itself on dense stems of *Elymus repens*. The community is greatly widespread in Poland. Couch grass (*Elymus repens*) is bothersome, difficult to eliminate due to long underground stolons, thanks to which it dominates in phytocoenoses. It tends to expand, inhabiting and turfing greater areas (Wysocki and Sikorski 2002; Matuszkiewicz 2007). The association is present in cities, railway areas, it grows on broken stone and gravel substrate. It inhabits very dry and heated habitats, usually rich in potassium and phosphorus, but without humus and poor in nitrogen.

***Poo-Tussilaginetum farfarae* R.Tx. 1931 (Table 5)**

The association of *Poo-Tussilaginetum farfarae* is a pioneer community of areas with loamy or clayey soils, where the ground is compact and prone to surface and short-term rainwater stagnation. It is also found on soils which are heavily waterlogged from the bottom up, often with high level of ground water, as in the study area. It is mostly an anthropogenic community occurring on richer loamy soils on exposed slopes and embankments. In Poland it is very common and widespread, but poorly documented phytosociologically. A very common species is coltsfoot (*Tussilago farfara*) and flattened meadow-grass (*Poa campressa*). Some authors put them in the suballiance of *Dauco-Melilotenion Artemisietea vulgaris* (Matuszkiewicz 2007).

Matuszkiewicz (2007) placed *Poo-Tussilaginetum farfarae* in *Agropyretea intermedio-repentis*, which is formed of seminatural communities composed mainly of rhizome and stoloniferous plants occupying varied dry, sunny and warm habitats, with shallow water grounds and stagnant surface water, mainly of neutral and alkaline soil pH.

The phytocoenoses of the study area inhabit lower areas adjacent slopes, characterised by loamy soils with a significant content of humus. Erosion processes on the slopes caused movement of organic-mineral substrate and its accumulation in the depression. As a result of this process there were formed deluvial soils, typical chernozems, humid to a large extent and gleyed from the bottom (CYt), formed alternately from light loam and sandy loam (Table 1).

Table. 5. *Poo-Tussilaginetum farfarae* community occurring at triticale crops at footslopes ares located in neighborhood

Tabela. 5. Zbiorowisko *Poo-Tussilaginetum farfarae* występujące w pszenżycie w obniżeniach

Successive No. / Numer kolejny		1	2	3	4	5	6	7		
Field No. of relevé / Numer zdjęcia w terenie		19	20	21	22	23	24	25		
Patch area / Powierzchnia zdjęcia [m^2]		80	100	85	75	85	90	100		$\bar{x}$
Cover of cultivated plants / Pokrycie przez rośliny uprawne [%]		40	35	25	30	25	20	20		28
Cover of weeds / Pokrycie przez chwasty [%]		80	90	100	100	95	100	100		95
Mechanical composition of A horison of soil / Gleba skład granulometryczny, poziom A (0–20 cm)		gl – light loam – glina lekka								
Number of species in relevé / Liczba gatunków w zdjęciu fitosocjologicznym		45	44	55	44	36	33	33		41
Mean values / Średnie wartości	thermic / termiczne (T)	1.8	2.0	1.8	1.9	1.6	1.7	1.7		1.8
	moisture / wilgotnościowe (W)	2.4	2.6	2.5	2.3	2.3	2.2	2.2		2.4
	reaction / odczynu (R)	3.7	4.1	3.7	3.7	3.6	3.8	3.8		3.8
	nitrogen content / zasobności w azot (N)	3.3	3.2	3.5	3.3	3.6	3.8	3.4		3.4
	biological activity / aktywności biologicznej (G)	2.9	2.9	3.0	2.9	2.7	2.8	2.6		2.8
									S	D
ChAssD.: *Poo-Tussilaginetum farfarae*										
Tussilago farfara		**3.3**	**3.3**	**3.4**	**2.3**	**3.4**	**2.3**	**1.3**	**V**	**2714**
Agrostis stolonifera ssp. *stolonifera*	D	**1.3**	**1.1**	**2.3**	**2.3**	**2.3**	**2.3**	**2.3**	**V**	**1393**
Ranunculus repens	D	**1.3**	**1.3**	**1.3**	**2.2**	**+**	**1.3**	**1.2**	**V**	**621**
I ChCl.: *Agropyretea intermedio-repentis*										
Elymus repens		**1.1**	**1.3**	**+**	1.3	**1.3**	**1.1**	**+**	**V**	**386**
Equisetum arvense		**1.3**	**1.3**	**+**	1.3	**.**	**1.3**	**+**	**V**	**314**
II ChCl.: *Stellarietea mediae*										
Apera spica-venti		**4.4**	**3.4**	**4.4**	**3.3**	**3.4**	**3.4**	**2.3**	**V**	**4179**
Matricaria maritima subsp. *inodora*		**1.3**	**1.3**	1.3	**1.3**	**+**	**1.3**	**+**	**V**	**386**
Myosotis arvensis		**1.1**	**1.1**	**1.1**	**1.1**	**+**	**1.1**	**+**	**V**	**386**
Anagallis arvensis		**+**	**+**	**+**	**+**	**+**	**+**	**+**	**V**	**100**
Centaurea cyanus		**+**	**+**	**+**	**+**	**+**	**.**	**+**	**V**	**86**
Sinapis arvensis		**+**	**+**	**+**	**+**	**+**	**+**	**.**	**V**	**86**
Sonchus arvensis		**1.3**	**1.3**	**2.3**	**.**	**+**	**.**	**+**	**IV**	**421**
Papaver rhoeas		**+**	1.3	**+**	**+**	**.**	**.**	**+**	**IV**	**129**
Chenopodium album		**+**	**+**	**+**	**+**	**.**	**+**	**.**	**IV**	**71**
Consolida regalis		**+**	**+**	**+**	**+**	**.**	**.**	**+**	**IV**	**71**
Euphorbia helioscopia		**+**	**+**	**+**	**.**	**+**	**+**	**.**	**IV**	**71**
Vicia villosa		**+**	**.**	**+**	**+**	**+**	**+**	**.**	**IV**	**71**
Avena fatua		**.**	**.**	1.1	**.**	**.**	**1.1**	**1.1**	**III**	**214**
Polygonum lapathifolium subsp. *pallidum*		**+**	**.**	**1.3**	**.**	**+**	**1.3**	**.**	**III**	**171**
Fallopia convolvulus		**+**	**+**	**+**	**1.1**	**.**	**.**	**.**	**III**	**114**
Polygonum aviculare		**.**	**.**	**+**	**+**	**+**	**+**	**.**	**III**	**57**
Vicia sativa		**+**	**+**	**+**	**.**	**+**	**.**	**.**	**III**	**57**
Viola arvensis		**.**	**+**	**.**	**+**	.	**.**	**+**	**III**	**43**
Lithospermum arvense		**.**	**+**	**+**	**+**	.	**.**	**.**	**III**	**43**
Galeopsis tetrahit		**.**	**.**	**+**	**.**	+	**.**	**+**	**III**	**43**
Sonchus asper		**.**	**.**	**+**	**+**	**+**	.	**.**	**III**	**43**
Anagallis cfr. *foemina*		**+**	**+**	.	**.**	**.**	**.**	**.**	**II**	**29**
Vicia hirsuta		**.**	**.**	**+**	**+**	**.**	.	**.**	**II**	**29**
Stellaria media		**.**	**.**	**+**	**+**	**.**	.	**.**	**II**	**29**
Capsella bursa-pastoris		**.**	**.**	**.**	**+**	**.**	**+**	.	**II**	**29**

