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PLANT COMMUNITIES ON THE RIDGE OF THE “PIOTRAWIN” QUARRY 19 YEARS AFTER TECHNICAL AND BIOLOGICAL RECLAMATION

ZBIOROWISKA ROŚLINNE WYSTĘPUJĄCE NA GRZBIECIE KAMIENIOŁOMU „PIOTRAWIN” 19 LAT PO REKULTYWACJI TECHNICZNO-BIOLOGICZNEJ

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Streszczenie. W 2014 roku wykonano badania na powierzchni grzbietowej kamieniołomu „Piotrawin”. Celem ich było określenie zmian sukcesyjnych, jakie zaistniały w zbiorowiskach wyróżnionych 16 lat wcześniej (w 1998 roku). Wykonano 20 zdjęć fitosocjologicznych. W fitocenozach z 2014 roku stwierdzono brak zbiorowisk segetalnych *Sileno inflantae-Linarietum minoris* i *Lathyro-Melandrietum noctiflori* obecnych w 1998 roku. W wyniku transformacji zbiorowiska *Inuletum ensifoliae* w 2014 roku prawie nie występują gatunki z klasy *Stellarietea mediae*. Fitocenon ten w 2014 roku jest uboższy florystycznie. Strukturę tworzy tylko 88 taksonów, w porównaniu ze znaczną liczbą gatunków (od 118 do 148) notowanych w zbiorowiskach w 1998 roku. Mniejsza jest także średnia liczba taksonów (34), w porównaniu ze znacznym bogactwem florystycznym zbiorowisk w 1998 roku (od 60 do 62 gatunków). Zbiorowisko *Inuletum ensifoliae* występujące w 2014 roku wykazuje także pewną odrębność florystyczną; zaistniały także różnice w stałości występowania i współczynnikach pokrycia wielu gatunków w poszczególnych klasach fitosocjologicznych. Fitocenozy z 2014 roku charakteryzują się małymi współczynnikami podobieństwa, które wahają się od 49,0 do 54,0%, w stosunku do zbiorowisk wyróżnionych w 1998 roku. Natomiast wzajemne podobieństwo zbiorowisk z 1998 roku jest bardzo duże i mieści się w zakresie od 72,5 do 80%. W zbiorowisku *Inuletum ensifoliae* w 2014 roku mniejsze są stopnie stałości i współczynniki pokrycia wielu gatunków z klasy *Artemisietea vulgaris* i *Molinio-Arrhenatheretea*, natomiast znacznie większe wartości osiągają taksony klasy *Festuco-Brometea*. Obserwuje się także intensywny rozwój gatunków zaroślowych z klasy *Rhamno-Prunetea*. Szczególnie licznie powierzchnię grzbietową kamieniołomu opanowują: *Cornus sanguinea* (S = V, D = 1625), *Rosa canina* (S = V, D = 738) i *Cerasus fruticosa* (S = IV, D = 225) oraz inne gatunki krzewiaste. Taksony te zasiedlają prawie wszystkie warstwy zbiorowiska, szczególnie warstwę b i zapewne za kilkadziesiąt lat obszar ten opanują fitocenozy *Rhamno-Cornetum sanguinei* oraz *Pruno-Ligustretum*, aktualnie otaczające wyrobisko kamieniołomu od południa i północy.

Key words: quarry of marl “Piotrawin”, xerothermic grasslands, technical and biological reclamation, phytosociological stability, ecological succession, cover coefficient, plant communities, association *Inuletum ensifoliae*.

Słowa kluczowe: kamieniołom margli „Piotrawin”, murawy kserotermiczne, rekultywacja techniczna i biologiczna, stałość fitosocjologiczna, sukcesja ekologiczna, współczynnik pokrycia, zbiorowisko roślinne, zespół *Inuletum ensifoliae*.

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 and upland hills. They are also found in the areas of anthropogenic origin, for example on limestone and marl southern and western slopes of quarries, where marl and limestone are extracted. The 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). 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*. A community of sword leaf inula (*Inuletum ensifoliae*) occurs within the last of the communities. The community was identified and described in Małopolska Upland (Wyżyna Małopolska) by Kozłowska (1925), as well as Kostuch and Misztal (2004, 2006, 2007), Loster and Gawroński (2005), Trąba (2006), in Lublin Upland (Wyżyna Lubelska) by Sławiński (1952), Fijałkowski and Izdebski (1957), Fijałkowski (1964), Fijałkowski and Adamczyk (1980, 1990), Izdebski and Fijałkowski (1959), Kucharczyk (2000), Kutyna and Malinowska (2012, 2015), Wołk (2000), Kimsa and Sokołowska (1973). In Sandomierska Upland (Wyżyna Sandomierska) and Iłża Forehills (Przedgórze Iłżeckie) it was described by Głazek (1968, 1984). Kutyna and Malinowska (2012) distinguished *Inuletum ensifoliae* community on two reclaimed terraces on the southwestern slope of the "Piotrawin" quarry. Both characteristic species of *Linum flavum* and *Inula ensifolia* communities were introduced to the area according to the guidelines project of technical and biological reclamation of the quarry slope after the end of exploitation. The taxa of this community were occasionally found on the ridge of the quarry two years after the reclamation performed between 1995 and 1996 (Kutyna and Malinowska 2015). Three years after the reclamation, floristic and phytosociological studies were carried out in 1998 on the flat ridge area of „Piotrawin” quarry. It was dominated by two segetal communities *Sileno inflatae-Linarietum minoris* and *Lathyro-Melandrietum*, and only a few (5 patches) phytocoenoses were classified as *Inuletum ensifoliae ensifoliae* (Kutyna and Malinowska 2015). To illustrate the changes in communities that have taken place after 16 years, another research of this area was performed in 2014. Its aim was to determine the scale of transformation that occurred in phytocenoses found on the ridge of „Piotrawin” quarry.

If interested, please refer to two publications by Kutyna and Malinowska (2012, 2015) where the detailed description of the nature of the study area is extensively presented.

MATERIAL AND METHODS

20 relevés were made on the ridge of "Piotrawin" quarry in 2014. All plant patches were included to *Inuletum ensifoliae* association. The analytical phytosociological table of the association was prepared 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).

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 phytosociological stability of species and the formula by Kulczyński (Szafer and Zarzycki 1972).

