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PLANT COMMUNITIES ON THE FLAT RIDGE OF THE "PIOTRAWIN" QUARRY LOCATED IN THE VICINITY OF VISTULA NEAR JÓZEFÓW ON THE VISTULA IN OPOLE LUBELSKIE COUNTY

ZBIOROWISKA ROŚLINNE WYSTĘPUJĄCE NA PŁASKIM GRZBIECIE KAMIENIOŁOMU „PIOTRAWIN" POŁOŻONEGO W SĄSIEDZTWIE WISŁY KOŁO JÓZEFOWA NAD WISŁĄ, POWIAT OPOLE LUBELSKIE

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Streszczenie. Na zrekultywowanej technicznie i biologicznie powierzchni grzbietowej (koronie) kamieniołomu "Potrawin", po upływie trzech lat, wykonano w 1998 roku 29 zdjęć fitosocjologicznych. Wyróżniono dwa zespoły segetalne (*Sileno inflatae-Linarietum minoris* i *Lathyro-Melandrietum noctiflori*) oraz jeden zespół muraw kserotermicznych (*Inuletum ensifoliae).* Zbiorowiska te są bardzo bogate florystycznie. Liczba taksonów w poszczególnych zespołach jest zróżnicowana i waha się od 120 (*Lathyro-Melandrietum noctiflori*) do 147 (*Sileno inflatae-Linarietum minoris*). Średnia liczba taksonów w zdjęciu poszczególnych zbiorowisk jest bardzo duża i waha się od 60 do 62. Dominującym syntaksonem w tych zbiorowiskach jest *Stellarietea mediae,* a liczba taksonów waha się od 26 do 39. Zbiorowiska te charakteryzują się ponadto licznym udziałem gatunków zbiorowisk ruderalnych (*Artemisietea vulgaris*), muraw kserotermicznych (*Festuco--Brometea*) i seminaturalnych (*Molinio-Arrhenatheretea*). Wymienione zbiorowiska wykazują zbliżone wzajemne podobieństwa florystyczne określone na podstawie stopni stałości fitosocjologicznej. Wysokie podobieństwo, na poziomie 76,8%, wykazują między sobą zbiorowiska segetalne. Mniejsze (72,1%) podobieństwo zaznacza się między *Sileno inflatae-Linarietum minoris* i *Inuletum ensifoliae*. Po upływie trzech lat dominują jeszcze na badanej powierzchni grzbietowej kamieniołomu zbiorowiska segetalne, ale w trakcie przeprowadzonego w 2013 roku rekonansu stwierdzono znaczącą transformację florystyczną zbiorowiska zmierzającą do opanowania przestrzeni przez gatunki zbiorowisk muraw kserotermicznych i zaroślowych z klasy *Rhamno-Prunetea*.

Key words: cover coefficient, ecological succession, opencast and discarded working, plant communities, phytosociological stability, quany of marl „Piotrawin", technical reclamation, xerothermic grasslands.
Słowa kluczowe: kamieniołom margli „Piotrawin", murawy kserotermiczne, rekultywacja techniczna, stałość fitosocjologiczna, sukcesja ekologiczna, współczynnik pokrycia, wyrobisko odkrywkowe porzucone, zbiorowisko roślinne.

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INTRODUCTION

Xerothermic grasslands are found in remarkably sunny areas which are warm and dry. They often occupy small areas on slopes exposed to the South, South-West and South-East, on the edges of river valleys and ravines, ice-marginal valleys, moraine hills, upland hills and rocky outcrops. They are also found in the areas of anthropogenic origin, for example on southern limestone slopes of quarries, and also on their flat ridges. These communities usually occur on shallow rocky substrates. Their surrounding soils are of the character of initial rendzinas and pararendzinas, and beyond the quarries of proper brown earth, chernozem formed on calcareous substrates (chalk, limestone, marlstone, serpentinite and other carbonate rocks). The soil in the ridge area (the crown of the excavation) of the "Piotrawin" quarry is of anthropogenic character. Calcareous debris (marl) is mixed with mineral soil of low humus content, underneath which (at the depth of 25–30 cm) solid rock is found, in this case it is Senonian marl (pläner sandstone).

The most typical xerothermic grasslands are most common in southern Poland, mainly in the Małopolska Upland (Wyżyna Małopolska) and Lublin Upland (Wyżyna Lubelska), as well as in Silesia, Western Volhynia and in the neighbourhood of Przemyśl. In northern Poland they are mainly found at the edges of the valleys of Lower Vistula and Lower Oder usually on a calcareous substrate, mainly on pararendzinas. These communities are found in the areas with distinct characteristics of continental climate, characterised by hot summers, where the annual rainfall totals less than 500 mm (Medwecka-Kornaś and Kornaś 1972). In other areas of the country, they occur sporadically and are usually anthropogenic communities of secondary character. Xerothermic grasslands are grouped in the class of *Festuco-Brometea*. Three alliances were distinguished within the class: *Seslerio-Festucion duriusculae, Festuco--Stipion* and *Cirsio-Brachypodion pinnati*. Within the communities of *Cirsio-Brachypodion pinnati* alliance with most mesophilic plants, there is a community of sword leaf inula (*Inuletum ensifoliae*). The community was identified by Kutyna and Malinowska (2012) on two reclaimed terraces of the „Piotrawin" quarry. It is characterised by fairly rich undergrowth, which includes rare species of herbs with colourful flowers. From the floristic point of view, it is a very interesting community, incredibly colourful and rich, composed of calcicoles and xerothermic plants. Most often it inhabits shallow rendzinas formed from chalk marl. The sites of occurrence of the community are known in many areas in southern and south-eastern Poland, among others in Nida Trough (Niecka Nidziańska) and Lublin Upland (Wyżyna Lubelska) as well as in Western Volhynian Upland (Wyżyna Zachodniowołyńska) (Matuszkiewicz 2007). They are dominated by the species of many herbs and grasses are only a small supplement to the floristic composition of the community. Phytocoenoses of the community are found on steep southern slopes of hillocks formed from i.a. Senonian marl (so-called "pläner sandstone"). The community was identified and described in Małopolska Upland (Wyżyna Małopolska) by Kozłowska (1925), as well as Kostuch and Misztal (2004, 2006, 2007), Kostuch et al. (2004), Loster and Gawroński (2005), Trąba (2006), in Lublin Upland (Wyżyna Lubelska) by Sławiński (1952), Fijałkowski and Izdebski (1957), Izdebski and Fijałkowski (1959), Fijałkowski (1964), Kimsa and Sokołowska (1973), Fijałkowski and Adamczyk (1980, 1990), Fijałkowski et al. (1988), Kucharczyk (2000), Wołk (2000). In Sandomierska Upland (Wyżyna Sandomierska) and Iłża Forehills (Przedgórze Iłżeckie) by Głazek (1968, 1984).

The aim of the study is the eco-phytosociological characteristic of the plant communities found in the reclaimed ridge area (the crown of the excavation) of the "Piotrawin" quarry, located on the eastern edge of Vistula valley.

Natural characteristic of the research area

Quarries are part of extreme landscape devastation caused by human activity exploiting rock mineral resources. The "Piotrawin" quarry is situated south of Piotrawin village and is adjacent to the village of Kaliszany. Its excavation from the SW and W reaches the Vistula and in the east it is only a few dozen metres away from the road No. 825 (Kaliszany – Opole Lubelskie) – Fig. 1.

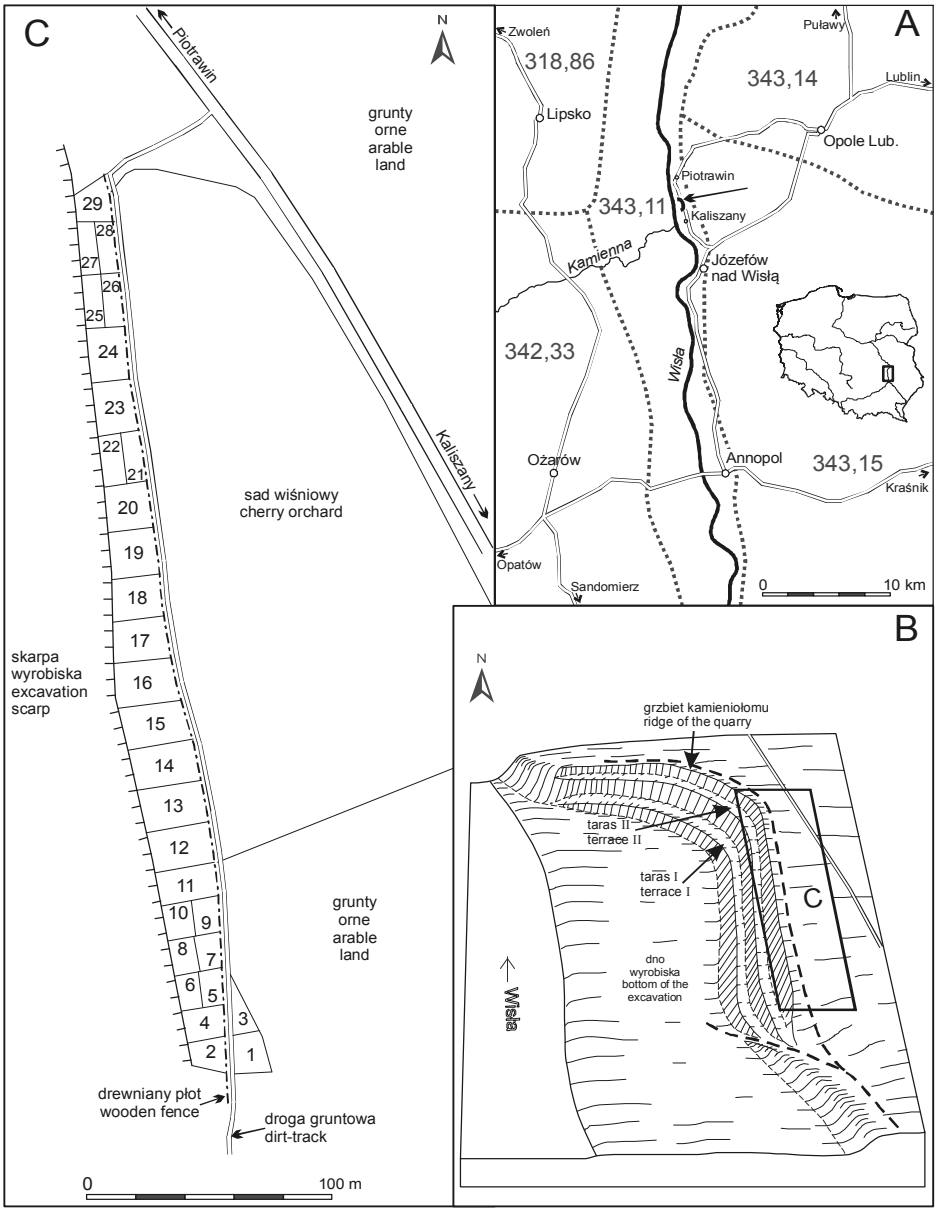

Fig. 1. Location of "Piotrawin" (A) quarry according to Kondracki (2009) mezoregions and localizations scheme of scarps, terraces and ridge of the quarry (B), and localizations of phytosociological relevés on quarry ridge area (C)