Table. 5. *Poo-Tussilaginetum farfarae* community occurring at triticale crops at footslopes ares located in neighborhood (cont.)
Tabela. 5. Zbiorowisko *Poo-Tussilaginetum farfarae* występujące w pszenżycie w obniżeniach (cd.)

III ChCl.: *Molinio-Arrhenatheretea*									
Potentilla anserina	**2.3**	1.3	**1.3**	**1.2**	**1.3**	**1.2**	**+**	**V**	**621**
Poa pratensis	**1.3**	1.1	**1.3**	**1.3**	**1.3**	**.**	**+**	**V**	**371**
Festuca pratensis	**1.3**	+	**.**	**1.2**	**1.3**	**1.3**	+	**V**	**314**
Phleum pratense	**+**	1.2	**+**	1.2	**+**	**.**	**+**	**V**	**200**
Festuca rubra	**1.3**	**.**	1.3	**1.2**	1.3	**+**	**.**	**IV**	**300**
Poa trivialis	**+**	**+**	**+**	**.**	**+**	**.**	**+**	**IV**	**71**
Alopecurus pratensis	**.**	**1.3**	**1.3**	1.2	**.**	**1.1**	**.**	**III**	**286**
Cerastium holosteoides	**1.1**	.	**1.2**	**1.2**	**+**	**.**	**.**	**III**	**229**
Daucus carota	**+**	**1.3**	**+**	**1.3**	**.**	**.**	**.**	**III**	**171**
Ranunculus acris subsp. *acris*	**+**	**+**	**+**	**.**	**+**	**.**	**.**	**III**	**57**
Rumex crispus	**.**	**.**	**.**	**+**	**+**	**+**	**+**	**III**	**57**
Prunella vulgaris	**+**	**.**	**+**	**+**	**.**	**.**	**.**	**III**	**43**
Achillea millefolium	**+**	**+**	**+**	**.**	**.**	**.**	**.**	**III**	**43**
Trifolium repens	**.**	**.**	**+**	**.**	**+**	**+**	**.**	**III**	**43**
Plantago lanceolata	**1.1**	**+**	**.**	**.**	**.**	**.**	**.**	**II**	**86**
Rumex acetosa	**.**	**.**	**.**	**.**	**.**	**1.3**	**+**	**II**	**86**
Heracleum sphondylium subsp. *sphondylium*	**.**	**.**	**.**	**+**	**.**	**1.3**	**.**	**II**	**86**
Dactylis glomerata	**.**	+	**.**	**.**	.	**.**	**+**	**II**	**29**
Taraxacum officinale agg.	**.**	**.**	.	**.**	**.**	**+**	**+**	**II**	**29**
IV ChCl.: *Artemisietea vulgaris*									
Cirsium arvense	**1.3**	2.3	**1.3**	**1.3**	**.**	**1.3**	+	**V**	**550**
Medicago lupulina	**+**	+	**.**	**.**	**+**	**+**	+	**IV**	**71**
Artemisia vulgaris	**.**	+	**+**	**1.3**	**.**	**.**	**.**	**III**	**100**
Melilotus alba	**+**	**+**	**+**	**+**	**.**	**.**	**.**	**III**	**57**
Picris hieracioides	**+**	**+**	**.**	**.**	**.**	**.**	**.**	**II**	**29**
Galium aparine	**.**	**.**	**+**	**.**	**.**	**.**	**+**	**II**	**29**
V ChCl.: *Festuco-Brometea*									
Anthemis tinctoria	**+**	**+**	**+**	**.**	**.**	**.**	**.**	**III**	**43**
Allium oleraceum	**+**	**+**	**+**	**.**	**.**	**.**	**.**	**III**	**43**
VI ChCl.: *Nardo-Callunetea*									
Agrostis capillaris	**2.3**	1.3	**+**	**1.1**	**1.3**	**1.3**	+	**V**	**564**
VII ChCl.: *Isoëto-Nanojuncetea*									
Juncus bufonius	**1.1**	**.**	**1.1**	**1.1**	**4.5**	**3.4**	**2.2**	**V**	**1750**
Plantago intermedia	**+**	**.**	**1.1**	**+**	**1.1**	+	**1.1**	**V**	**257**
VIII Accompanying species – Gatunki towarzyszące									
Mentha arvensis	**3.3**	**3.3**	**3.3**	**2.3**	**3.4**	**2.3**	1.3	**V**	**2714**
Camelina microcarpa	**+**	**+**	**+**	**+**	**.**	**.**	**+**	**IV**	**71**
Arenaria serpyllifolia	**+**	**+**	**+**	**+**	**.**	**+**	**.**	**IV**	**71**
Polygonum persicaria	**.**	.	**+**	**.**	+	**.**	**.**	**II**	**29**