RESULTS AND DISCUSSION

Inuletum ensifoliae Kozł. 1925 (Table 1)

In 2014, there were only phytocenoses of *Inuletum ensifoliae* on the ridge of the “Piotrawin” quarry. The community structure was formed by 88 taxa, and the individual plant patches were floristically rich. The number of species ranged from 28 to 39, the average was 34 (Table 1). In 1998, the area was inhabited mainly by segetal communities – *Sileno inflatae-Linarietum minoris* and *Lathyro-Melandrietum noctiflori*, and only five plant patches in the area were classified as *Inuletum ensifoliae* syntaxon (Kutyna and Malinowska 2015). Both characteristic species of *Linum flavum* and *Inula ensifolia* association were introduced to the area in 1995 during the process of biological reclamation. In 2014, the phytocenoses were inhabited more often by *Linum flavum* (S = V, D = 1278) and slightly more rarely by *Inula ensifolia* (S = IV) which reached a slightly lower coverage coefficient at 428 (Table 1). Segetal species communities of *Stellarietea mediae* were barely found in the structure of the association. More numerous were species of *Festucetalia valesiacae* order and *Festuco-Brometea* class. The most common and the most numerous were *Salvia verticillata* (S = V, D = 930), *Sanguisorba minor* (S = V, D = 868), *Euphorbia cyparissias* (S = V, D = 490) and *Scabiosa ochroleuca* (S = V, D = 490). Beside thermophilic, extremely calciphilic and xerothermic species of grasslands found on shallow rendzinas, exposed limestone and marlstone, the ridge of the quarry is often inhabited by numerous species of ruderal communities of *Artemisietea vulgaris* class and by species of semi-natural communities primarily of *Arrhenatheretalia elatioris* order and *Arrhenatherion elatioris* alliance.

The structure of *Inuletum ensifoliae* community is floristically diverse. Great richness of species and the participation of taxa from different classes indicate that the phytocenoses are currently in the phase of floristic restoration. There are species of xerothermic grasslands, ruderal communities and dry as well as fresh meadows. The dominant species in the syntaxon of *Artemisietea vulgaris* are *Rubus caesius* (S = V, D = 1063) and *Picris hieracioidis* (S = V, D = 533), while the latter species is distinctive for *Dauco-Picridetum hieracioidis* association. Common, but less numerous are: *Pastinaca sativa*, *Hypericum perforatum* and *Echium vulgare*. They reach the fourth degree of stability (Table 1). Among species of *Molinio-Arrhenatheretea* class, the main and constant components of the association are *Arrhenatherum elatius* (S = V, D = 930) and *Daucus carota* (S = V, D = 425). *Agrostis capillaris* and *Galium mollugo* are also frequently found (S = IV). A significant component of most phytocenoses (relevé 1–15) is *Genista tinctoria*, a taxon introduced during biological reclamation of the object in the years 1995–1996. Ecological conditions in this area are favourable for the species to grow and develop, with S = IV and D = 1525.

Table. 1. *Inuletum ensifoliae* Kozł. 1925, variant with *Genista tinctoria* (relevés 1–15), subvariant with *Thymus serpyllum* (relevés 1–7), typicum variant (relevés 16–20)

Tabela. 1. *Inuletum ensifoliae* Kozł. 1925, wariant z *Genista tinctoria* (zdjęcia 1–15), subwariant z *Thymus serpyllum* (zdjęcia 1–7), wariant typowy (zdjęcia 16–20)

Successive No. Numer kolejny	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
Field No. of relevé Numer zdjęcia w terenie	20	11	10	9	12	8	6	7	19	5	18	17	4	2	3	1	14	13	15	16	\bar{X}		
Patch area Powierzchnia platu [m ²]	80	80	80	80	80	90	90	90	70	80	80	80	90	100	100	100	70	80	80	80			
Cover of herb layer Pokrycie powierzchni zdjęcia przez rośliny [%]	80	80	90	95	90	95	85	100	90	80	75	90	90	75	80	80	80	85	90	90	86,0		
Number of species in relevé Liczba gatunków w zdjęciu fitosocjologicznym	35	37	31	35	37	35	33	36	33	39	34	35	35	36	34	35	28	31	32	31	34		
																					S	D	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
ChAss.: <i>Inuletum ensifoliae</i>																							
<i>Linum flavum</i>	+	1.1	+	1.1	1.3	2.3	.	2.3	3.3	3.3	+	1.1	2.3	2.3	2.3	2.2	3.3	1.2	1.2	1.2	V	1278	
<i>Inula ensifolia</i>	+	.	+	1.2	.	.	3.2	.	2.3	1.3	+	1.2	1.2	1.2	.	1.1	+	.	+	+	IV	428	
I ChO.: <i>Festucetalia valesiacae</i>																							
<i>Salvia verticillata</i>	1.2	1.2	1.2	.	1.2	1.3	+	1.3	.	1.3	2.3	2.3	2.3	2.2	2.3	2.2	2.3	2.3	1.2	1.2	V	930	
<i>Scabiosa ochroleuca</i>	1.1	1.2	+	+	+	1.3	1.2	+	+	1.1	+	1.2	+	+	+	+	1.2	+	1.2	2.2	V	343	
<i>Campanula sibirica</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	V	90	
<i>Anthemis tinctoria</i>	.	+	.	+	.	.	+	.	.	+	+	.	+	.	+	+	+	+	.	.	III	45	
II ChCl.: <i>Festuco-Brometea</i>																							
<i>Sanguisorba minor</i>	2.3	1.2	2.3	2.3	2.3	2.3	.	2.3	1.2	1.2	+	1.2	.	1.2	1.2	1.1	1.3	2.3	1.2	1.3	V	868	
<i>Euphorbia cyparissias</i>	1.3	1.2	+	2.3	1.3	1.3	.	1.2	+	1.3	.	1.1	2.3	1.2	1.1	+	.	1.3	1.3	1.2	V	490	
<i>Centaurea stoebe</i>	+	+	+	+	+	+	1.2	+	.	+	.	+	+	+	+	+	+	+	+	+	IV	105	
<i>Eryngium planum</i>	+	+	+	+	.	+	+	.	+	+	1.1	1.1	+	.	.	.	+	.	.	+	IV	105	
<i>Anthyllis vulneraria</i> ssp. <i>polyphylla</i>	.	+	.	.	.	+	.	.	.	+	+	+	1.2	+	+	.	+	.	.	.	III	65	
<i>Centaurea scabiosa</i>	.	+	.	.	1.3	+	.	.	.	+	+	+	.	+	+	+	.	.	.	.	III	65
<i>Carlina vulgaris</i>	+	+	.	.	+	.	+	+	.	+	+	.	+	+	+	+	.	.	.	.	III	55
<i>Poa compressa</i>	.	+	.	+	.	+	+	.	.	+	.	.	.	.	+	.	.	+	+	+	III	45
III ChCl.: <i>Epilobietea angustifolii</i>																							
<i>Calamagrostis epigejos</i>	.	.	.	.	.	.	+	.	+	.	.	+	.	+	.	+	.	.	.	.	II	25

Table. 1. *Inuletum ensifoliae* Kozł. 1925, variant with *Genista tinctoria* (relevés 1–15), subvariant with *Thymus serpyllum* (relevés 1–7), typicum variant (relevés 16–20) (cont.)