Rys. 1. Położenie kamieniołomu „Piotrawin" (A) na tle mezoregionów według Kondrackiego (2009) oraz schemat lokalizacji skarp, tarasów oraz grzbietu kamieniołomu (B), a także rozmieszczenie zdjęć fitosocjologicznych na powierzchni grzbietu (C)

The rocks of the excavation slope rise about 80 m above the level of the Vistula river and are attractive to wildlife researchers. Various fossils dating back about 65 million years can be found in Senonian marls (so-called “pläner sandstone”). There is a viewing point on the flat ridge (the crown) of the excavation, from where one can observe the Vistula and its valley. On the opposite side of the river, at the height of the quarry Kamienna river flows into the Vistula. South of the quarry, in the channel of the Vistula River, on alluvial sandy shoals there is an orhithological reserve Kaliszańskie Islands (Wyspy Kaliszańskie). The “Piotrawin” quarry has the status of a documentation site. In the environmental aspect, it has numerous floral, faunistic and landscape values, so it is attractive in regards to tourism and recreation in its area. It is located in Wrzelowiecki Landscape Park, which is situated in the central--western part of Lublin Upland and it includes the north-western part of Urzędowskie Hills (Wzniesienia Urzędowskie), which is a subregion of Lublin Upland. The western edge of this protected area is the Lesser Polish Gorge of the Vistula (Małopolski Przełom Wisły) within which the “Piotrawin” quarry is located (Kondracki 2009). The quarry and its adjacent areas are situated in the geological unit known as Lublin Trough (Niecka Lubelska), which is the south-eastern part of Precambrian margin trough of East European Craton. It is filled with a layer of Mesozoic rocks 500–600 m thick. Carbonate rocks being the sediments of warm Cretaceous sea are deposited on Jurassic rocks, which form the substrate of Lublin Trough. The bedrock of the “Piotrawin” quarry and its buffer zone are formed by carbonate-silica and carbonate rocks of the following types: limestone, pläner sandstone, marl and chalk. Of the listed rocks, the most resistant to weathering and water are pläner sandstones (apart from calcium carbonate they are also formed of silica). Due to this complexity, the right slope of the Vistula valley is at this point steep and relatively high. Pläner sandstones are exposed in the dormant “Piotrawin” quarry. North of the Piotrawin village, the edge of the Vistula valley is clearly declining, and its right bank is low, the river valley broadens from this point. The destructive processes of less resistant rocks such as marls and chalk withing the Tertiary led to the lowering of the river valley edges. High insolated slopes with xerothermic plants are found along the Vistula (eastern edge) from Popow and Nieszawa up to Kaliszany and the southern part of Piotrawin. There are many rare and protected species within the thermophilic communities.

The diversity of soils in this area is fundamentally influenced by it geological structure, type of bedrock and land relief. Rendzinas occur in the outcrop areas of the carbonate rocks from the Cretaceous such as: pläner sandstones, marls and chalk.

The researched area is thermally privileged, the average temperature is 7.8^{o}C, while in the eastern part of the Lublin Region it is 7.2^{o}C. The average temperature of the coldest month (January) is –2.8^{o}C, and the average temperature of the warmest month (July) is +18.8^{o}C. The area is the most insolated region in Poland. It oscillates from 46–50% of relative insolation and it reaches the highest values from June to September (Fijałkowski 1994). The vegetation season (the temperature above 5.0^{o}C) lasts from 200 up to 210 days, and the frost-free period lasts 180 days a year. Large number of cloudless days is also important, as well as, little cloudiness and high value of solar radiation (100–102 kcal $\cdot$ cm^{-2}). Precipitation is lower than country average and it oscillates from 520 to 540 mm. There is a considerable share of snowfall – snow cover lingers for about 60 days. Hail occurs frequently, which

is very disadvantageous for intensive developing fruit-farming in this area. The area is characterised by the longest summer period in Lublin Region (102 days). High--pressure weather prevails in the area, which is favourable for human. The area of Wrzelowiecki Landscape Park is characterised, apart from Vistula (with an average flow of 475 $m^3 \cdot sec^{-1}$), by the lowest density of drainage system in the country. On the west, the quarry is adjacent to the Vistula, whose riverbed is in this place about 400 m wide. The pollution of the water in the Vistula in this area is very significant and it exceeds the acceptable standards of cleanliness. It is of transit character and originates mainly from Upper Silesian Industrial Area, Kraków and Tarnobrzeg Sulphur Basin (mining is finished).

In the vicinity of the quarry on the slopes of the Vistula valley, both from the side of Kaliszany and Piotrawin, there are shrubland communities of *Rhamno-Prunetea class* and of *Berberion* alliance. The habitats are dominated by phytocoenoses of *Pruno-Ligustretum* association. The fundamental structure of the community is often and in large numbers formed by: European barberry (*Berberis vulgaris*), dog rose (*Rosa canina*), small-flowered sweet briar (*R. micrantha*), sweet briar (*R. rubiginosa*), wayfarer (*Viburnum lantana*) and most of all, the species characteristic for the association – wild privet (*Ligustrum vulgare*) and blackthorn (*Prunus spinosa*) very often attaining numerous and dense clusters of specimens (*Rubo fruticosi-Prunetum spinosae*). The constant components of shrubland community are also: common dogwood (*Cornus sanguinea*), common hawthorn (*Crataegus monogyna*), black locust (*Robinia pseudoacacia*), common buckthorn (*Rhamnus catharica*) and European spindle (*Euonymus europaeus*). The communities are also inhabited, however less frequently and in smaller numbers, by: Scots pine (*Pinus sylvestris*), common juniper (*Juniperus communis*), various species of oak (*Quercus* sp.) and maple (*Acer* sp.), as well as species of blackberry (*Rubus* sp.). The structure of these phytocoenoses is completed with wild fruit trees: apple trees (*Malus* sp.), pear (*Pyrus* sp.) and cherries (*Cerasus* sp.), including rare Steppe cherry (*Cerasus fruticosa*). Beside these species, black elder shrubs (*Sambucus nigra*) and rare rowan (*Sorbus aucuparia*), are occasionally found in the community. On the east side, the quarry is adjacent to orchards (mainly cherry orchards) and raspberry plantations as well as vegetable plantations (onion, garlic) and few cereal crops. A community of segetal plants – *Lathyro-Melandrietum noctiflori* of the *Caucalidion lappulae* association – can be found there, which is typical of shallow rendzinas.

Marl mining in “Piotrawin” quarry ceased in 1994. Late autumn in 1995, the environmental reclamation processes were started in the excavation place. Escarpments and rock ledges (terraces) were formed at the foothils of the pit. Undulating ridge areas of the quarry that had occurred between a dirt road adjacent to the orchard and the edge of the slope were leveled and evened. Their substrate is anthropogenic soil. Crushed rock debris (marl) was mixed with mineral soil with grass turf at some places. The substrate is mainly a loose form of limestone dust. The width of the flat ridge area (the crown of the excavation) from the dirt road to the edge of the quarry oscillates from 8 to 14 m (Fig. 1). The area was separated from the dirt road with a wooden fence. Wide rods were used for this purpose. According to Wołk (1996) the excavation place in the ”Piotrawin” quarry has its own, incredibly picturesque landscape resulting from the flowering of field poppies. They play an important role of pioneer plants and due to their commonness they are a valuable and colourful component of the flora on rendzina.

In November 1995, first planting of common dogwood (*Cornus sanguinea*) was performed – 150 seedlings on the ridge of the slope. Steppe cherry (*Cerasus fructicosa*) was also introduced – 10 seedlings, 40 seedlings of pheasant's eye (*Adonis vernalis*), 100 seedlings of golden flax (*Linum flavum*) and 20 tufts of needle grass (*Stipa capillata*). In the spring 1996, some seedlings were added, mainly of golden flax. Planting shrubs (common juniper, wild privet, common dogwood) was performed mainly on the ridge of the excavation pit of the quarry along its entire length, locating the shrubs in the vicinity of the dirt road, however not on the terraces of the quarry. The main goal of environmental reclamation of this area was to initiate natural succession of vegetation characteristic for this type of habitat. 12 species of plants, mainly obtained from the previously reclaimed excavation pit in Nasiłowo quarry, were used for sowing on the rocky terraces of the pit. Sowing was performed at the end of October 1996. The seeds of the following plants were sown: European Michaelmas Daisy (*Aster amyllus*), mullein (*Verbascum* sp.), Oregano (*Origanum vulgare*), golden flax (*Linum flavum*), black medick (*Medicago lupulina*), Bokhara clover (*Melilotus alba*), dyer's broom (*Genista tinctoria*), white broom (*Chamactisus albus*), swordleaf inula (*Inula ensifolia*), Common kidneyvetch (*Anthyllis vulneraria*), Fuller's teasel (*Dipsacus sylvestris*) and Viper's Bugloss (*Echium vulgare*). Most of the seeds sown were of swordleaf inula and golden flax (Wołk 1996).