Plant species occurring only in I degree (S) of relevé constance in plant communities. After a name of species the number of the relevé in which species occurred is given and in brackets the quantity degrees and sociability.
Gatunki roślin występujące w zbiorowisku wyłącznie w I stopniu stałości (S). Po nazwie gatunku podano numery zdjęć fitosocjologicznych, w których wystąpił gatunek, w nawiasach – stopnie ilościowości i towarzyskości.
Explanations – Objaśnienia: S – phytosociological stability – stałość fitosocjologiczna, D – cover coefficient – współczynnik pokrycia, $\bar{x}$ – medium value – wartości średnie.
II: *Euphorbia exigua* 2(+); *Sonchus oleraceus* 3(+); **III:** *Carex hirta* 3(+); *Lolium perenne* 4(+); **IV:** *Epilobium hirsutum* 5(+); **V:** *Hieracium echioides* 3(+); **VIII:** *Vicia dasycarpa* 5(+).

Triticale cultivation in these areas is characterised by considerable agricultural negligence. Its density is very low (28% on average). In this situation numerous unused areas are inhabited by weeds, which on average reach the coverage at the level of 95% (Table 5). The community is the least floristically diverse. A total of 71 species were recorded in 7 plant patches (Table 2). Their number in each relevé ranges from 33 to 55, and equals 41 on average (Table 5). The floristic composition of the plant patches indicates that it is a cold habitat (T = 1.8). Small T values of the community in comparison to average T values for the slope and the summit are due to greater humidity of soil located in the depression, so that there is smaller solar insolation in these areas. An average value W = 2.4 indicates periodically highly wet soils (W values range from 2.2 to 2.6) – Wójcik (1983); Kutyna (1998). Soil pH is alkaline (R = 3.8) and some patches hve neutral pH. Soils are rich in nitrogen (N = 3.4) and are biologically active (G = 2.8) – Kutyna (1998). The community found in the depression shows little similarity to phytocoenoses of the slope (42.3%) and slightly higher to the phytocoenoses of the summit (51.1%).

Species of *Stellarietea mediae* (27) and *Molinio-Arrhenatheretea* (23) are predominant in the community – Table 2. The dominant characteristic species of the association is *Tussilago farfara* (S = V, D = 2714) – Table 5. It is accompanied by two species distinguishing the association – *Agrostis stolonifera* subsp. *stolonifera* and *Ranunculus repens*, which are stable components of the phytocoenoses (S = V) reaching significant D values (1393 and 621 respectively). Plant patches are also very often inhabited by *Elymus repens* (S = V, D = 386) and *Equisetum arvense* (S = V, D = 314). Species of *Stellarietea mediae* have also a significant share in the structure of the plant community. Six of them: *Apera spica-venti, Matricaria maritima* subsp. *inodora, Myosotis arvensis, Anagallis arvensis, Centaurea cyanus* and *Sinapis arvensis* are stable components of 7 plant patches, however *Apera spica-venti* is dominant and reaches a high coverage coefficient = 4179. The remaining 5 species have D values at the level from 86 to 386 (Table 5).