Tabela. 1. *Inuletum ensifoliae* Kozł. 1925, wariant z *Genista tinctoria* (zdjęcia 1–15), subwariant z *Thymus serpyllum* (zdjęcia 1–7), wariant typowy (zdjęcia 16–20) (cd.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
VIII ChCl.: <i>Nardo-Callunetea</i>																								
<i>Genista tinctoria</i>		3.4	3.3	3.4	2.3	2.3	1.3	2.3	4.3	2.3	2.3	2.2	1.2	1.3	1.3	1.2	.	.	.	.	.	IV	1525
IX ChCl.: <i>Trifolio-Geranietea sanguinei</i>																								
<i>Medicago falcata</i>		1.2	2.3	.	1.3	2.3	1.3	.	1.2	1.2	1.2	1.1	1.2	1.2	1.3	1.2	.	1.2	2.2	.	2.3	IV	650	
<i>Vicia tenuifolia</i>		.	.	+	+	.	+	.	+	.	+	.	+	+	+	+	.	.	+	+	+	IV	65	
<i>Agrimonia eupatoria</i>		1.2	1.3	1.2	1.3	1.3	.	.	+	.	+	1.2	.	.	.	.	.	.	1.2	1.2	+	III	215
<i>Coronilla varia</i>		.	.	1.3	.	.	.	.	.	.	+	.	.	+	.	.	.	.	+	+	.	II	45
X ChCl.: <i>Rhamno-Prunetea</i>																								
<i>Cornus sanguinea</i> a		1.3	I	25
<i>Cornus sanguinea</i> b		2.3	2.3	2.3	2.3	2.3	1.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.2	2.3	2.2	2.3	2.3	2.3	2.3	V	1625	
<i>Cornus sanguinea</i> (juv.) c		.	1.1	.	.	1.3	.	.	.	.	.	.	.	.	.	.	.	1.3	1.3	1.2	1.3	II	150
<i>Rosa canina</i> b		1.3	2.3	1.2	1.2	2.3	1.3	1.3	1.2	1.3	1.3	.	1.2	2.3	1.2	1.3	1.2	2.3	.	2.3	2.3	V	738	
<i>Rosa canina</i> (juv.) c		.	+	1.3	.	1.2	1.3	I	80	
<i>Cerasus fruticosa</i> b		.	.	.	+	.	1.3	+	1.3	1.2	1.3	+	.	+	1.2	1.2	.	.	1.2	+	1.3	IV	225	
<i>Rosa rubiginosa</i> b		.	.	+	1.1	.	.	.	+	1.1	+	2.2	+	1.1	.	.	.	1.2	.	.	1.3	III	233	
<i>Ligustrum vulgare</i> b		.	+	1.2	.	.	.	.	.	1.2	.	1.1	.	.	.	+	.	.	.	.	.	II	85
XI Accompanying species – Gatunki towarzyszące																								
<i>Juniperus communis</i> b		.	1.1	1.2	1.2	.	.	1.3	.	1.3	1.3	2.2	1.2	.	+	.	.	+	.	.	.	III	273	
<i>Juniperus communis</i> c		1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	I	25	
<i>Acer pseudoplatanus</i> b		+	.	.	+	+	.	.	+	+	+	II	30	
<i>Acer pseudoplatanus</i> c		+	I	5	

Plant species occurring only in I degree 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.

I: *Asparagus officinalis* 3,9,18(+); II: *Artemisia campestris* 13(+), *Elymus hispidus* 15(+), 5(3.3), *Veronica spicata* 15(+), 13 (1.2); III: *Sorbus aucuparia* (juv.) 12(+); IV: *Carduus acanthoides* 19(+), *Linaria vulgaris* 19(+), *Medicago lupulina* 16(1.2), *Reseda lutea* 9,13,16(+), *Solidago canadensis* 3,12,16(1.2), *Tanacetum vulgare* 5,18(+); V: *Convolvulus arvensis* 6,8(+); VII: *Centaurea jacea* 1,5,18(+), *Festuca rubra* 6,14(+), *Plantago lanceolata* 4(+), *Prunella vulgaris* 6(+), *Vicia cracca* 16(+); IX: *Astragalus cicer* 13,16(+), 12(1.3), *Campanula rapunculoides* 5,19(+), *Clinopodium vulgare* 19,20(+), *Fragaria viridis* 1,2(1.3); X: *Berberis vulgaris* b 5(1.3), *Crataegus monogyna* b 7(+), *Prunus spinosa* b 18(2.3); XI: *Galeopsis angustifolia* 19(+), *Juglans regia* b 19(1.3), *Malus sp.* b 8(+), 20(1.3), *Ononis spinosa* 17,18,19,20(+), *Pinus sylvestris* b 8(+), 16(1.2), 2(1.3), 5(2.3), c 2,12(+), 5(1.3), *Quercus sp.* b 5(+), *Senecio jacobaea* 2,4,7,8(+), *Syringa vulgaris* b 14(+); ChCl: ***Stellarietea mediae***: *Conyza canadensis* 1,7(+), *Lathyrus tuberosus* 4,6,7,8(+), *Silene vulgaris* 7(+).

Based on those two significant values of synthetic characteristics of communities, which were reached in *Inuletum ensifoliae*, a variant of *Genista tinctoria* was distinguished. It is likely that in the next few years, it will successfully populate previously unoccupied areas. *Thymus serpyllum* is found together with this taxon in 6 patches (relevés 1–6). The presence of this taxon in 6 relevés allowed to distinguish in the variant of *Genista tinctoria*, the lowest syntaxonomic unit in the rank of subvariant. The species is not common ($S = II$) within all patches of the community in the ridge area of the quarry, and its coverage ($D = 343$) is also small. The individuals of *Thymus serpyllum* most often inhabit spaces which have not been occupied by *Genista tinctoria*, these are often on light and desiccated limestone soil.