MATERIAL AND METHODS

Biological reclamation of exhausted quarries usually poses a lot of difficulty and is a a long process. This is mostly due to the fact that quarry area is devoid of soil and thus there are no conditions for the development of plants. Encroachment of vegetation is hindered by vertical walls of rock slopes. Two terraces were built during the technical reclamation on the quarry slope exposed to SW and W. The ridge of the quarry was also reclaimed. The area was leveled and prepared for bio-reclamation (the details were described in the previous chapter). The substrate in this area is weathered limestone debris, which is heavily grained and thick (due to the technical reclamation), and its small elements are joined with powdered lime binder. At some places variable content of organic matter and humus can be found in it. Mineral fractions (sand and dust) are practically non-existent in this substrate. The area is inhabited by several species of calciphytes. 29 relevés were made between 15 th–20 th August 1998 on the substrate (Fig. 1). Plant communities in this area are floristically diverse. Several patches were included to *Inuletum ensifoliae* association using mainly the guide by Matuszkiewicz (2007) and taking into account the study by Filipek (1974a, 1974b), Prajs (2010), and particularly by Friedrich and Semczyszyn (2002) as well as Kutyna et al. (2011) on xerothermic plants. Much larger number of patches was included to the segetal association of *Sileno inflatae-Linarietum minoris* using the study by Herbich (1993) as well as Prajs and Antkowiak (2006). In some of these phytocoenoses there are characteristic species of *Lathyro-Melandrietum noctiflori* phytocoenon. The characteristic of this syntaxon was made on the basis of works by Kutyna (1988), Szmeja (1989) and Anioł-Kwiatkowska (1990). The floristic composition of most of the phytocoenoses found in the ridge area (the crown of the excavation) of the quarry is characterised by the presence of segetal communities taxa, xerothermic grasslands and ruderal communities. The transitional nature of these phytocoenoses indicates the ecological succession that can be observed within them.

Phytosociological stability (S) and cover coefficients (D) of the communities species were determined using the study by Dzwonko (2007). When calculating the value of cover coefficient (D) for the degree of abundance „+" the value of 1 was chosen. The names of the species were given according to Mirek et al. (2002). Similarity coefficients of the communities were calculated using the formula by Kulczyński (Szafer and Zarzycki 1972).

RESULTS AND DISCUSSION

Floristically rich plant communities are found on the flat and reclaimed ridge of the "Piotrawin" quarry. In total, 161 taxa were recorded within 29 patches of vegetation classified as three associations: *Sileno inflatae-Linarietum minoris, Lathyro-Melandrietum noctiflori* and *Inuletum ensifoliae*. The biggest number of species (147) was recorded in the association of *Sileno inflatae-Linarietum minoris*, a little less (120) were found in the patches of the other phytocoenons (Table 1).

Table 1. Range of grades of stability in the particular syngenetic groups of *Sileno inflatae-Linarietum minoris* (a), *Lathyro-Melandrietum noctiflori* (b) and *Inuletum ensifoliae* (c)
Tabela 1. Rozkład stopni stałości w poszczególnych grupach syngenetycznych *Sileno inflatae-Linarietum minoris* (a), *Lathyro-Melandrietum noctiflori* (b) i *Inuletum ensifoliae* (c)

Phtosociological classes Klasy fitosocjologiczne		Grades of stability – Stopnie stałości					Total Razem
		V	IV	III	II	I	
		Number of species – Liczba gatunków					
Stellarietea mediae	a	11	2	8	5	13	39
	b	9	3	6	5	3	26
	c	1	7	7	10	4	29
Artemisietea vulgaris	a	6	6	2	5	6	25
	b	5	6	3	2	6	22
	c	1	5	3	5	6	20
Molinio-Arrhenatheretea	a	4	4	1	6	5	20
	b	3	6	3	–	3	15
	c	2	1	3	6	4	16
Festuco-Brometea	a	1	4	3	7	3	18
	b	5	3	4	5	2	19
	c	5	1	1	7	6	20
Trifolio-Geranietea sanguinei	a	1	2	2	5	3	13
	b	1	3	1	2	1	8
	c	1	1	2	3	–	7
Rhamno-Prunetea	a	–	–	1	1	5	7
	b	1	–	–	1	1	3
	c	–	1	1	2	1	5
Agropyretea intermedio-repentis	a	3	–	–	–	1	4
	b	1	1	1	–	1	4
	c	1	1	–	1	1	4
Koelerio glaucae-Corynephoretea canescentis	a	–	–	–	2	–	2
	b	–	–	1	–	3	4
	c	–	–	–	–	1	1
Nardo-Callunetea	a	–	–	1	–	–	1
	b	–	–	–	–	1	1
	c	–	–	–	1	–	1
Accompanying species Gatunki towarzyszące	a	2	–	1	3	12	18
	b	2	1	–	5	10	18
	c	–	2	2	3	10	17
					Total Razem	a	147
						b	120
						c	120

Out of 29 relevés, 18 were classified as phytocoenoses prevailing in these habitats of the segetal association *Sileno inflatae-Linarietum minoris,* slightly less were classified as other associations. Species characteristic for two other associations are also found in the structure of this phytocoenon, however they occur in its patches less frequently and in smaller number.

The distinguished communities are characterised by significant mutual floristic similarity determined from the degree of constancy of occurrence of the species forming the floristic structure of these phytocoenoses. Mutual similarity coefficient at the level of 72.1% was demonstrated by the communities of *Inuletum ensifoliae* and *Sileno inflatae-Linarietum minoris*. The phytocoenoses of the latter segetal association demonstrates also the highest similarity coefficient (76.8%) to the segetal community of *Lathyro-Melandrietum noctiflori*.

***Sileno inflatae-Linarietum minoris* J. Herbich 1993** (Table 2)

The community is distinguished by two characteristic species – *Chaenorhinum minus* and *Silene vulgaris*. It was first identified and described in the Kashubian Lake District by Herbich (1993). The association most often develops within winter grains, however it also demonstrates numerous floristic connections to root crops which was also confirmed by the authors' study. The phytocenoses mainly occur on rendzinas, pararendzinas and lake marl with alkaline or neutral reaction. According to Hebrich (1993) the association belongs to the dynamic range of local form of calcareous beech "orchid beech" from the *Cephalanthero--Fagenion* subassociation (Herbich 1993, Matuszkiewicz 2007).

Herbich (1993) distinguished an association in winter and spring grain sowings. The patches of the communities are floristically rich and are characterised by the dominance of calciphile and thermophile species. Within the phytocenoses of winter grains (15 relevés), he recorded 100 species of vascular plants and 11 bryophytes, and the number of taxa in the patches oscillates between 28 and 40, it is 34 on average. There are less of them in spring grains (59), probably due to the fact that only 5 relevés were used for the analysis. Yet the number of species in the patches is significant and it ranges from 32 to 37, on average it is 35. *Chaenorhinum minus* is a constant component (S = V) in the community of winter grains and in the spring phytocenoses it reaches the third degree of stability. Slightly less common is *Silene inflata*, which reaches S = III in winter grains and S = IV in spring grains. In both types of crops, the structure of the community is in the vast majority formed by the characteristic species of *Polygono-Chenopodietalia* and *Stellarietea mediae*. They have smaller share of the characteristic taxa of *Centauretalia cyani* and *Caucalidion lappulae* (Herbich 1993). Apart from the characteristic species of the association, *Medicago lupulina* (species of the *Artemisietea vulgaris* class) was assigned to the diagnostic species "reinforcing" with association rank. It is a constant component of the community (S = V) in both types of crops, but it reaches an insignificant cover coefficient D = 370 in winter crops and D=87 in spring crops. Slightly higher values of cover coefficient are reached by species characteristic for *Chaenorhinum minus* association (D = 397 in winter grains and 220 in spring grains) and *Silene inflata* (D = 320 in winter grains and D = 1150 in spring grains). The phytocoenoses of the association are found on soils formed from lake marl, classified as rendzinas. They are distinguished by a very high content of calcium carbonate, which exceeds 80%, and are also characterised by a relatively low level of humus with 23–25 cm thickness.

Table. 2. *Sileno inflatae-Linarietum minoris* Herbich 1993
Tabela. 2. *Sileno inflatae-Linarietum minoris* Herbich 1993

Successive No. Numer kolejny	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
Field No. of relevé Numer zdjęcia w terenie	1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	25	$\bar{x}$	
Patch area [m^2] Powierzchnia płatu	100	100	80	90	90	90	80	80	100	100	100	100	100	100	100	100	100	70		
Cover of herb layer [%] Pokrycie powierzchni zdjęcia przez rośliny	80	100	95	100	75	80	95	70	100	100	85	90	100	90	70	90	85	100	89,2	
Number of species in relevé Liczba gatunków w zdjęciu fitosocjologicznym	57	61	64	67	56	62	62	59	68	67	67	65	63	64	53	60	56	73	62	
																			S	D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
ChAss. *Sileno inflatae-Linarietum minoris*																				
Chaenorhinum minus	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**V**	**500**
Silene vulgaris	**1.2**	**1.2**	**1.1**	**1.2**	**1.1**	**1.2**	**1.2**	**1.2**	**1.1**	**+**	**1.2**	**+**	**1.1**	**+**	**+**	**+**	**1.2**	**1.1**	**V**	**389**
I ChAll.: *Caucalidion lappulae*																				
Stachys annua	**+**	**+**	**1.1**	**1.1**	**1.2**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.2**	**V**	**456**
Euphorbia exiqua	**+**	**.**	**1.1**	**+**	**.**	**1.1**	**+**	**+**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**+**	**V**	**333**
Avena fatua	**+**	**.**	**.**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**V**	**89**
Aethusa cynapium ssp. *agrestis*	**.**	**.**	**+**	**.**	**+**	**+**	**.**	**+**	**+**	**+**	**+**	**+**	**+**	**.**	**+**	**+**	**+**	**+**	**IV**	**72**
Melandrium noctiflorum	**+**	**.**	**.**	**.**	**.**	**+**	**.**	**.**	**.**	**+**	**.**	**.**	**+**	**+**	**.**	**.**	**+**	**.**	**II**	**33**
II ChO.: *Centauretalia cyani*																				
Papaver rhoeas	**1.2**	**1.1**	**1.1**	**1.1**	**+**	**1.1**	**2.2**	**1.2**	**1.1**	**2.2**	**2.2**	**+**	**1.2**	**2.2**	**1.3**	**1.3**	**2.2**	**1.3**	**V**	**803**
Consolida regalis	**1.1**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**1.1**	**+**	**1.1**	**+**	**1.1**	**V**	**189**
III ChAll.: *Polygono-Chenopodion,* ChO.: *Polygono-Chenopodietalia*																				
Chenopodium album	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**+**	**.**	**+**	**.**	**+**	**+**	**+**	**.**	**+**	**V**	**83**
Atriplex patula	**+**	**.**	**+**	**.**	**+**	**.**	**1.2**	**.**	**.**	**+**	**.**	**.**	**.**	**.**	**+**	**+**	**.**	**1.2**	**III**	**89**
Euphorbia helioscopia	**+**	**.**	**+**	**+**	**.**	**.**	**+**	**.**	**+**	**.**	**.**	**+**	**.**	**.**	**+**	**+**	**+**	**+**	**III**	**56**
Sonchus asper	**.**	**+**	**+**	**+**	**+**	**.**	**+**	**.**	**.**	**+**	**+**	**.**	**.**	**.**	**+**	**+**	**.**	**+**	**III**	**56**
Veronica persica	**+**	**+**	**+**	**.**	**.**	**.**	**+**	**.**	**+**	**.**	**.**	**+**	**.**	**.**	**.**	**.**	**.**	**+**	**II**	**39**
Sonchus arvensis	**.**	**.**	**+**	**.**	**+**	**.**	**+**	**+**	**+**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**II**	**28**