Characteristic species of *Molinio-Arrhenatheretea* also have a significant share in the structure of the association. Grass species such as *Poa pratensis, P. trivialis, Festuca pratensis, F. rubra* and *Phleum pratense* prevail among them. The frequency of their inhabitance in plant patches is considerable (S = IV–V). The coverage coefficients are not high. *Potentilla anserina* is also a stable component of the phytocoenoses (S = V, D = 621). There are much less species of *Artemisietea vulgaris.* The exception is *Cirsium arvense* (S = V, D = 550). The representative of *Nardo-Callunetea* is *Agrostis capillaris* (S = V, D = 564). Species of *Festuco-Brometea* have small share in the phytocoenoses of the association. However, there are found shallow-rooted hygrophilous therophytes such as *Juncus bufonius* and *Plantago intermedia.* Both reaching S = V, and *Juncus bufonius* reaching significant D = 2714 (Table 5). Great soil moisture favours intensive development of a hydrophyte such as *Mentha arvensis* (S = V, D = 2714).

The community of *Poo-Tussilaginetum farfarae* and environmental conditions in which it occurs in Poland has been described by several geobotanists. Kutyna et al. (2013) distinguished it in post-exploitation mine in “Krzynka”. It is found on loams and strong loamy sand of alkaline pH (pH per 1M KCl = 7.2) containing large amounts of $CaCO_3$ (7.9–9.0%). Plant coverage ranges from 50% to 100% in some places. Characteristic species of *Tussilago farfara* and *Poa compressa* occur commonly and numerously, reaching S = V, D = 1272 and S = V, D = 753 respectively. *Calamagrostis epigejos* (S = V, D = 436) and *Artemisia vulgaris* (S = V, D = 414)

are also stable components of the phytocoenoses. Species of *Matricaria maritima* subsp. *inodora* and *Vicia hirsuta* z *Stellarietea mediae*, as well as *Medicago lupulina* and *Hypericum perforatum* of *Artemisietea vulgaris* as well as *Taraxacum officinale* and *Achillea millefolium* of *Molinio-Arrhenatheretea* are also commonly found (S = IV). All of them have small cover coefficients. Presence of Scots pine (*Pinus sylvestris*) was also noted in the community, where it appeared by seed dispersal, and in the future will probably permanently inhabit the area creating dense young pine forest.

Młynkowiak and Kutyna (2005a) distinguished the association in the area of mine excavation in Mieleń Drawski. The phytocoenoses inhabited substrate such as silty loam, clayey and sandy gravel containing calcium carbonate. The community found in the area of the western part of Pojezierze Drawskie (excavation in Mieleń Drawski) have an optimal form. Both *Poa compressa* and *Tussilago farfara* occur in the V degree of stability, whereas coltsfoot have larger coverage (D = 2300) in comparison to flattened meadow-grass (D = 745). Among species distinguishing this association often recorded were: *Agrostis stolonifera* subsp. *stolonifera* (S = IV) as well as *Ranunculus repens* and *Convolvulus arvensis* (S = III). The most numerous was *Molinio-Arrhenatheretea* (21 species). In total, 82 species were recorded in the association, of which the vast majority (51) occur sporadically (S = I), which indicates that the structure of the community is not completely formed and stable. Plant patches of the association are relatively rich in species, on average there were 21 species in each relevé, whereas floristically richer are the communities located at the foot of more fertile slopes than on the slopes. Coverage of plants is also larger on flat areas. Smiliar pattern was also noted by Stanisławek (1995). Plant patches of the association were dominated by characteristic species accompanied by species of *Artemisietea vulgaris* and *Molinio-Arrhenatheretea* as well as *Agropyretalia*. He also emphasises that the association of *Poo-Tussilaginetum farfarae* stablises the area of dumping grounds. According to Balcerkiewicz and Pawlak (1990), *Poa compressa* and accompanying species of *Agropyretalia* and *Dauco-Melilotion* are dominant in the patches of the association. Due to well-developed root system, *Poa compressa* is used to sward difficult areas such as slopes or gravel pits, where it prevents erosion (Kozłowski et al. 1998). *Tussilago farfara* plays a similar role in the community as it is characterised by well-developed rhizomes reaching approximately 60 cm deep (Tymrakiewicz 1962).

The association of *Poo-Tussilaginetum farfarae* was also distinguished by Kutyna and Dziubak (2005) in the area of flotation tailings dumping ground “Gilów”. Plant patches inhabited very compact surfaces (clays, silty loams and silty deposits. Their pH was alkaline. The authors distinguished typical variant for the community as well as of *Calamagrostis epigejos*. The form of the association was represented by only one characteristic species – *Tussilago farfara* (S = V, D = 1258). *Calamagrostis epigejos* is absent in the typical variant, while it dominates in the second variant (S = V, D = 1761). In total 66 species were recorded in the community and their average number (14) per relevé was not large.

Ratyńska (2001) distinguished the association of *Poo-Tussilaginetum farfarae* on roadsides, landfill sites, floodbanks and landslides, always on clay grounds with varied degree of sandiness. The areas inhabited by the community are to a smaller or bigger degree eroded, soil pH is always alkaline. The alkaline character of the soils of these habitats is emphasised by many authors i.a. Fijałkowski (1963), Sowa (1971) and Kępczyńska-Rijken (1977). Ratyńska (2001)

distinguished the phytocoenoses of *Poo-Tussilaginetum farfarae* association on the basis of only one characteristic species – *Tussilago farfara*. Kutyna and Dziubak (2005) did the similar by distinguishing the community on flotation tailings dumping ground "Gilów". The second characteristic species – *Poa compressa* is absent in the association. Its presence would "strenghten" the rank of the association. The community distinguished by Ratyńska (2001) is floristically rich. 13 to 26 species, and 17 species on average, were recorded per relevé. High levels of stability were reached by species of *Agropyretea intermedio-repentis* and *Artemisietea vulgaris*. Plant patches of the association in the area of Poznań's Warta Gorge (Poznański Przełom Warty) were of pioneer character and they occupy both natural sites and those under secondary erosion leading to sliding of soil.