A very important element of *Inuletum ensifoliae* community in 2014 is the presence in its structure of species of shrub communities of *Rhamno-Prunetea* class. *Cornus sanguinea*, which dominates in it, found mainly in layer b ($S = IV$), is significantly rarer in layer c ($S = II$). The species does not form any dense shrubs yet, there are a few individuals in the patches that form a compact crown. It may be supposed that in the future the species will become a dominating taxon in this area. Successional changes indicate the transition of the communities from the stage of xerothermic grasslands to shrub associations. The species did not appear naturally but was introduced in the process of reclamation in the years 1995–1996 in the ridge area of the quarry, and it adapted perfectly. It is accompanied by steppe cherry (*Cerasus fruticosa*), also introduced according to the project of reclamation. It is also often found, however it does not have the same scale of expansion as *Cornus sanguinea*. Shrub species spreading over the phytocoenoses of *Inuletum ensifoliae* also include *Rosa canina* and *R. fruticosa*, self-sown taxa on the ridge of the quarry. *Rosa canina* is a constant component of the syntaxon ($S = V$) and it reaches $D = 738$ (Table 1). The shrubby appearance of the community is complemented also by *Juniperus communis* – introduced species, which adapted well on marl ground ($S = III$, $D = 273$). The analysis of the community in 2014 shows that a significant part of patches has a layered structure. Species of spermatophytes are found in layer c, as well as grass and shrublet taxa. Above it, there is an “umbrella” of shrub communities species, which are loosely scattered in the area. Open spaces between shrubs provide sufficient inlet of light and warmth to the soil surface that allow for the development of herbaceous plants in layer c. Along with the growing number of individual shrub taxa and their increasing density, the development of herbaceous layer will be hindered, and numerous species will be eliminated from the community. As a result of ecological succession, after several decades, *Inuletum ensifoliae* will most probably be replaced by *Pruno-Ligustretum* and *Rhamno-Cornetum sanguinei* phytocoenoses. The communities currently surround the excavation of “Piotrawin” quarry from the south (from Kaliszany side) and from the north (from Piotrawin side). Several years ago, the slopes of the excavation and its ridge were devoid of all shrub species, and currently their number is growing.

Changes in plant communities after 16 years

With time, plant communities undergo transformation. Their species composition is gradually transformed, and there are changes in quantitative and spacial relations between the populations of different taxa. The process of secondary ecological succession is a durable phenomenon, which lasts for several decades or longer. The stage of relative

stability of a community, which is defined as climax corresponding to the ecological conditions of a particular habitat (biotope), is preceded by several stages of succession. On the flat part of the ridge of "Piotrawin" quarry, numerous changes in species composition of phytocoenoses were observed. In 1998, mainly segetal communities of *Sileno inflantae-Linarietum minoris* – (18 patches) occurred in this area, much rarer was *Lathyro-Melandrietum noctiflori* – (6 patches), and only 5 patches were related by their floristic composition to the syntaxon of xerothermic grassland *Inuletum ensifoliae*. The phytocoenoses are floristically rich. The number of species is significant and it equals 148, 120 and 118 respectively (Table 2 and 3). The individual plant patches of these communities are characterised by a high average number of species within a range of 60–62 taxa (Table 3).

After 16 years, in 2014, only phytocoenoses of *Inuletum ensifoliae* community were found in this area. The floristic composition of the community has undergone a major transformation. Only 3 species of segetal communities of *Stellarietea mediae* were occasionally found, in comparison to 1998 when the number of taxa in these phytocoenoses ranged from 28 to 41 (Table 2).

In 2014, significantly fewer species were recorded in the community. The structure was formed by only 88 taxa, also the average number of species was lower (34), and the range of taxa number in individual patches (28–39) was considerably smaller in comparison to 1998 (Table 3). Additionally, the number of species in the phytocoenoses of communities was different in 1998 and in 2014. In 2014, the total number of species in *Inuletum ensifoliae* was smaller (Table 3). Fewer taxa reaching the fifth and fourth degree of stability could be observed within *Artemisietea vulgaris* class, while their number increased in the fifth class within *Festuco-Brometea* class. The number of shrub taxa of *Rhamno-Prunetea* class, which occur in higher degrees of stability, has also particularly increased (Table 2 and 3).

The confirmation of changes occurring in the communities are the coefficients of mutual similarity of the distinguished phytocoenons. Segetal communities of *Sileno inflantae-Linarietum minoris* and *Lathyro-Melandrietum noctiflori* have very large (80%) similarity coefficient (Table 4). In relation to the phytocoenosis of *Inuletum ensifoliae* distinguished in 1998, segetal communities are characterised with slightly lower values (72.5% and 74.5%). In 2014, the community was characterised by low similarity coefficient (49.0–50.5%) in relation to segetal communities (Table 4). The phytocoenoses of *Inuletum ensifoliae* association occurring in 1998 and 2014 are also characterised by low mutual similarity (54%). Small values of similarity probably result from a smaller number of species in the community of 2014 and a slightly larger share of species reaching the fifth and the fourth degree of stability within *Festuco-Brometea*.

Moreover, the confirmation of the changes in the structure of communities of 1998 and 2014, are also the different stability degrees and cover coefficients in individual phytosociological classes of the distinguished phytocoenoses.

The first and the biggest change that has occurred in the compared communities is almost a total lack of species of *Stellarietea mediae* class in the phytocoenoses of 2014, as was mentioned before (Table 3). In 1998, the species within the class were characterised by high degrees of stability and by significant cover coefficients. Another important change in the structure of *Inuletum ensifoliae* of 2014 was a smaller number of taxa of *Molinio-Arrhenatheretea* class reaching the fifth and the fourth degree of stability with the exception of: *Arrhenatherum elatius* (S = V, D = 930), *Daucus carota* (S = V, D = 425) and *Galium mollugo* (S = IV, D = 248).