Cont. Table 2 – cd. tab. 2

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
IV ChO., ChAll.: *Sisymbrietalia, Sisymbrion officinalis*																				
Conyza canadensis	+	+	+	+	.	1.1	.	.	+	+	+	+	+	+	+	+	+	+	V	106
Lactuca seriolla	.	.	.	.	+	+	+	+	1.1	.	.	.	+	+	.	+	+	.	III	72
V ChCl.: *Stellarietea mediae*																				
Anagallis arvensis	+	+	1.1	+	+	+	+	+	+	1.1	+	+	1.1	1.1	+	1.1	1.1	1.1	V	256
Sinapis arvensis	+	+	+	+	+	+	+	+	+	1.1	+	+	+	1.1	+	+	+	1.1	V	167
Fallopia convolvulus	.	.	.	+	+	+	.	+	+	.	+	.	+	+	.	+	+	+	IV	61
Setaria viridis	+	.	.	.	.	+	+	+	+	+	+	+	.	+	.	.	.	.	III	50
Apera spica-venti	.	.	.	+	+	+	.	+	.	+	.	.	+	.	+	.	.	+	III	44
Matricaria maritima ssp. *inodora*	.	.	.	.	+	.	+	.	.	.	+	.	+	+	+	+	.	+	III	44
Polygonum aviculare	+	.	.	.	+	.	+	+	+	+	.	+	.	+	.	.	.	.	III	44
Viola arvensis	.	.	.	.	.	.	+	.	.	.	+	.	.	+	.	.	+	+	II	28
Stellaria media	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	II	22
VI ChCl. *Artemisietea vulgaris*																				
Pastinaca sativa	1.2	1.3	1.2	1.2	1.2	1.1	1.2	1.2	1.1	1.2	1.2	1.2	2.2	1.2	1.2	1.2	1.2	2.3	V	639
Picris hieracioides	1.2	1.2	1.2	1.2	1.2	1.2	.	1.2	1.2	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	V	472
Cichorium intybus	+	+	1.2	1.2	1.2	1.2	.	+	1.3	1.2	1.2	1.2	1.3	1.2	.	.	1.2	1.2	V	350
Carduus crispus	.	1.2	.	1.3	+	1.2	1.2	1.3	1.3	1.2	+	1.2	+	1.2	+	1.2	1.2	1.2	V	350
Melilotus officinalis	1.2	.	1.2	1.2	.	1.1	.	+	2.2	+	+	+	+	1.2	+	+	+	1.2	V	308
Echium vulgare	+	+	1.2	1.2	+	.	+	+	1.2	1.2	+	.	+	+	+	.	+	+	V	172
Rubus caesius	.	1.2	.	1.2	.	1.2	1.2	1.3	1.2	1.2	1.2	2.3	1.2	1.3	1.3	1.3	1.2	.	IV	458
Carduus acanthoides	.	.	.	1.2	.	1.2	1.2	1.2	1.2	1.2	1.2	1.2	.	2.3	.	1.2	1.2	.	IV	375
Medicago lupulina	1.3	.	2.2	1.2	.	1.1	1.2	1.1	.	1.2	.	1.1	+	1.1	+	+	+	1.2	IV	369
Cerinthe glabra	.	+	+	+	1.2	1.2	.	1.3	1.3	.	.	1.2	1.2	.	1.2	1.3	2.2	+	IV	342
Artemisia vulgaris	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	.	1.3	.	.	.	.	1.2	+	IV	339
Linaria vulgaris	+	+	.	+	.	+	+	.	+	+	+	.	1.1	+	+	+	.	+	IV	94
Cirsium arvense	+	.	+	+	.	1.2	.	+	.	.	1.2	1.2	.	1.2	1.2	1.2	.	.	III	189
Hypericum perforatum	+	.	+	+	.	.	.	.	+	+	+	+	.	+	+	.	+	.	III	56
Dipsacus silvestris	.	.	.	1.2	.	.	+	.	.	+	.	.	.	.	+	.	1.1	+	II	78
Erysimum cheiranthoides	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	.	II	39
Melandrium album	+	+	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	+	II	33
Verbascum thapsus	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	II	22
Solidago canadensis	.	+	.	.	.	.	.	.	.	+	+	.	+	+	.	.	.	.	II	22
VII ChCl.: *Agropyretea intermedio-repentis*																				
Tussilago farfara	+	1.1	1.1	1.2	1.2	2.2	1.1	1.3	1.3	2.2	1.2	1.3	1.3	2.3	1.2	2.2	.	1.3	V	728
Elymus repens	1.2	1.2	2.2	1.2	.	1.2	1.1	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.2	.	1.2	1.2	V	514
Convolvulus arvensis	1.3	1.3	+	+	+	+	.	1.2	+	1.2	1.2	1.2	1.2	1.2	1.2	1.2	+	+	V	317

Cont. Table 2 – cd. tab. 2

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
VIII ChCl.: *Koelerio glaucae-Corynephoretea canescentis*																				
Senecio vernalis	+	.	.	.	.	+	.	.	.	+	+	.	.	.	.	+	+	+	II	39
Trifolium campestre	.	.	+	.	+	.	+	.	+	.	.	.	.	.	+	+	.	.	II	33
IX ChCl.: *Molinio-Arrhenatheretea*																				
Daucus carota	1.3	2.2	1.2	1.1	1.2	1.1	1.2	1.2	2.3	1.1	1.2	1.2	1.2	1.2	.	1.2	1.2	1.2	V	611
Lolium perenne	1.2	1.1	1.1	1.2	1.2	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.2	1.2	1.2	V	500
Agrostis capillaris	.	1.2	1.2	.	1.2	1.2	1.3	.	1.2	1.2	1.2	1.3	1.3	1.2	1.3	1.2	1.2	1.2	V	417
Taraxacum officinale	+	+	+	+	+	.	+	.	+	+	+	+	+	+	+	.	+	+	V	83
Festuca rubra	.	2.2	1.2	1.3	1.2	1.3	1.2	.	1.2	1.2	2.2	1.2	1.2	1.3	.	1.2	.	2.2	IV	597
Achillea millefolium	1.2	.	.	.	+	.	.	+	.	+	+	1.2	1.2	1.2	2.2	1.2	.	+	IV	264
Pimpinella saxifraga	+	+	.	+	.	+	+	+	1.2	.	1.2	+	.	+	.	.	+	1.2	IV	133
Trfolium pratense	1.2	.	1.2	+	+	+	+	+	.	+	+	.	+	.	.	.	.	+	IV	106
Dactylis glomerata	+	1.2	.	+	.	+	.	+	.	.	+	+	+	.	.	+	.	+	III	78
Centaurea jacea	.	1.2	1.2	2.2	.	.	.	+	.	.	.	.	.	.	.	.	.	.	II	125
Galium mollugo	+	1.2	+	+	.	+	.	.	.	.	.	1.2	.	.	.	.	+	.	II	83
Campanula patula	.	.	+	1.2	.	1.2	+	.	.	.	.	+	.	.	+	.	.	.	II	78
Vicia cracca	+	.	.	.	+	.	.	.	.	1.1	.	1.2	.	.	.	.	.	.	II	67
Cerastium holesteoides	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	+	.	.	II	22
Trifolium hybridum	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	II	22
X ChCl.: *Festuco-Brometea*																				
Anthemis tinctoria	1.1	1.3	1.2	2.2	1.3	2.2	1.3	1.3	1.3	2.2	1.2	2.2	1.3	1.2	2.2	1.3	1.3	2.3	V	917
Poa compressa	1.3	1.3	1.2	1.2	1.1	1.2	.	.	1.2	1.2	+	1.2	1.2	1.2	.	1.2	.	2.2	IV	431
Salvia verticillata	.	.	1.2	.	.	.	1.2	.	1.2	+	1.2	2.2	1.3	1.2	.	1.3	1.2	1.2	IV	353
Euphorbia cyparissias	+	+	+	1.2	+	1.1	.	1.1	1.2	.	1.1	.	1.2	1.2	+	+	.	+	IV	233
Sanguisorba minor	.	+	+	.	1.2	.	1.1	+	+	+	.	+	.	1.2	.	+	.	1.2	IV	150
Centaurea scabiosa	1.3	1.2	.	1.2	.	1.3	.	1.2	1.2	.	1.2	1.3	1.3	.	.	.	.	1.2	III	278
Eryngium planum	.	1.2	.	+	+	.	.	.	+	+	.	.	1.2	.	+	+	.	.	III	89
Asparapus officinalis	.	.	.	.	+	.	.	.	+	+	+	+	1.1	+	+	+	.	.	III	72
Anthyllis vulneraria	+	1.2	1.2	.	1.2	.	.	.	.	.	+	.	.	.	.	.	.	.	II	94
Phleum phleoides	.	1.2	.	.	.	.	1.2	+	1.2	.	.	.	.	.	.	.	.	+	II	94
Centaurea stoebe	.	1.2	1.2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1.2	II	89
Scabiosa ochroleuca	.	.	.	1.2	.	+	+	.	.	.	.	+	.	1.2	+	.	.	+	II	83
Hieracium echioides	.	+	.	.	.	.	.	.	+	+	.	1.1	.	.	.	1.1	.	.	II	72
Campanula sibirica	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	II	33
Carlina vulgaris	.	.	+	.	.	+	.	.	.	+	.	.	+	.	.	.	+	.	II	28
XI ChCl.: *Nardo-Callunetea*																				
Genista tinctoria	+	+	1.2	+	.	1.2	.	1.2	1.2	+	.	+	.	.	.	.	.	.	III	139