Wróbel (2004) distinguished phytocoenoses of *Tussilago farfara* in the rank of the community, probably due to the absence of the second characteristic species – *Poa campressa*. They develop in places where clay roadsides were damaged by cars or by roadworks to strengthen ditch banks with external substrate – mainly sand mixed with gravel and crushed road stone. The phytocoenoses are poor, dominated by *Tussilago farfara* (D = 4583). The plant patches are also inhabited by *Calamagrostis epigejos.* In total, 37 species of herbaceous plants were recorded, 16 per relevé on average.

The impact of land relief and the usage of habitats on the structure of plant communities and environmental conditions (Table 6)

The elements of land relief (summit, slope, depression) and the usage of habitats have a significant impact on the floristic composition of plant communities and their structure as well as phytosociological classification.

Agrophytocoenoses of *Lathyro-Melandrietum noctiflori* develop on the flat summit in cereal cultivation. They are syntaxonomically diversified into typical variant with the significant share of two species – *Anthemis tinctoria* and *Melampyrum arvense* of *Festuco-Brometea* as well as of *Camelina microcarpa.*

The association of *Convolvulo arvensis-Agropyretum repentis* is found on the slope. Its structure is composed by several species of segetal (*Stellarietea mediae*), seminatural (*Molinio-Arrhenatheretea*), and ruderal communities (*Artemisietea vulgaris*) as well as xerothermic grasslands (*Festuco-Brometea*). The essential character of the communities is made by the characteristic species of the association – *Elymus repens* and *Convolvulus arvensis* (Table 6).

The floristic richness of the community may result from the usage of the habitat. Cropped lands that have been fallow for a long time make potential conditions for species of varied environmental needs to penetrate the community. The process of secondary succession occurs within them. The process of transforming the community occurs in a long period of time, hence the lack of signs of floristic stability in these phytocoenoses.

The habitats in the depression are considerably different in terms of environmental conditions. The soils are compact (light loam), strongly moist, gley, periodically with stagnant water. Agricultural usage is difficult. Cultivation of cereals, including triticale, does not provide satisfactory crops, with its average density of 28% (Table 6). The phytocoenoses are floristically the poorest (71 species). *Poo-Tussilaginetum farfarae* community is of anthropogenic character with dominant characteristic species of *Tussilago farfara* and two distinguishing species – *Agrostis stolonifera* ssp. *stolonifera* and *Ranunculus repens*.

Table 6. Phytosociological stability (S) and cover coefficients (D) of species occurrig in communities in different habitats

Tabela 6. Zróżnicowanie stałości fitosocjologicznej (S) i współczynników pokrycia (D) gatunków w zbiorowiskach roślinnych występujących w różnych siedliskach

Plant communities Zbiorowiska roślinne		*Lathyro--Melandrietum noctiflori*		*Convolvulo arvensis--Agropyretum repentis*		*Poo--Tussilaginetum farfarae*	
Cultivated plants Rośliny uprawne		winter wheat pszenica ozima spring barley jęczmień jary spring wheat pszenica jara		fallow land for 10 years od 10 lat odłóg		triticale pszenżyto	
Location area Lokalizacja powierzchni		summit wierzchowina		slope zbocze		footslope podnóża zbocza	
Number of relevés Liczba zdjęć fitosocjologicznych		17		13		7	
The average of the average values Średnie ze średnich wartości	thermic termicznych (T)	2.3		2.5		1.8	
	moisture wilgotnościowych (W)	3.5		3.5		2.4	
	reaction odczynu (R)	4.2		4.2		3.8	
	nitrogen content zasobności w azot (N)	3.3		2.6		3.4	
	biological activity aktywności biologicznej (G)	3.3		2.7		2.8	
Number of species in plant communities Liczba gatunków w zbiorowiskach		82		122		71	
Medium cover of culivated plants Średnie pokrycie przez rośliny uprawne [%]		63.8		–		28.0	
Medium cover of herb layer Średnie pokrycie powierzchni zdjęcia przez rośliny [%]		48.2		87.0		95.0	
Mean number of species in relevé Średnia liczba gatunków w zdjęciu fitosocjologicznym		33		48		41	
		1		2		3	
		S	D	S	D	S	D
ChAss.: *Lathyro-Melandrietum noctiflori*							
Melandrium noctiflorum		V	474	II	23		
Euphobia exigua		V	371			I	14
Lathyrus tuberosus		III	171				
ChAss.: *Convolvulo arvensis--Agropyretum repentis*							
Elymus repens		V	932	V	1000	V	386
Convolvulus arvensis		IV	165	V	588		
ChAss.: *Poo-Tussilaginetum farfarae*							
Tussilago farfara						V	2714
Agrostis stolonifera subsp. *stolonifera*	D					V	1393
Ranunculus repens	D					V	621
I ChO.: *Centauretalia cyani*							
Centaurea cyanus		V	1697	IV	69	V	86
Consolida regalis		V	921	IV	350	IV	71
Papaver rhoeas		V	221	V	242	IV	129
Vicia sativa		III	47	III	54	III	57
Avena fatua		IV	841			III	214
Lithospermum arvense		IV	302			III	43
Vicia villosa		II	47			IV	71
II ChO.: *Polygono-Chenopodietalia*							
Chenopodium album		IV	194	III	108	IV	71
Polygonum aviculare		III	47	II	23	III	57