Table 2. Range of grades of stability in the particular syngenetic groups of *Sileno inflatae-Linarietum minoris* (a), *Lathyro-Melandrietum noctiflori* (b) and *Inuletum ensifoliae* (c) in communities occurring in 1998 year and in *Inuletum ensifoliae* (d) in 2014

Tabela 2. Rozkład stopni stałości w poszczególnych grupach syngenetycznych *Sileno inflatae-Linarietum minoris* (a), *Lathyro-Melandrietum noctiflori* (b) i *Inuletum ensifoliae* (c) w zbiorowiskach występujących w 1998 roku oraz w *Inuletum ensifoliae* (d) w 2014 roku

Phytosociological classes Klasy fitosocjologiczne	Grades of stability – Stopnie stałości					Total Razem	
	V	IV	III	II	I		
	number of species – liczba gatunków						
<i>Stellarietea mediae</i>	a	11	2	8	5	15	41
	b	9	3	6	5	5	28
	c	1	7	7	10	7	32
	d	–	–	–	–	3	3
<i>Artemisietea vulgaris</i>	a	6	6	2	5	6	25
	b	5	6	3	2	4	20
	c	1	5	3	5	4	18
	d	2	3	2	6	5	18
<i>Festuco-Brometea</i>	a	1	4	3	7	2	17
	b	3	3	4	5	2	17
	c	5	1	1	7	6	20
	d	6	3	5	–	4	18
<i>Molinio-Arrhenatheretea</i>	a	4	4	1	6	5	20
	b	3	6	3	–	3	15
	c	2	1	3	6	4	16
	d	2	2	3	4	5	16
<i>Trifolio-Geranietea sanguinei</i>	a	1	2	2	5	3	13
	b	1	3	1	2	2	9
	c	1	1	2	3	–	7
	d	–	2	1	1	4	8
<i>Rhamno-Prunetea</i>	a	–	–	1	1	5	7
	b	1	–	–	1	3	5
	c	–	1	1	2	1	5
	d	2	1	1	1	3	8
<i>Agropyretea intermedio-repentis</i>	a	3	–	–	–	1	4
	b	1	1	1	–	1	4
	c	1	1	–	1	1	4
	d	–	1	1	–	1	3
<i>Koelerio glaucae-Corynepherea canescentis</i>	a	–	–	–	2	–	2
	b	–	–	1	–	3	4
	c	–	–	–	–	1	1
	d	–	–	–	1	–	1
<i>Nardo-Callunetea</i>	a	–	–	1	–	–	1
	b	–	–	–	–	1	1
	c	–	–	–	1	–	1
	d	–	1	–	–	–	1
<i>Epilobietea angustifolii</i>	a	–	–	–	–	–	–
	b	–	–	–	–	–	–
	c	–	–	–	–	–	–
	d	–	–	–	1	1	2
Accompanying species Gatunki towarzyszące	a	2	–	1	3	12	18
	b	2	1	–	5	9	17
	c	–	2	2	3	7	14
	d	–	–	1	1	8	10
Total Razem						a	148
						b	120
						c	118
						d	88

Table 3. Phytosociological stability (S) and cover coefficient (D) of species occurring in communities on the ridge of the "Piotrawin" quarry in 1998 and 2014 years

Tabela 3. Stałość fitosocjologiczna (S) i współczynniki pokrycia (D) gatunków zbiorowisk roślinnych występujących na grzbiecie kamieniołomu „Piotrawin” w 1998 i 2014 roku

Years – Lata	1998				2014			
Plant communities Zbiorowiska roślinne	<i>Sileno inflatae- -Linarietum minoris</i>		<i>Lathyro- -Melandrietum noctiflori</i>		<i>Inuletum ensifoliae</i>		<i>Inuletum ensifoliae</i>	
Number of relevés Liczba zdjęć fitosocjologicznych	18		6		5		20	
Number of species in plant communities Liczba gatunków w zbiorowisku	148		120		118		88	
Medium cover of herb layer Średnie pokrycie powierzchni zdjęcia przez rośliny [%]	89,2		88,3		79,0		86,0	
Range number of species in relevé Zakres liczby gatunków w zdjęciu fitosocjologicznym	53–73		57–65		48–73		28–39	
Mean number of species in relevé Średnia liczba gatunków w zdjęciu fitosocjologicznym	62		61		60		34	
	1		2		3		4	
	S	D	S	D	S	D	S	D
ChAss.: <i>Sileno inflatae-Linarietum minoris</i>								
<i>Chaenorhinum minus</i>	V	500	V	83	III	60		
<i>Silene vulgaris</i>	V	389	I	17	II	40	I	5
ChAss.: <i>Lathyro-Melandrietum noctiflori</i>								
<i>Lathyrus tuberosus</i>	I	11	V	433	IV	80	I	20
<i>Melandrium noctiflorum</i>	II	33	V	433	II	40		
I ChAll.: <i>Caucalidion lappulae</i>								
<i>Stachys annua</i>	V	456	V	300	III	550		
<i>Euphorbia exiqa</i>	V	333	III	167	IV	140		
<i>Avena fatua</i>	V	89	V	83	III	60		
<i>Aethusa cynapium</i> ssp. <i>agrestis</i>	IV	72	III	167	III	390		
II ChO.: <i>Centauretalia cyani</i>								
<i>Papaver rhoeas</i>	V	803	V	1058	V	670		
<i>Consolida regalis</i>	V	189	V	283	IV	320		
<i>Lithospermum arvense</i>	I	11			III	60		
III ChAll.: <i>Polygono-Chenopodion</i>, ChO.: <i>Polygono-Chenopodietalia</i>								
<i>Chenopodium album</i>	V	83	II	33	III	60		
<i>Euphorbia helioscopia</i>	III	56	IV	67	IV	80		
<i>Atriplex patula</i>	III	89	II	33	II	40		
<i>Sonchus asper</i>	III	56	II	33	II	40		
<i>Veronica persica</i>	II	39	III	50				
<i>Sonchus arvensis</i>	II	28			I	20		
IV ChO., ChAll.: <i>Sisymbrietalia</i>, <i>Sisymbrium officinalis</i>								
<i>Coryza canadensis</i>	V	106	IV	67	II	40	I	20
<i>Lactuca seriolla</i>	III	72	IV	133	IV	80		
V ChCl.: <i>Stellarietea mediae</i>								
<i>Anagallis arvensis</i>	V	256	V	300	III	140		
<i>Sinapis arvensis</i>	V	167	V	233	IV	160		
<i>Fallopia convolvulus</i>	IV	61	II	100	IV	80		
<i>Apera spica-venti</i>	III	44	II	33	II	40		
<i>Polygonum aviculare</i>	III	44	III	50	II	40		
<i>Matricaria maritima</i> ssp. <i>inodora</i>	III	44	I	17	II	40		
<i>Viola arvensis</i>	II	28	III	50	II	40		
<i>Stellaria media</i>	II	22	I	17	II	40		
<i>Vicia hirsuta</i>	I	11	III	50	I	20		
<i>Setaria viridis</i>	III	50						
ChAss.: <i>Inuletum ensifoliae</i>								
<i>Linum flavum</i>	I	11	II	33	V	500	V	1278
<i>Inula ensifolia</i>			II	33	V	260	IV	428
VI ChO.: <i>Festucetalia valesiacea</i>								
<i>Anthemis tinctoria</i>	V	917	V	558	V	750	III	45
<i>Salvia verticillata</i>	IV	353	IV	333	II	450	V	930

Table 3. Phytosociological stability (S) and cover coefficient (D) of species occurring in communities on the ridge of the "Piotrawin" quarry in 1998 and 2014 years (cont.)