Cont. Table 2 – cd. tab. 2

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
XII ChCl.: *Trifolio-Geranietea sanguinei*																				
Medicago falcata	**1.1**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**.**	**1.2**	**.**	**+**	**1.2**	**+**	**1.1**	**+**	**.**	**+**	**+**	**V**	**300**
Campanula rapunculoides	**+**	**+**	**1.2**	**.**	**.**	**.**	**1.2**	**.**	**+**	**.**	**1.2**	**+**	**+**	**.**	**+**	**+**	**.**	**1.2**	**IV**	**150**
Vicia tenuifolia	**.**	**1.1**	**.**	**+**	**.**	**.**	**+**	**+**	**1.2**	**.**	**+**	**.**	**+**	**+**	**.**	**+**	**+**	**+**	**IV**	**106**
Coronilla varia	**.**	**.**	**+**	**1.2**	**.**	**+**	**.**	**1.2**	**.**	**1.2**	**.**	**+**	**+**	**+**	**1.2**	**.**	**+**	**.**	**III**	**144**
Origanum vulgare	**.**	**.**	**+**	**.**	**1.1**	**.**	**+**	**.**	**.**	**.**	**+**	**+**	**+**	**.**	**1.1**	**.**	**+**	**+**	**III**	**94**
Agrimonia eupatoria	**.**	**.**	**1.2**	**.**	**.**	**.**	**+**	**.**	**1.2**	**.**	**.**	**1.1**	**.**	**.**	**+**	**+**	**.**	**.**	**II**	**100**
Clinopodium vulgare	**.**	**.**	**+**	**.**	**.**	**1.1**	**.**	**.**	**.**	**.**	**+**	**.**	**+**	**.**	**.**	**1.1**	**.**	**.**	**II**	**72**
Astragalus cicer	**.**	**.**	**+**	**.**	**.**	**.**	**1.1**	**.**	**.**	**.**	**+**	**.**	**1.2**	**.**	**.**	**+**	**.**	**.**	**II**	**72**
Thalictrum minus	**.**	**.**	**.**	**+**	**.**	**.**	**+**	**.**	**.**	**1.1**	**.**	**.**	**.**	**.**	**.**	**.**	**+**	**.**	**II**	**44**
XIII ChCl.: *Rhamno-Prunetea*																				
Cornus sanguinea (juv.)	**.**	**.**	**.**	**1.2**	**.**	**+**	**1.2**	**.**	**.**	**1.2**	**1.2**	**+**	**+**	**.**	**.**	**.**	**.**	**1.2**	**III**	**156**
Cerasus fruticosa (juv.)	**.**	**1.2**	**.**	**.**	**.**	**.**	**.**	**1.2**	**.**	**.**	**1.2**	**.**	**.**	**+**	**.**	**.**	**1.2**	**1.2**	**II**	**144**
XIV Accompanying species – Gatunki towarzyszące																				
Diplotaxis muralis	**.**	**+**	**1.2**	**1.1**	**1.2**	**1.1**	**1.1**	**1.2**	**1.1**	**.**	**1.1**	**1.2**	**1.1**	**1.1**	**.**	**1.2**	**1.1**	**+**	**V**	**372**
Arenaria serpyllifolia	**+**	**+**	**.**	**+**	**.**	**+**	**.**	**+**	**+**	**1.1**	**1.1**	**+**	**+**	**+**	**+**	**+**	**+**	**1.1**	**V**	**150**
Lupulla squarosa	**.**	**+**	**.**	**.**	**.**	**.**	**+**	**+**	**.**	**+**	**+**	**+**	**.**	**.**	**.**	**+**	**+**	**+**	**III**	**50**
Senecio jacobaea	**.**	**.**	**1.2**	**+**	**.**	**.**	**+**	**.**	**.**	**+**	**+**	**.**	**+**	**.**	**.**	**.**	**.**	**.**	**II**	**56**
Camelina microcarpa	**+**	**1.1**	**+**	**.**	**+**	**+**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**II**	**50**
Cardaminopsis arenosa	**.**	**.**	**.**	**.**	**.**	**+**	**.**	**.**	**.**	**+**	**.**	**.**	**.**	**.**	**+**	**.**	**+**	**.**	**II**	**22**

Plant species occurring only in I degree of phytosociological constance in plant communities. After a name of species the number of the phytosociological 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. Po nazwie gatunku podano numery zdjęć fitosocjologicznych, w których wystąpił gatunek, w nawiasach – stopnie ilościowości i towarzyskości.

I: *Adonis aestivialis* 12,14,15(+), *Lathyrus tuberosus* 1,14(+); **II:** *Agrostemma githago* 18(2.3), *Lithospermum arvense* 2,11(+); **III:** *Capsella bursa-pastoris* 4(+), *Fumaria officinalis* 8,9(+); **IV:** *Malva neglecta* 5(+), *M. pusilla* 5,10(+), *Sisymbrium loeselii* 9,10(+); **V:** *Galeopsis tetrahit* 5,8(+), *Papaver dubium* 1(+), *Raphanus raphanistrum* 14(+), *Vicia hirsuta* 18(+); **VI:** *Arcium lappa* 4,5,6(+), *Armoracia rusticana* 4,5(+), *Galium aparine* 3,7,12(+), *Medicago sativa* 7(+), *Tanacetum vulgare* 10(+), *Urtica dioica* 9,12(+); **VII:** *Falcaria vulgaris* 17,18(+); **IX:** *Arrhenatherum elatius* 8,11,18(1.2), *Avenula pubescens* 11,16,18(+), *Plantago lanceolata* 5(+), *P. maior* 1,2,3(+), *Rumex crispus* 10,12(+); **X:** *Allium oleraceum* 5(+), *Linum flavum* 2,3(+), *Thymelaea passerina* 5,8(+); **XII:** *Fragaria viridis* 4,14,17(+), *Veronica teucrium* 8,13(+), *Verbascum lychnitis* 9,13,14(+); **XIII:** *Berberis vulgaris* (juv.)1(+), 4(1.2), *Crategus monogyna* 4(1.2), *Euonymus europaeus* (juv.) 7,11,14(+), *Ligustrum vulgare* (juv.) 4,6,8(1.2), *Rosa canina* (juv.) 4,6(1.2); **XIV:** *Elymus hispidus* 13(+), 2,9(1.2), *Erodium cicutarium* 3,9,11(+), *Galeopsis angustifolia* 6,10(+), *Lolium multiflorum* 9,16(+), 18(1.1), *Mentha arvensis* 10(+), *Neslia paniculata* 9,17,18(+), *Ononis spinosa* 12(+), 13,15(1.2), *Robinia pseudoacacia* (juv.) 2(+), *Senecio vulgaris* 5(+), *Sherardia arvensis* 3,9,14(+), *Solanum dulcamara* 2(+), *Trifolium aureum* 14(+).

Calciphilous association of *Sileno inflatae-Linarietum minoris* was also distinguished by Prajs and Antkowiak (2006) in the valley of the Kulawa river (Zaborski National Park). Phytocoenoses of the community inhabit lake rendzina soils, which are very rich in calcium carbonate and and can be found in various crops (e.g. oats, barley, and triticale). To distinguish the association and to learn its structure, Prajs and Antkowiak (2006) used 9 patches of plants. In total, they recorded 53 taxa. The number of species in individual patches is varied and it ranges from 14 to 32, on average it is 21. In the association, there are numerous species of *Polygono-Chenopodietalia*: *Fumaria officinalis, Euphorbia helioscopia* and *Lamium amplexicaule*, similarly to the community described by Herbich (1993). However, the community is decidedly poorer in species in comparison to the association distinguished by Herbich (1993) in the Kashubian Lake District. *Chaenorhinum minus* is a constant component of the association (S = V) and it reaches a significant cover coefficient (D = 1417). Slightly rarer and less numerous is *Silene inflata* (S = III, D = 317).

The *Sileno inflatae-Linarietum minoris* association occurs also on the ridge of the "Piotrawin" quarry pit (the crown of the excavation). In total, 147 taxa (Table 1) were recorded in the community. They are represented by 18 patches of vegetation. The community is floristically very rich. The number of species ranges from 53 to 73, on average it is 62 (Table 2).

The floristic composition of these phytocoenoses is typical for segetal communities. After technical reclamation carried out in the years 1995–1996, leveling the ridge area of the pit and mixing limestone substrate with mineral soil material, the area to a large degree resembled "farmland". The area is adjacent to agricultural crops and orchards, in this case currently there is a cherry orchard. Decades ago, the area was used for agriculture. The main crops were wheat, barley and sugar beet. The management of the "Piotrawin" quarry leased and then bought over 1 ha field from a farmer, in order to expand exploitation activity of the quarry. The soil at the crown of the excavation surely contains numerous diaspores of segetal community species, and it is also adjacent to farmland. Therefore, after the reclamation in the first phase of overgrowing, segetal communities were formed in this area. Over the years, the process of ecological succession has been followed by the reformation of the floristic structure of this community. Already in 1998, immediately after bio-reclamation (introducing many species of xerothermic grasslands, as discussed in previous chapters), several patches of vegetation indicated the formation of a structure of *Inuletum ensifoliae* xerothermic grasslands association. During the exploration of the area in 2013, it was also found that the ridge of the quarry was being infested by shrubland species of *Rhamno--Prunetea* class and the number of *Festuco-Brometea* taxa was growing. The number of segetal communities species visibly decreased at that time. During 15 years, there has been a rapid floristic transformation in this area. In 2014, the authors plan to conduct a floristic and phytosociological research in order to minutely determine the scale of the reformation of the former community.

Sileno inflatae-Linarietum minoris association is represented in the study area by both characteristic species of the phytocoenon – *Chaenorhinum minus* and *Silene inflata*. They are constant components (S = V) of the community (Table 2) and their cover coefficients are not too large, and are accordingly D = 500 and D = 389. Both species are characterised by fine-structure morphology with small biomass, hence their cover coefficients are not

significant. They were most frequently recorded in the vegetation patches at the 1st degree of abundance (Table 2). The community is represented by a significant number of species of almost all syntaxa of *Stellarietea mediae* class. *Polygono-Chenopodion* alliance, *Polygono--Chenopodietalia* order (8 taxa) and *Stellarietea mediae* class (13 taxa) are characterised by the largest group of species. A significant share of *Polygono-Chenopodietalia* species in the community at the quarry ridge confirms the results of the studies by Herbich (1993) as well as by Prajs and Antkowiak (2006). *Centauretalia cyani* is characterised by a smaller number of species (4 taxa), as was in the case of the structure of communities described by the aforementioned authors. The presence of calciphile and thermophile species of *Caucalidion lappulae* alliance, indicates extremely carbonate habitats. The appearance of several species of *Sisymbrietalia* order indicates the beginning of segetal community reformation, which in the process of ecological succession, tends to the direction of ruderal communities and xerothermic grasslands.