Table 6. Phytosociological stability (S) and cover coefficients (D) of species occurrig in communities in different habitats (cont.)
Tabela 6. Zróżnicowanie stałości fitosocjologicznej (S) i współczynników pokrycia (D) gatunków w zbiorowiskach roślinnych występujących w różnych siedliskach (cd.)

	1		2		3	
	S	D	S	D	S	D
Capsella bursa-pastoris D	II	29	III	46	II	29
Sonchus arvensis D	I	29	I	8	IV	421
Geranium pusillum	I	12	II	23		
Atriplex patula	II	53				
III ChCl.: *Stellarietea mediae*						
Matricaria maritima subsp. *inodora*	V	359	IV	100	V	386
Apera spica-venti	V	521	II	123	V	4179
Euphorbia helioscopia	V	171	III	46	IV	71
Viola arvensis	V	312	III	46	III	43
Anagallis arvensis	IV	159	III	115	V	100
Myosotis arvensis	IV	118	II	31	V	386
Sinapis arvensis	IV	71	II	38	V	86
Fallopia convolvulus	V	265	I	8	III	114
Stellaria media	IV	215	I	15	II	29
Vicia hirsuta	II	29	I	15	II	29
Anagallis cfr. *foemina*	II	24	II	23	II	29
Sonchus asper	I	12	I	15	III	43
Papaver argemone	II	24	III	46		
Lamium amplexicaule	III	94	I	8		
Vicia angustifolia	I	12	II	23		
Veronica polita	IV	77				
Veronica persica	III	141				
Chaenorhinum minus	II	71				
Anchusa arvensis	II	29				
Papaver dubium	II	24				
Thlaspi arvense	II	24				
Conyza canadensis			IV	277		
Chamomilla recutita			II	115		
Lactuca serriola			II	85		
Polygonum lapathifolium subsp. *pallidum*					III	171
Galeopsis tetrahit					III	43
IV ChCl.*: Molinio-Arrhenatheretea*						
Daucus carota	III	53	IV	292	III	171
Festuca rubra	I	6	V	1285	IV	300
Taraxacum officinale agg.	I	6	IV	108	II	86
Phleum pratense	I	6	III	200	V	200
Cerastium holosteoides	II	24	II	31	III	229
Trifolium repens	II	24	I	15	III	43
Achillea millefolium	I	6	II	38	III	43
Lolium perenne	I	12	II	23	I	14
Poa pratensis	I	6	II	31	V	371
Alopecurus pratensis	I	6	I	8	III	286
Knautia arvensis	I	36	II	62		
Festuca pratensis			III	200	V	314
Dactylis glomerata			V	562	II	29
Plantago lanceolata			III	85	II	86
Rumex crispus			III	54	III	57
Potentilla anserina			I	8	V	621
Prunella vulgaris			I	8	III	43
Rumex acetosa			II	31	II	86
Vicia cracca			V	238		
Bromus hordeaceus			IV	123		
Tragopogon pratensis			III	77		
Arrhenatherum elatius			II	462		
Galium mollugo			II	192		

Table 6. Phytosociological stability (S) and cover coefficients (D) of species occurrig in communities in different habitats (cont.)
Tabela 6. Zróżnicowanie stałości fitosocjologicznej (S) i współczynników pokrycia (D) gatunków w zbiorowiskach roślinnych występujących w różnych siedliskach (cd.)

	1		2		3	
	S	D	S	D	S	D
Poa annua			II	54		
Poa trivialis					IV	71
Ranunculus acris subsp. *acris*					III	57
Heracleum sphondylium subsp. *sphondylium*					II	86
V ChCl.: *Koelerio glaucae--Corynephoretea canescentis*						
Sedum acre			III	204		
Senecio vernalis			III	54		
Festuca cfr. *ovina*			II	258		
Helichrysum arenarium			II	62		
Potentilla argentea			II	23		
VI ChCl.: *Artemisietea vulgaris*						
Cirsium arvense	V	224	II	54	V	550
Medicago lupulina	III	147	V	238	IV	71
Artemisia vulgaris	IV	112	IV	262	III	100
Picris hieracioides	I	18	V	846	II	29
Galium aparine	IV	88			II	29
Rubus cfr. *caesius*	II	94	V	1315		
Melilotus officinalis	III	94	V	604		
Hypericum perforatum	I	6	V	531		
Medicago sativa	I	18	II	38		
Melilotus alba			V	342	III	57
Melandrium album			V	146		
Echium vulgare			IV	185		
Erigeron ramosus			II	69		
Anchusa officinalis			II	54		
Cynoglossum officinale			II	23		
VII ChCl.: *Agropyretea intermedio--repentis*						
Falcaria vulgaris	III	82	V	365		
Cerastium arvense	II	24	II	31		
Equisetum arvense	II	29			V	314
VIII ChCl.*: Festuco-Brometea*						
Anthemis tinctoria	III	165	V	946	III	43
Melampyrum arvense	III	141	V	485		
Centaurea scabiosa	II	53	IV	231		
Centaurea stoebe	I	6	IV	427		
Artemisia campestris			V	404		
Poa compressa			IV	185		
Acinos arvensis			III	873		
Phleum phleoides			III	362		
Hieracium echioides			III	235		
Dianthus carthusianorum			III	227		
Sanguisorba minor			III	146		
Plantago media			III	115		
Petrorhagia prolifera			II	131		
Asparagus officinalis			II	92		
Allium oleraceum			I	77	III	43
IX ChCl.: *Trifolio-Geranietea sanguinei*						
Agrimonia eupatoria			IV	296		
Medicago falcata			III	265		
Fragaria viridis			II	431		
Verbascum lychnitis			II	54		
X ChCl.: *Nardo-Callunetea*						
Agrostis capillaris	I	12	II	92	V	564