Tabela 3. Stałość fitosocjologiczna (S) i współczynniki pokrycia (D) gatunków zbiorowisk roślinnych występujących na grzbiecie kamieniołomu „Piotrawin” w 1998 i 2014 roku (cd.)

	1		2		3		4	
	S	D	S	D	S	D	S	D
<i>Scabiosa ochroleuca</i>	II	83	III	117	IV	80	V	343
<i>Campanula sibirica</i>	II	33	III	183	I	20	V	90
<i>Asparagus officinalis</i>	III	72			I	100	I	15
VII ChCl.: Festuco-Brometea								
<i>Sanguisorba minor</i>	IV	150	II	100	V	100	V	868
<i>Euphorbia cyparissias</i>	IV	233	IV	200	II	120	V	490
<i>Poa compressa</i>	IV	431	V	367	II	200	III	45
<i>Eryngium planum</i>	III	89	II	33	V	340	IV	105
<i>Centaurea scabiosa</i>	III	278	III	250	III	220	III	65
<i>Centaurea stoebe</i>	II	89	IV	333	II	120	IV	105
<i>Anthyllis vulneraria</i> ssp. <i>polyphylla</i>	II	94	V	350	II	120	III	65
<i>Carlina vulgaris</i>	II	28	I	17	II	40	III	55
<i>Hieracium echinoides</i>	II	72	III	50	I	20		
<i>Phleum phleoides</i>	II	94	II	100	I	100		
<i>Plantago media</i>			I	17	II	20		
VIII ChCl.: Artemisietea vulgaris								
<i>Picris hieracioides</i>	V	472	V	500	IV	200	V	553
<i>Pastinaca sativa</i>	V	639	IV	542	V	340	IV	115
<i>Echium vulgare</i>	V	172	V	283	III	60	IV	65
<i>Cichorium intybus</i>	V	350	V	367	IV	200	III	55
<i>Melilotus officinalis</i>	V	308	IV	333	IV	240	II	45
<i>Rubus caesius</i>	IV	458	III	117	II	120	V	1063
<i>Medicago lupulina</i>	IV	369	V	233	IV	160	I	25
<i>Cerinth glabra</i>	IV	342	IV	200	III	220	II	25
<i>Artemisia vulgaris</i>	IV	339	IV	350	II	140	II	35
<i>Cirsium arvense</i>	III	189	IV	217	IV	240	II	35
<i>Hypericum perforatum</i>	III	56	III	50	I	20	IV	85
<i>Linaria vulgaris</i>	IV	94	IV	67	I	20	I	5
<i>Dipsacus silvestris</i>	II	78	II	33	III	60	II	25
<i>Verbascum thapsus</i>	II	22	I	17	II	40	III	50
<i>Carduus crispus</i>	V	350	V	150	II	40		
<i>Melandrium album</i>	II	33	III	50	II	40		
<i>Carduus acanthoides</i>	IV	375	I	17			I	5
<i>Medicago sativa</i>	I	6	II	100	I	20		
<i>Solidago canadensis</i>	II	22					II	75
<i>Erysimum cheiranthoides</i>	II	39			I	20		
IX ChCl.: Epilobietea angustifoli								
<i>Calamagrostis epigejos</i>							II	25
X ChCl.: Agropyreteae intermedio-repentis								
<i>Tussilago farfara</i>	V	728	IV	333	IV	320	III	45
<i>Elymus repens</i>	V	514	V	367	II	120	IV	370
<i>Convolvulus arvensis</i>	V	317	III	183	V	180	I	10
XI ChCl.: Koelerio glaucae-Corynepheretea canescentis								
<i>Senecio vernalis</i>	II	39	III	50				
<i>Trifolium campestre</i>	II	33	I	17				
<i>Thymus serpyllum</i>			I	83	I	100	II	343
XII ChCl.: Molinio-Arrhenatheretea								
<i>Arrhenatherum elatius</i>	I	83	IV	333	IV	570	V	930
<i>Daucus carota</i>	V	611	V	433	III	300	V	425
<i>Lolium perenne</i>	V	500	V	500	II	200	III	110
<i>Agrostis capillaris</i>	V	417	I	17	V	420	IV	268
<i>Achillea millefolium</i>	IV	254	IV	200	V	420	III	45
<i>Dactylis glomerata</i>	III	78	III	183	II	40	III	45
<i>Trifolium pratense</i>	IV	106	IV	67	III	140	II	30
<i>Taraxacum officinale</i>	V	83	V	83	III	140	II	25
<i>Festuca rubra</i>	IV	597	IV	267	II	200	I	10
<i>Pimpinella saxifraga</i>	IV	133	IV	342	I	20	II	25
<i>Galium mollugo</i>	II	83	I	17	I	83	IV	248

Table 3. Phytosociological stability (S) and cover coefficient (D) of species occurring in communities on the ridge of the "Piotrawin" quarry in 1998 and 2014 years (cont.)

Tabela 3. Stałość fitosocjologiczna (S) i współczynniki pokrycia (D) gatunków zbiorowisk roślinnych występujących na grzbiecie kamieniołomu „Piotrawin” w 1998 i 2014 roku (cd.)