Constant components of the community (S = V) and reaching significant cover coefficients are: *Papaver rhoeas* (D = 803), *Stachys annua* (D = 456), *Euphorbia exiqua* (D = 333) and *Anagallis arvensis* (D = 256). Very common (S = V) are also the species, which reached lower D values. These include: *Consolida regalis* (D = 189) and *Sinapis arvensis* (D = 167) (Table 2). Very frequently recorded (S = IV – V) are also taxa characterised by low cover coefficients: *Conyza canadensis* (D = 106), *Avena fatua* (D = 89), *Chenopodium album* (D = 83) and *Aethusa cynapium* ssp. *agrestis* (D = 72) – Table 2.

The floristic structure of the association identified by the authors of this paper is similar to the species composition of the phytocoenon described by Herbich (1993) as well as by Prajs and Antkowiak (2006), but only in terms of *Stellarietea mediae* class taxa, since the association described by the aforementioned authors occurs only within agricultural plants. The communities on the ridge of the quarry are slightly different types of phytocoenoses, since they are characterised by the presence of numerous species of various phytosociological classes: *Artemisietea vulgaris* (25 taxa), *Molinio-Arrhenatheretea* (20), *Festuco-Brometea* (18) and *Trifolio-Geranietea sanguinea* (13) – Table 1. The community differs from the syntaxon identified by Herbich (1993) and by Prajs and Antkowiak (2006) by the numerous share of species from the distinguished classes. Very frequent (S = V) and abundant of *Artemisietea vulgaris* class are: *Pastinaca sativa* (D = 639), *Picris hieriacioides* (D = 472), *Cichorium intybus* (D = 350), *Carduus crispus* (D = 350) and *Mellilotus officinalis* (D = 308) – Table 2. Frequent (S = IV) and slightly less abundant in vegetation patches are: *Rubus caesius* (D = 458), *Medicago lupulina* (D = 369), *Cerinthe glabra* (D = 342), *Artemisia vulgaris* (D = 339) and *Echium vulgare* (D = 172). Very frequent (S = V) and relatively abundant of *Molinio-Arrhenatheretea* class are: *Daucus carota* (D = 611), *Lolium perenne* (D = 500) and *Agrostis capillaris* (D = 417). Frequent (S = IV) of the class are: *Festuca rubra* (D = 597) and *Achillea millefolium* (D = 264). *Festuco-Brometea* class is most frequently (S = V) and abundantly represented by *Anthemis tinctoria* (D = 917), frequently (S = IV) by: *Poa compressa* (D = 431), *Salvia verticillata* (D = 353), *Euphorbia cyparissias* (D = 233) and *Sanguisorba minor* (D = 150). Moreover, in the patches very frequently (S = V) and abundatly occur the species of *Agropyretea intermedio-repentis* class: *Tussilago farfara* (D = 728), *Elymus repens* (D = 514) and *Convolvulus arvensis* (D = 317) – Table 2. Most frequent of *Trifolio-Geranietea sanguinei* class is *Medicago falcata* (S = V, D = 300) and *Campanula rapunculoides* (S = IV, D = 150) – Table 2.

***Lathyro-Melandrietum noctiflori* OBERD. 1957 = *Papaveri-Melandrietum noctiflori* Wassch.1941** (Table 3)

Six patches of vegetation on the ridge of the quarry "Piotrawin" (the crown of the excavation) were included into *Lathyro-Melandrietum noctiflori* association. It was distinguished on the basis of more numerous presence of two characteristic species of the phytocoenon – *Melandrium noctiflorum* (S = V, D = 433) and *Lathyrus tuberosus* (S = V, D = 433) – Table 3. In the patches, where both mentioned species occur, characteristic taxa of *Sileno inflatae-Linarietum minoris* are also recorded. However, their cover coefficients are very low and in most of the sample units they are recorded with cover-abundance value "+". Species diversity of the 6 patches indicates, that the association has also the characteristics of segetal community and its floristic structure is significantly similar to the previously characterised phytocoenon.

The structure of the association is formed by 119 taxa (Table 1). Species of *Stellarietea mediae* class have the biggest share (26 species) – Table 1. The dominant role in the community phytocenoses is played by 11 taxa, which are constant components of the association (S = V) but they reach different values of cover coefficients. Both characteristic species *Melandrium noctiflorum* and *Lathyrus tuberosus* belong to this important group of species. Apart from them, the significant species of segetal communities are: *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) – Table 3. As was previously mentioned, the structure of the communities is formed by xerothermic grasslands thermophilic species of *Festuco-Brometea* class (19 taxa) and ruderal communities species of *Artemisietea vulgaris* class (22 taxa), as well as by taxa of meadow communities *Molinio-Arrhenatheretea* (15 species) and to a lesser degree by thermophilic fringe communites *Trifolio-Geranietea sanguinei* (8 species) – Table 1. The most common and most numerous from these syntaxa are: *Anthemis tinctoria*, *Picris hieriacioides* and *Lolium perenne*. They are constant components of the community (S = V) and can reach cover coefficients at the level D = 500 – 558 – Table 3. Among fringe communities species the dominant species is *Medicago falcata* (S = IV, D = 542) – Table 3. Vegetation patches are very rich floristically.The number of taxa in the sample unit varies from 57 to 64, and on average it is 61 (Table 3).

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

The characteristic species of the association are constant components of the community (S = V), and their cover coefficients are varied. *Lathyrus tuberosus* reaches D = 952, and *Melandrium noctiflorum* D = 194. The structure of the association is also 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 structure of the association is formed by 80 taxa, and the vegetation patches are floristically richer. The number of species in 20 relevés ranges from 29 to 38, on average it is 33 taxa.

Table. 3. *Lathyro-Melandrietum noctiflori* Oberd. 1957 (relevés 1– 6) and *Inuletum ensifoliae* Kozł. 1925 (relevés 7–11).
Tabela. 3. *Lathyro-Melandrietum noctiflori* Oberd. 1957 (zdjęcia 1– 6) i *Inuletum ensifoliae* Kozł. 1925 (zdjęcia 7–11).

Successive No. Numer kolejny	1	2	3	4	5	6		7	8	9	10	11	
Field No. of relevé Numer zdjęcia w terenie	3	2	26	27	21	22	$\bar{x}$	20	23	28	24	29	$\bar{x}$
Patch area [m^2] Powierzchnia płatu	70	80	70	70	80	70		100	100	70	100	90	
Cover of herb layer [%] Pokrycie powierzchni zdjęcia przez rośliny	100	80	95	80	90	85	88,3	70	100	80	75	70	79,0
Number of species in relevé Liczba gatunków w zdjęciu fitosocjologicznym	58	63	58	65	64	57	61	63	62	48	73	55	60

	1	2	3	4	5	6	S	D	7	8	9	10	11	S	D
ChAss.: *Lathyro-Melandrietum noctiflori*															
Lathyrus tuberosus	**1.1**	**+**	**1.1**	**1.2**	**1.1**	**1.1**	**V**	**433**	**+**	**+**	**+**	**+**	**.**	**IV**	**80**
Melandrium noctiflorum	**1.1**	**1.1**	**1.1**	**+**	**1.1**	**1.1**	**V**	**433**	**+**	**+**	**.**	**.**	**.**	**II**	**40**
I ChAll.: *Caucalidion lappulae*															
Stachys annua	**+**	**+**	**1.1**	**1.1**	**1.1**	**+**	**V**	**300**	**1.1**	**2.2**	**1.1**	**.**	**.**	**III**	**550**
Avena fatua	**+**	**+**	**+**	**+**	**.**	**+**	**V**	**83**	**+**	**.**	**.**	**+**	**+**	**III**	**60**
Chaenorhinum minus	**+**	**.**	**+**	**+**	**+**	**+**	**V**	**83**	**.**	**+**	**+**	**.**	**+**	**III**	**60**
Euphorbia exiqua	**+**	**.**	**1.1**	**.**	**+**	**.**	**III**	**167**	**+**	**1.1**	**.**	**+**	**+**	**IV**	**140**
Aethusa cynapium ssp. *agrestis*	**.**	**.**	**1.2**	**+**	**+**	**.**	**III**	**167**	**+**	**2.2**	**+**	**.**	**.**	**III**	**390**
Silene vulgaris	**1.1**	**.**	**.**	**+**	**.**	**.**	**I**	**17**	**.**	**.**	**+**	**.**	**+**	**II**	**40**
II ChO.: *Centauretalia cyani*															
Papaver rhoeas	**1.1**	**+**	**2.2**	**2.2**	**2.2**	**1.3**	**V**	**1058**	**2.2**	**1.2**	**1.3**	**1.1**	**+**	**V**	**670**
Consolida regalis	**+**	**.**	**1.1**	**1.1**	**1.1**	**+**	**V**	**283**	**+**	**1.1**	**1.1**	**.**	**1.2**	**IV**	**320**
Lithospermum arvense									**+**	**+**	**.**	**+**	**.**	**III**	**60**
III ChAll.: *Polygono-Chenopodion,* ChO.: *Polygono-Chenopodietalia*															
Euphorbia helioscopia	**.**	**.**	**+**	**+**	**+**	**+**	**IV**	**67**	**+**	**+**	**.**	**+**	**+**	**IV**	**80**
Chenopodium album	**.**	**.**	**.**	**+**	**+**	**.**	**II**	**33**	**+**	**+**	**.**	**.**	**+**	**III**	**60**
Atriplex patula	**.**	**.**	**+**	**+**	**.**	**.**	**II**	**33**	**.**	**+**	**.**	**+**	**.**	**II**	**40**
Sonchus asper	**+**	**+**	**.**	**.**	**.**	**.**	**II**	**33**	**+**	**.**	**.**	**.**	**+**	**II**	**40**
Veronica persica	**+**	**+**	**.**	**.**	**.**	**+**	**III**	**50**							
IV ChCl.: *Stellarietea mediae*															
Sinapis arvensis	**+**	**+**	**+**	**1.1**	**1.1**	**+**	**V**	**233**	**+**	**1.1**	**+**	**.**	**+**	**IV**	**160**
Anagallis arvensis	**+**	**+**	**+**	**1.1**	**1.2**	**1.1**	**V**	**300**	**.**	**1.1**	**+**	**.**	**+**	**III**	**140**
Lactuca seriolla	**+**	**.**	**.**	**+**	**1.1**	**+**	**IV**	**133**	**+**	**+**	**+**	**+**	**.**	**IV**	**80**
Conyza canadensis	**.**	**+**	**+**	**.**	**+**	**+**	**IV**	**67**	**+**	**.**	**.**	**.**	**+**	**II**	**40**
Fallopia convolvulus	**+**	**.**	**.**	**1.1**	**.**	**.**	**II**	**100**	**.**	**+**	**.**	**.**	**+**	**IV**	**80**
Polygonum aviculare	**+**	**.**	**.**	**+**	**+**	**.**	**III**	**50**	**.**	**+**	**+**	**.**	**.**	**II**	**40**
Viola arvensis	**.**	**.**	**+**	**+**	**+**	**.**	**III**	**50**	**+**	**+**	**.**	**.**	**.**	**II**	**40**
Vicia hirsuta	**.**	**.**	**+**	**+**	**+**	**.**	**III**	**50**	**.**	**+**	**.**	**.**	**.**	**I**	**20**
Apera spica-venti	**.**	**.**	**.**	**.**	**+**	**+**	**II**	**33**	**.**	**+**	**.**	**.**	**+**	**II**	**40**
Matricaria maritima ssp. *inodora*	**.**	**.**	**.**	**.**	**.**	**+**	**I**	**17**	**.**	**+**	**.**	**.**	**+**	**II**	**40**
Stellaria media	**.**	**.**	**+**	**.**	**.**	**.**	**I**	**17**	**+**	**+**	**.**	**.**	**.**	**II**	**40**
ChAss.: *Inuletum ensifoliae*															
Linum flavum	**.**	**.**	**+**	**.**	**+**	**.**	**II**	**33**	**1.2**	**1.2**	**1.1**	**1.1**	**1.2**	**V**	**500**
Inula ensifolia	**.**	**.**	**+**	**.**	**.**	**+**	**II**	**39**	**1.1**	**+**	**+**	**1.1**	**+**	**V**	**260**