Table 6. Phytosociological stability (S) and cover coefficients (D) of species occurrig in communities in different habitats (cont.)
Tabela 6. Zróżnicowanie stałości fitosocjologicznej (S) i współczynników pokrycia (D) gatunków w zbiorowiskach roślinnych występujących w różnych siedliskach (cd.)

	1		2		3	
	S	D	S	D	S	D
XI ChCl.: *Rhamno-Prunetea*						
Rosa cfr. *canina* b			II	85		
XII ChCl.: *Isoëto-Nanojuncetea*						
Juncus bufonius					V	1750
Plantago intermedia					IV	257
XIII Accompanying species – Gatunki towarzyszące						
Arenaria serpyllifolia	IV	135	V	358	IV	71
Camelina microcarpa	IV	718	IV	138	IV	71
Veronica arvensis	II	35	II	31		
Brassica napus v. *oleifera*	II	35				
Senecio jacobaea			III	77		
Ranunculus bulbosus			II	38		
Cerasus vulgaris (juv.)			II	31		
Holosteum umbellatum			II	23		
Mentha arvensis					V	2714
Polygonum persicaria					II	29

Under the table there is a list of plant species, which in all communities reaived only I degree of relevé constance (S). After a name of species the numer of the relevé in which species occurred is given in brackets. Cover coefficients (D) of these species are small, that is why they hore been omitted in the table.
Pod tabelą zamieszczono gatunki roślin, które we wszystkich zbiorowiskach roślinnych uzyskały wyłącznie I stopień stałości (S). Po nazwie gatunku zaznaczono w nawiasach numer zbiorowiska, w którym takson wystąpił. Współczynniki pokrycia (D) tych gatunków są niewielkie, dlatego zostały w tabeli pominięte.
I: *Valerianella dentata* (1); **II:** *Sonchus oleraceus* (3); **III:** *Bromus sterilis* (1,2); *B. tectorum* (1,2); *Descurainia sophia* (1); *Fumaria officinalis* (1); *Lamium purpureum* (1); *Setaria viridis* (2); *Silene vulgaris* (2); *Vicia tetrasperma* (2); **IV:** *Avenula pubescens* (1,2); *Plantago major* (1); *Trifolium pratense* (1); *Carex hirta* (2,3); *Leontodon autumnalis* (2); **V:** *Trifolium campestre* (2); **VI:** *Berteroa incana* (2); *Lamium* sp. (2); *Epilobium hirsutum* (3); **VIII:** *Bromus inermis* (2); **IX:** *Campanula rapunculoides* (2); **X:** *Hieracium pilosella* (2); **XI:** *Crataegus monogyna* b (2); *Prunus spinosa* b (2); **XIII:** *Erodium cicutarium* (1,2); *Hordeum vulgare* (1); *Malus domestica* (2); *Sinapis alba* (2); *Vicia dasycarpa* (3).

Environmental conditions of the three habitats are significantly varied. With the use of phytoindicational Ellenberg's method, it was determined that the warmest were slopes (T = 2.5) and summit (T = 2.3), much cooler was the depression (T = 1.8). This is evidenced by the degree of soil moisture. The driest (W = 3.5) is the soil on the slope, and periodically overmoist (W = 2.4) ia found in the depression. The soil of the summit and slope habitats contain $CaCO_3$ and their pH is alkaline (R = 4.2), while in the depression R = 3.8 (soil pH is neutral). The content of N is also varied. On the summit and in the depression mean values of N are similiar (N = 3.3 – 3.4) and they indicate that the soils are rich in nitrogen. Erosion processes on the slope cause smaller content of humus, consequently there are less species requiring greater soil fertility, hence N = 2.6. Biological activity of soil is the largest in cereal cultivation on the summit, and slightly smaller in other parts of the terrain.