	1		2		3		4		
	S	D	S	D	S	D	S	D	
<i>Centaurea jacea</i>	II	125	IV	200	II	120	I	15	
<i>Vicia cracca</i>	II	167	III	117	I	20	I	5	
<i>Trifolium hybridum</i>	II	22	III	50	II	40			
<i>Campanula patula</i>	II	78	I	17	I	20			
<i>Avenula pubescens</i>	I	17			II	120			
<i>Cerastium holosteoides</i>	II	22							
<i>Lotus corniculatus</i>							II	45	
XIII ChCl.: Nardo-Callunetea									
<i>Genista tinctoria</i>	III	139	I	17	II	120	IV	1525	
XIV ChCl.: Trifolio-Geranietea sanguinei									
<i>Medicago falcata</i>	V	300	IV	542	V	100	IV	650	
<i>Campanula rapunculoides</i>	IV	150	IV	133	IV	160	I	10	
<i>Vicia tenuifolia</i>	IV	106	II	100	II	40	IV	65	
<i>Coronilla varia</i>	III	164	II	33	III	390	II	45	
<i>Agrimonia eupatoria</i>	II	100	V	150	III	140	III	215	
<i>Fragaria viridis</i>	I	17	IV	133	II	120	I	50	
<i>Origanum vulgare</i>	III	94	III	117	II	120			
<i>Astragalus cicer</i>	II	72	II	100	I	100	I	15	
<i>Clinopodium vulgare</i>	II	72	II	33			I	10	
<i>Veronica teucrium</i>	I	11	II	33	I	20			
<i>Thalictrum minus</i>	II	44							
XV ChCl.: Rhamno-Prunetea									
<i>Cornus sanguinea</i>	a						I	25	
<i>Cornus sanguinea</i>	b	III	156	V	283	IV	240	V	1625
<i>Cornus sanguinea</i> (juv.)	c						II	150	
<i>Cerasus fruticosa</i>		II	144	I	83	III	140	IV	225
<i>Ligustrum vulgare</i>	b	I	83	II	167	II	40	II	85
<i>Rosa canina</i>	b	I	56	I	83	II	120	V	738
<i>Rosa canina</i> (juv.)	c						I	80	
<i>Rosa rubiginosa</i>	b						III	233	
XVI Accompanying species									
Gatunki towarzyszące									
<i>Diplotaxis muralis</i>	V	372	V	100	IV	320			
<i>Arenaria serpyllifolia</i>	V	150	IV	133	II	40			
<i>Lappula squarosa</i>	III	50	V	150	III	60			
<i>Camelina microcarpa</i>	II	50	I	17	I	20			
<i>Cardaminopsis arenosa</i>	II	22	I	17	I	20			
<i>Neslia paniculata</i>	I	17	I	17	II	40			
<i>Trifolium aureum</i>	I	6	I	17	II	40			
<i>Ononis spinosa</i>	I	61	II	167	IV	490	I	20	
<i>Senecio jacobaea</i>	II	56	I	17	I	20	I	20	
<i>Galeopsis angustifolia</i>	I	11	II	33	III	60	I	5	
<i>Juniperus communis</i>	b						III	273	
<i>Juniperus communis</i> (juv.)	c						I	25	
<i>Acer pseudoplatanus</i>	b						II	30	
<i>Acer pseudoplatanus</i> (juv.)	c						I	5	

The IIant species occurring in I degree of phytosociological constance in plant communities. After a name of species in brackets the number of the phytosociological relevé in which taxon occurred is given. Cover coefficients (D) of these species are small, that is why they have been omitted in the table. – Gatunki roślin występujące w zbiorowisku wyłącznie w I stopniu stałości (S). Po nazwie gatunku podano w nawiasie numer zbiorowiska, w którym takson wystąpił. Współczynniki pokrycia (D) tych gatunków są niewielkie, dlatego zostały w tabeli pominięte.

I: *Adonis aestivialis* (1), *Thymelea passerina* (1,2,3); **II:** *Agrostemma githago* (1); **III:** *Capsella bursa-pastoris* (1,3), *Fumaria officinalis* (1), *Veronica polita* (3); **IV:** *Malva neglecta* (1), *M. pusilla* (1,2,3), *Sisymbrium loeselii* (1); **V:** *Galeopsis tetrahit* (1,3), *Papaver dubium* (1), *Raphanus raphanistrum* (1); **VII:** *Allium oleraceum* (1,3), *Artemisia campestris* (3,4), *Elymus hispidus* (4), *Veronica spicata* (4); **VIII:** *Arctium lappa* (1), *Armoracia rusticana* (1,2), *Galium aparine* (1), *Reseda lutea* (4), *Tanacetum vulgare* (1,2,4), *Urtica dioica* (1); **IX:** *Sorbus aucuparia* (juv.) (4); **X:** *Falcaria vulgaris* (1,2,3); **XI:** *Trifolium arvense* (2); **XII:** *Plantago lanceolata* (1,4), *P. maior* (1), *Prunella vulgaris* (4), *Rumex crispus* (1); **XIV:** *Galium verum* (2), *Verbascum lychnitis* (1,2); **XV:** *Berberis vulgaris* b (1,2,3,4), *Crataegus monogyna* b (1,4), *Euonymus europaeus* (1), *Prunus spinosa* b (4); **XVI:** *Erigeron acer* (2), *Elymus hispidus* (1), *Erodium cicutarium* (1), *Juglans regia* b (4), *Lolium multiflorum* (1), *Malus sp.* (4), *Mentha arvensis* (1), *Pinus sylvestris* b, c (juv.) (4), *Quercus sp.* (4), *Ranunculus bulbosus* (2), *Robinia pseudoacacia* (juv.) (1), *Senecio vulgaris* (1,2,3), *Sherardia arvensis* (1,3), *Solanum dulcamara* (1), *Syringa vulgaris* b (4).

Table 4. Similarity coefficients of plant communities [%] occurring on the ridge of the "Piotrawin" quarry in 1998 and 2014 years

Tabela 4. Współczynniki podobieństwa zbiorowisk roślinnych [%] występujących na grzbiecie kamieniołomu „Piotrawin” w 1998 i 2014 roku

Plant communities Zbiorowiska roślinne		<i>Sileno inflantae- -Linarietum minoris</i>	<i>Lathyro- -Melandrietum noctiflori</i>	<i>Inuletum ensifoliae</i>	<i>Inuletum ensifoliae</i>
Years – Lata			1998		2014
<i>Sileno inflantae- -Linarietum minoris</i>		X	80,0	72,5	49,0
<i>Lathyro-Melandrietum noctiflori</i>	1998	80,0	X	74,5	50,5
<i>Inuletum ensifoliae</i>		72,5	74,5	X	54,0
<i>Inuletum ensifoliae</i>	2014	49,0	50,5	54,0	X

Considerable changes also occur among the species of *Festuco-Brometea* class. First, the coverage of surface by both taxa characteristic to the association – *Linum flavum* and *Inula ensifolia* – has increased. D value for *Linum flavum* increased from 500 to 1278 in 2014, and for *Inula ensifolia* D has increased only slightly – from 260 to 428. Within *Festucetalia valesiaca* alliance, the stability and coverage D of *Salvia verticillata* increased from 450 to 930 and of *Scabiosa ochroleuca* from 80 to 343. Among the species of *Festuco-Brometea* class, there was also an increase of D, which in case of *Sanguisorba minor* was from 100 to 868 and in case of *Euphorbia cyparissias* from 120 to 490. The changes of D value indicate clearly the growing domination of xerothermic grasslands in the phytocoenoses of 2014.