Cont. Table 3 – cd. tab. 3

	1	2	3	4	5	6	S	D	7	8	9	10	11	S	D
V ChCl.: *Festuco-Brometea*															
Anthemis tinctoria	1.1	1.1	2.3	+	.	1.3	V	558	1.3	2.2	1.2	1.1	1.3	V	750
Poa compressa	1.2	1.3	1.3	+	+	1.3	V	367	1.2	.	.	.	1.3	II	200
Anthyllis vulneraria	1.1	1.3	+	.	1.2	1.2	V	350	.	.	.	+	1.2	II	120
Sanguisorba minor	1.1	.	.	.	.	+	II	100	+	+	+	+	+	V	100
Eryngium planum	.	+	.	+	.	.	II	33	+	1.2	+	+	1.3	V	340
Scabiosa ochroleuca	.	1.2	.	+	.	+	III	117	+	.	+	+	+	IV	80
Euphorbia cyparisiass	.	1.3	+	.	+	1.3	IV	200	.	.	.	+	1.1	II	120
Salvia verticillata	1.2	1.3	.	.	1.1	1.3	IV	333	.	.	.	2.3	1.3	II	450
Centaurea stoebe	.	.	1.1	1.2	1.2	1.1	IV	333	.	.	+	1.2	.	II	120
Centaurea scabiosa	.	1.3	.	.	1.2	1.2	III	250	1.2	+	.	1.2	.	III	220
Campanula sibirica	1.1	1.1	.	.	.	+	III	183	.	.	.	+	.	I	20
Phleum phleoides	1.2	.	.	+	.	.	II	100	.	.	.	1.1	.	I	100
Carlina vulgaris	.	+	.	.	.	.	I	17	.	.	+	+	.	II	40
Hieracium echioides	.	.	.	+	+	+	III	50	+	1.1	.	.	.	I	20
Plantago media	.	.	.	.	.	+	I	17	+	1.1	.	.	.	II	120
VI ChCl.: *Artemisietea vulgaris*															
Picris hieriacioides	1.2	1.2	1.2	1.2	1.3	1.2	V	500	1.2	+	+	1.3	.	IV	200
Cichorium intybus	+	+	1.2	1.2	1.3	1.2	V	367	1.2	1.2	.	+	+	IV	200
Medicago lupulina	1.3	1.1	+	+	+	+	V	233	+	+	.	+	1.2	IV	160
Echium vulgare	1.2	1.3	+	+	1.3	.	V	283	+	.	+	+	.	III	60
Carduus crispus	1.2	+	+	+	+	.	V	150	+	+	.	.	.	II	40
Pastinaca sativa	1.3	2.3	1.3	1.2	.	.	IV	542	+	1.2	1.2	+	1.2	V	340
Mellilotus officinalis	1.2	.	1.1	1.2	1.2	.	IV	333	+	+	1.1	1.1	.	IV	240
Cirsium arvense	1.2	+	1.2	+	+	.	IV	217	+	1.2	1.2	.	+	IV	240
Cerinthe glabra	.	.	1.2	1.2	+	+	IV	200	1.2	+	1.2	.	.	III	220
Artemisia vulgaris	1.1	1.2	.	1.2	+	1.2	IV	350	+	1.2	.	+	.	II	140
Linaria vulgaris	+	.	.	+	+	+	IV	67	.	.	.	.	+	I	20
Rubus caesius	.	1.2	+	.	+	.	III	117	+	.	.	1.2	.	II	120
Melandrium album	.	.	+	+	+	.	III	50	.	.	.	+	+	II	40
Dipsacus silvestris	+	.	+	.	.	.	II	33	.	.	+	+	+	III	60
Hypericum perforatum	.	+	+	.	+	.	III	50	.	.	+	.	.	I	20
Verbascum thapsus	.	+	.	.	.	.	I	17	.	.	+	+	.	II	40
Medicago sativa	1.1	+	.	.	.	.	II	100	.	.	.	+	.	I	20
VII ChCl.: *Agropyretea intermedio-repentis*															
Tussilago farfara	1.2	1.2	1.2	+	1.2	+	V	367	1.2	1.2	1.2	.	+	IV	320
Convolvulus arvensis	1.2	.	1.2	.	+	.	III	183	+	1.2	+	+	+	V	180
Elymus repens	1.2	1.2	1.2	.	1.2	.	IV	333	.	1.2	.	+	.	II	120
VIII ChCl.: *Koelerio glaucae- Corynephoretea canescentis*															
Senecio vernalis	+	.	+	+	.	.	III	50							
IX ChCl.: *Molinio-Arrhenatheretea*															
Achillea millefolium	1.2	+	.	+	.	1.2	IV	200	1.2	1.2	1.2	+	1.2	V	420
Daucus carota	1.1	1.1	1.2	1.2	1.2	+	V	433	.	1.2	1.2	1.2	.	III	300
Lolium perenne	1.1	1.3	1.1	1.2	1.2	1.2	V	500	1.1	1.1	.	.	.	II	200
Arrhenatherum elatius	.	.	1.1	1.1	1.2	1.3	IV	333	+	.	1.2	1.2	2.3	IV	570
Festuca rubra	.	1.2	1.2	1.2	+	.	IV	267	.	.	1.2	.	1.1	II	200
Trfolium pratense	+	.	.	+	+	+	IV	67	.	+	.	1.1	+	III	140
Centaurea jacea	+	+	1.2	.	1.2	.	IV	200	.	.	.	1.1	+	II	120
Taraxacum officinale	+	+	.	+	+	+	V	83	+	.	+	.	1.3	III	140
Agrostis capillaris	.	+	.	.	.	.	I	17	1.2	1.2	1.2	1.3	+	V	420
Pimpinella saxifraga	.	+	.	+	+	2.3	IV	342	.	.	.	+	.	I	20

Cont. Table 3 – cd. tab. 3

	1	2	3	4	5	6	S	D	7	8	9	10	11	S	D
Dactylis glomerata	.	1.1	.	.	+	1.2	III	183	.	.	+	+	.	II	40
Trifolium hybridum	+	.	+	.	+	.	III	50	+	.	.	.	+	II	40
Vicia cracca	1.2	+	.	+	.	.	III	117	+	.	.	.	.	I	20
Avenula pubescens									.	+	.	.	1.3	II	120
X ChCl.: *Trifolio-Geranietea sanguinei*															
Medicago falcata	2.2	1.2	.	.	1.2	1.2	IV	542	+	+	+	+	+	V	100
Agrimonia eupatoria	+	+	+	+	.	1.2	V	150	.	1.2	.	+	+	III	140
Campanula rapunculoides	+	.	+	+	1.2	.	IV	133	+	+	1.1	.	+	IV	160
Fragaria viridis	.	+	1.1	.	+	+	IV	133	.	1.1	.	+	.	II	120
Coronilla varia	.	.	+	+	.	.	II	33	+	2.2	+	.	.	III	390
Origanum vulgare	.	1.1	+	+	.	.	III	117	.	.	.	1.2	+	II	120
Vicia tenuifolia	.	.	1.2	+	.	.	II	100	.	+	+	.	.	II	40
Astragalus cicer	.	+	.	.	1.1	.	II	100	.	1.1	.	.	.	I	100
Veronica teucrium	.	+	.	.	.	+	II	33	.	.	+	.	.	I	20
Clinopodium vulgare	.	+	.	+	.	.	II	33							
XI ChCl.: *Rhamno--Prunetea*															
Cornus sanguinea (juv.)	1.2	+	.	1.2	1.2	+	V	283	1.2	1.2	.	+	+	IV	240
Cerasus fruticosa (juv.)	1.2	.	.	.	.	.			+	.	1.2	+	.	III	140
Ligustrum vulgare (juv.)	.	1.2	.	.	.	1.2	II	167	.	.	+	+	.	II	40
Rosa canina (juv.)	.	.	.	.	.	1.2	I	83	.	.	.	+	1.3	II	120
XII ChCl.: *Nardo-Callunetea*															
Genista tinctoria	1.2	+	.	.	.	.	I	17	+	.	.	1.3	.	II	120
XIII Accompanying species – Gatunki towarzyszące:															
Diplotaxis muralis	+	+	+	+	+	+	V	100	1.2	1.1	+	.	1.1	IV	320
Lapulla squarrosa	+	.	+	+	+	1.2	V	150	+	+	+	.	.	III	60
Arenaria serpyllifolia	+	+	.	+	.	1.2	IV	133	.	+	.	+	.	II	40
Ononis spinosa	.	.	.	1.3	.	1.3	II	167	+	2.3	+	.	1.3	IV	490
Galeopsis angustifolia	.	.	.	+	.	+	II	33	+	.	+	.	+	III	60
Neslia paniculata	.	.	.	+	.	.	I	17	+	.	.	.	+	II	40
Trifolium aureum	.	.	+	.	.	.	I	17	+	.	.	+	.	II	40

Plant species occurring only in I degree of phytosociological constance in plant communities. After a name of species the number of the phytosociological 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. Po nazwie gatunku podano numery zdjęć fitosocjologicznych, w których wystąpił gatunek, w nawiasach – stopnie ilościowości i towarzyskości.