A total of 159 plant species were recorded in the three types of communities. Species of *Stellarietea mediae* have the biggest share in the distinguished phytocoenoses. The most numerous are *Lathyro-Melandrietum noctiflori* (43 species), which is understandable due to the character of use (cropped lands) and soil conditions (typical eutrophic brown soil formed of clay). A significant share of species of this class is also observed in the other two

communities. Another determinant group in creating the phytocoenoses are the species of seminatural communities of *Molinio-Arrhenatheretea*. Most of them are of *Convolvulo arvensis-Agropyretum repentis* (26 species) and *Poo-Tussilaginetum farfarae* (23). Much less are of *Lathyro-Melandrietum noctiflori* (14).

Ruderal species have a significant share in creating the communities. The biggest number (16) are of *Convolvulo arvensis-Agropyretum repentis*, and the smallest can be observed among *Poo-Tussilaginetum farfarae* (7). *Convolvulo arvensis-Agropyretum repentis* is additionally enlarged by a significant number of thermophilous and calciphilous xerothermic grasslands (17), which is justified by environmental conditions (alkaline pH and significant soil warmth as well as its dryness) characteristic for southern and south-eastern slopes.

Distinction of the phytocoenoses of the communities and varied phytosociological stability of species is evidenced in the mutual similarity coefficients, in the range of 42.3–51.1%. The detailed information on S and D values can be found in Table 6. If interested, please refer to it, as its analysis would be to a large extent a repetition of information already presented when characterising the three phytocoenoses (Tables 3, 4 and 5).

CONCLUSIONS

1. The following were found in the ecologically diverse study area and the allotted transect:
   a) on the summit, within cultivation, there is a segetal community of *Lathyro-Melandrietum noctiflori* internally diversified into the typical variant as well as *Anthemis tinctoria* and *Melampyrum arvense*;
   b) on the slopes (fallow lands), the anthropogenic association of *Convolvulo arvensis--Agropyretum repentis*, whose phytocoenoses are characterised by floristic variety resulting from the transformation of the community in the process of secondary succession;
   c) in the depression, within agriculturally neglected fields of triticale, *Poo-Tussilaginetum farfarae* phytocoenon.
2. The studied habitats are characterised by varied environmental conditions, which is confirmed by phytoindicators (average of TWRNG mean value):
   a) the summit (T = 2.3) and the slope (T = 2.5) are the warmest, the coldest is the depression (T = 1.8);
   b) the summit and the slope are inhabited by many thermophilous taxa, hence W = 3.5, the depression is periodically wet (W = 2.4) with a significant share of hygrophytes;
   c) the soil of the summit and the slope contains $CaCO_3$, which is confirmed both by soil science research and studies with the use of phytoindicators. Significant share of calciphilous species determine the value of R = 4.2. Soils in the depression are of neutral pH (R = 3.8);
   d) nitrogen content (N) in soils on the summit and in the depression is similar (N = 2.8 – 3.3), while it is smaller on the slope (N = 2.6), which is probably due to the humus loss resulting from surface water erosion;
   e) biological soil activity (G) is the largest on the summit and in the depression (G = 3.3 – 3.4), and the smallest on the slope (G = 2.7).

3. Floristic distinction of the communities and varied phytosociological stability of species determines their small mutual similarity, which ranges from 42 to 51%.
4. Floristically richest community is found on the slope (122 species), the poorest (71) was recorded in the depression.
5. Species of *Stellarietea mediae* are most common in the structure of all of the phytocoenons, most of them are of *Lathyro-Melandrietum noctiflori* (43), and fewest of *Tussilaginetum farfarae* (27). Species of *Molinio-Arrhenatheretea* and *Artemisietea vulgaris* have also a significant share.

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Abstract. 37 relevés were made in the area of West Oder western edge located between the village of Moczyły and the hamlet of Kamionka. Geobotanical study was conducted in three elements of the terrain. 17 relevés were made on flat tops of the edge with cereal cultivation, 11 on the southern and southeastern slope within long-term fallow, and 7 in the depression (with triticale cultivation). 4 outcrops were made along the transect from which samples were taken in order to determine basic soil parameters (grain size distribution, pH and $CaCO_3$ content). *Lathyro--Melandrietum noctiflori* segetal community was distinguished on the summit and it was internally diversified into the typical variant as well as *Anthemis tinctoria* and *Melampyrum arvense*. The slopes are inhabited by floristically rich *Convolvulo arvensis-Agropyretum repentis* phytocoenoses. It is characterised by species diversity resulting from the process of community transformation, which occurs on the slope of the habitat during secondary succession. *Poo-Tussilaginetum farfarae* phytocoenoses develop at the footslope (in the depression), which is characterised by different ecological conditions compared to the slope and the summit. With the use of phytoindicational properties of plant species and Ellenberg's method the following mean values were determined: thermal relations of the habitat (T), humidity (W), pH of the soil (R), content of nitrogen (N) and biological activity of the soil (G). The warmest are the habitats on the slope (T = 2.5) and on the summit (T = 2.3). In the depression, the habitats are very cold (T = 1.8). The driest soils are those of the summit and the slope (W = 3.5). In the depression the soils are periodically wet (W = 2.4). The pH of the soil on the summit and the slope is alkaline (R = 4.2) and in the depression it is neutral (R = 3.8). The content of N in the soil of the summit and the slope is similar (N = 2.8–3.3), and slightly lower on the slope (N = 2.7) which is due to the loss of humus caused by surface water erosion occurring on the slope of the hill. The results obtained with this method are very close to the soil parameters obtained with analytical soil science methods.

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