I: *Thymelaea passerina* 1,7(+); **III:** *Capsella bursa-pastoris* 10(+), *Sonchus arvensis* 10(+),*Veronica polita* 10(+); **IV:** *Galeopsis tetrahit* 7(+), *Malva pusilla* 4,7(+); **V:** *Allium oleraceus* 10(+), *Artemisia campestris* 10(+), *Asparapus officinalis* 10(1.1); **VI:** *Armoracia rusticana* 2(+), *Carduus acanthoides* 4(+), *Erysimum cheiranthoides* 10(+), *Galium aparine* 2, 10(+), *Lamium maculatum* 2(+), *Solidago canadensis* 10(+), *Tanacetum vulgare* 5(+); **VII:** *Falcaria vulgaris* 4,10(+); **VIII:** *Thymus serpyllum* 5,10(1.2), *Trifolium arvense* 2(+), *T. campestre* 3(+); **IX:** *Campanula patula* 3,7(+), *Galium mollugo* 10(+), 2(1.2); **X:** *Galium verum* 5(+), *Verbascum lychnitis* 5(+); **XI:** *Berberis vulgaris* (juv.) 2,10(+); **XIII:** *Camelina microcarpa* 5,10(+), *Cardaminopsis arenosa* 6,8(+), *Erigeron acer* 2(+), *Senecio jacobaea* 1,11(+), *S. vulgaris* 5,11(+), *Sherardia arvensis* 10(+), *Ranunculus bulbosus* 6(+).

Lathyro-Melandrietum association was also distinguished by Trzcińska-Tacik (2000). The phytocoenoses are present in cereals on the soils of organic and conventional farms in the village Tempoczów – Rędziny. The floristic composition of the patches from organic and conventional farms was to a great extent similar. Trzcińska-Tacik (2000) classified them into *Lathyro-Melandrietum* association, but noted that the floristic composition gravitates also 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 rare in conventional farms and slightly more frequent in organic farms. *Lathyro-Melandrietum* community is floristically very rich, characterised by the presence of 153 taxa, it is far poorer in conventional farms, where it is formed by only 80 taxa. 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.

Lathyro-Melandrietum association was also distinguished by Anioł-Kwiatkowska (1990) in the area of Dalkowskie Hills and Trzebnickie Hills. The phytocoenoses inhabit mainly winter grains, and they were most frequently recorded in wheat. Two characteristic species *Lathyrus tuberosus* and *Melandrium noctiflorum* occur in the *Lathyro-Melandrietum* association. *Lathyrus tuberosus* is a constant component of the community (S = IV–V) both in the phytocenoses of Dalkowskie Hills and Trzebnickie Hills. It reaches significant cover coefficients, respectively D = 1105 and D = 2950. *Melandrium noctiflorum* is less frequently recorded. In the communities of Dalkowskie Hills it is found sporadically (S = I, D = 326), slightly more frequently in Trzebnickie Hills (S = III, D = 452). Characteristic species of *Caucalidion lappulae* association are also found in the structure of this phytocoenose. The most frequent and most numerous were *Euphorbia exiqua* and *Avena fatua*. *Lathyro-Melandrietum* is a floristically rich community of cereal, on average there are from 16 species in one relevé (on Dalkowskie Hill) up to 24 (on Trzebnickie Hill), while in 17 patches of the community (Dalkowskie Hill) 81 taxa were recorded. Phytocoenoses develop on compacted soils formed by medium dusty clay and alkaline loess formations, mainly on southern, warm and dry slopes of glacial hillocks.

Lathyro-Melandrietum noctiflori association is also referred to in Poland as *Euphorbio--Melandrietum* Müller 1964. The community is found mainly on black loam soil of Pleistocene ice-marginal lake in the area of Pyrzyce Lowland (Nizina Pyrzycka) and black soils of Wrocław which are rich in calcium carbonate.

According to Matuszkiewicz (2007) the information of the occurrence of this community in Lublin Upland (Wyżyna Lubelska) is due to a misunderstanding, while in fact there are poorer or anthropogenically impoverished forms of *Caucalido-Scandicetum* on poorer by nature or secondarily degraded Jurassic and cretaceous rendzinas.

***Inuletum ensifoliae* Kozł. 1925** (Table 3)

Five patches of vegetation were classified to xerothermic grassland community *Inuletum ensifoliae*. It was distinguished due the frequent occurrence in it of the two characteristic species of *Linum flavum* association (S = V, D = 500) and *Inula ensifolia* (S = V, D = 260).

Both species were introduced in this area as a part of bio-reclamation of the ridge area of the quarry. In the floristic structure of the association there are often found the same species as were mentioned in the characteristic of the previous associations. Most species are represented by the following classes: *Stellarietea mediae* (29 taxa) as well as *Artemisietea vulgaris* and *Festuco-Brometea* (20 taxa each) – Table 1. Species of *Stellarietea mediae* class are recorded frequently, but their cover coefficients, apart from a few taxa, are mostly of two digits. Only two species – *Papaver rhoeas* (S = V, D = 670) and *Consolida regalis* (S = IV, D = 320) were frequently and numerously found (Table 3). The ridge area is also frequently and numerously inhabited by the species of xerothermic grasslands such as *Anthemis tinctoria* (S = V, D = 750) and *Eryngium planum* (S = V, D = 340) along with ruderal communities: *Pastinaca sativa* (S = IV, D = 340) and other (Table 3). The structure of the association is formed by numerous species of seminatural *Molinio-Arrhenatheretea* communities: *Achillea millefolium* (S = V, D = 420), *Agrostis capillaris* (S = V, D = 420) and *Arrhenatherum elatius* (S = IV, D = 570). The individual patches are floristically rich. The number of species varies from 48 to 73, and the average is 60. *Linum flavum* and *Inula ensifolia* were introduced in the whole ridge area. Only a part of the substrate gave satisfactory results for the growth and development of the introduced taxa. *Inuletum ensifoliae* association was distinguished by Kutyna and Malinowska (2012) on two reclaimed terraces located on the slope of the "Piotrawin" quarry. The community was floristically slightly poorer in comparison to the phytocoenoses found in the ridge area of the quarry. In 2001, 100 taxa were recorded, and in 2011 – 92. The most dominant were species of *Festuco-Brometea* class, 33 and 34 taxa respectively. The share of *Artemisietea vulgaris* class species was also significant in the structure of the association – 26 and 18. While the share of segetal communities is small. The number of species was not big, there were respectively 5 and 2 taxa recorded in the years of the study (Kutyna and Malinowska 2012). In the communities of the ridge area, segetal communities taxa were dominant, there were 39, 26 and 29 species respectively in the individual associations (Table 1). There is also a big share of species of *Artemisietea vulgaris*, *Festuco-Brometea* and *Molinio-Arrhenatheretea* classes (Table 1).

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CONCLUSIONS

1. In the technically and biologically reclaimed ridge area of the quarry “Piotrawin” (the crown of the excavation) two segetal associations were distinguished (*Sileno inflatae-Linarietum minoris* and *Lathyro-Melandrietum noctiflori*) along with one association of xerothermic grasslands – *Inuletum ensifoliae.*
2. The associations reveal high mutual floristic similarity at the level of 72.1–76.8%. Higher mutual similarities are revealed by phytocenoses of segetal communities. It is lower in reference to *Inuletum ensifoliae.*

3. The communities are dominated by characteristic species of *Stellarietea mediae*, which is represented by 39, 26 and 29 taxa respectively.
4. Moreover, the structure of the phytocoenons is formed by numerous species of the following classes: *Artemisietea vulgaris*, *Festuco-Brometea* and *Molinio-Arrhenatheretea*.
5. The communities are very rich floristically and the number of species in individual associations varies from 147 (*Sileno inflatae-Linarietum minoris*) to 120 (*Lathyro-Melandrietum noctiflori*) and (*Inuletum ensifoliae*).
6. All patches of the phytocoenoses are characterised by species richness. The average number of species in one relevé, for the distinguished associations, ranges from 60 to 62 taxa.
7. The floristic and phytosociological studies conducted three years after the technical and biological reclamation, revealed the occurring process of ecological succession heading for the formation of xerothermic grassland communities heading for the formation of shrub phytocoenoses of *Rhamno-Prunetea* class.

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Abstract. In 1998, three years after technical and biological reclamation, 29 relevés were made in the ridge area (the crown of the excavation) of the quarry "Piotrawin". Two segetal associations were distinguished (*Sileno inflatae-Linarietum minoris* and *Lathyro-Melandrietum noctiflori*) as well as one xerothermic grassland association (*Inuletum ensifoliae).* The communities are floristically very rich. The number of taxa in the individual associations is varied and it ranges from 120 (*Lathyro-Melandrietum noctiflori*) to 147 (*Sileno inflatae-Linarietum minoris*). The average number of taxa in a relevé of individual communities is very high and it

ranges from 60 to 62. The dominant syntaxon in these communities is *Stellarietea mediae*, the number of taxa ranges from 26 to 39. Moreover, the communities are characterised by a numerous participation of ruderal communities species (*Artemisietea vulgaris*), xerothermic grasslands (*Festuco-Brometea*) and seminatural grasslands (*Molinio-Arrhenatheretea*). The aforementioned communities have close mutual floristic similarities determined on the basis of the degree of phytosociological stability. High mutual similarity, at the level of 76.8%, is demonstrated by segetal communities. Smaller mutual similarity (72.1%) occurs between *Sileno inflatae-Linarietum minoris* and *Inuletum ensifoliae*. After three years, the segetal communities were still dominant in the researched ridge area of the quarry, but during a reconnaissance performed in 2013 a significant floristic transformation of the community was noted, which tends to the infestation of the area with xerothermic grasslands communities species and scrubs of *Rhamno-Prunetea* class.