In comparison to phytocoenoses of 1998, some changes were observed in 2014 within ruderal communities of *Artemisietea vulgaris* class. The degrees of stability and cover coefficients of a significant number of taxa were lowered. It applies to the occurrence of: *Medicago lupulina*, *Artemisia vulgaris*, *Cerithe glabra*, *Melilotus officinalis* and *Cirsium arvense* (Table 3). Similar S and D values in both of the compared periods were observed in relation to the dominant *Picris hieracioides* taxon, present in all the communities. There was, however, an increase in the stability (S = V) and especially the value (D = 1063) of an expansive species of *Rubus caesius*. This invasive shrub taxon intensively enters the open spaces on the ridge of the quarry. It forms dense patches, which are difficult to pass. It may be supposed, that it will increase its presence in the community.

Very significant changes occur in the process of secondary succession within the shrub species of *Rhamno-Prunetea* class. Further expansion and encroachment of species of *Rhamno-Cornetum sanguinei* and *Pruno-Ligustretum* on the studied area were recorded in 2014. Particularly intensive development was a share of *Cornus sanguinea* inhabiting all the layers of the community, and it was most numerous in layer b reaching there values of S = V and D = 1625. A similar state of intensity applies to *Rosa canina* (S = V, D = 738) and *Cerasus fruticosa* (S = IV, D = 225). The presence of these species in the phytocoenoses and the significant values of S and D they have reached, clearly indicate that in a dozen or so years the xerothermic grasslands will be replaced by shrub communities of the above-mentioned syntaxa. Herbaceous species of *Inuletum ensifoliae* phytocoenoses will probably remain only in the open spaces which have not been dominated either by shrub species of

Rhamno-Prunetea class, by introduced woody taxa, or by *Juniperus communis*, which is numerous in this area. Moreover, the species accompanying the community of 1998 were absent in the community of 2014. These were: *Diplotaxis muralis*, *Arenaria serpyllifolia*, *Lapulla squarrosa*, *Camelina microcarpa*, *Cardaminopsis arenosa*, *Neslia paniculata* and *Trifolium aureum* (Table 3). The majority are the species developing mainly in segetal communities and reproducing generatively. Their growth had been hindered due to the lack of open spaces and therefore they were absent in the community of 2014. As a result of their competition with perennials, some of them lost their chance to grow in 2014. Thermophilic dense shrubs formed by: common dogwood, various species of roses, privet, hawthorn, barberry, blackthorn and many other shrubs as well as xerothermic herbaceous plants of *Festuco-Brometea* and *Trifolio-Geranietea sanguinei* class, are present in habitats rich in calcium carbonate. The favourable habitat conditions on the ridge of the quarry and the current floristic composition of the community show that the above-mentioned shrub species will dominate the excavation area, the slopes and the ridge of the quarry. Currently, the shrub communities dominate the areas surrounding the quarry from the south and north.

CONCLUSIONS

1. In the technically and biologically reclaimed ridge area of the quarry "Piotrawin" (the crown of the excavation) two segetal associations were distinguished in 1998 (*Sileno inflatae-Linarietum minoris* and *Lathyro-Melandrietum noctiflori*) along with one association of xerothermic grasslands – *Inuletum ensifoliae*.
2. In 2014, as a result of ongoing transformation of the communities, the area was inhabited only by *Inuletum ensifoliae* association with *Genista tinctoria* variant and within it – *Thymus serpyllum* subvariant.
3. In 1998, segetal communities and *Inuletum ensifoliae* were characterised by floristic richness. The number of species in the community was significant (from 118 to 148 taxa) and in 2014 there are only 88 of them. The average number of species in patches was large and it ranged from 60 to 62 taxa, and in 2014 there are only 34 of them.
4. In *Inuletum ensifoliae* community of 2014 there are hardly any species of *Stellarietea mediae* class and many spermatophyte species accompanying phytocoenoses are absent.
5. *Inuletum ensifoliae* phytocoenoses present in 2014 reveal great floristic distinction in comparison to taxa of 1998. The confirmation of this are low mutual similarity coefficients (49.0–54.0%).
6. In the community of 2014, the share of species of *Artemisietea vulgaris* and *Molinio-Arrhenatheretea* class in the structure of the association is smaller. They reach lower degrees of stability and D values (with the exception of *Rubus caesius*). However, the share of taxa of *Festuco-Brometea* class has increased.
7. In 2014, as a result of the process of secondary ecological succession, there was an intensive development of shrub species in *Rhamno-Prunetea* class. Particularly frequent and numerous was the occurrence in layer b of *Cornus sanguinea* (S = V, D = 1625), *Rosa canina* (S = V, D = 738) and *Cerasus fruticosa* (S = IV, D = 225).

8. In several decades, the ridge area of "Piotrawin" quarry, as well as its slopes and two terraces will be covered by shrub species of *Rhamno-Cornetum sanguinei* and *Pruno-Ligustretum*, which currently surround the excavation from the south and north.

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Abstract. The research was conducted in 2014 in the ridge area of „Piotrawin” quarry. The aim of the study was to determine the natural succession changes that had occurred in the communities distinguished 16 years earlier (in 1998). 20 relevés were made. Segetal communities of *Sileno inflantae-Linarietum minoris* and *Lathyro-Melandrietum noctiflori* which had been present in 1998, were not found in phytocenoses of 2014. As a result of the transformation of *Inuletum ensifoliae* community, the species of *Stellarietea mediae* class were hardly present in 2014. The phytocoenon was floristically poorer in 2014. The structure comprised of only 88 taxa, compared to the large number of species (from 118 to 148) recorded in the communities of 1998. The average number of taxa was also smaller (34) in comparison to the significant floristic richness of communities in 1998 (from 60 to 62 species). *Inuletum ensifoliae* community present in 2014 demonstrated also a certain floristic distinction, there have also been differences in the stability of occurrence and cover coefficients of many species in individual phytosociological classes. The phytocoenoses of 2014 are characterised by small coefficients of similarity, which range from 49.0% to 54.0% in relation to the communities distinguished in 1998. In contrast, the relative similarity of communities of 1998 was very high and it ranged from 72.5% to 80%. In the community of *Inuletum ensifoliae* of 2014, the stability degrees and cover coefficients for

a range of species of *Artemisietea vulgaris* and *Molinio-Arrhenatheretea* are lower, while the taxa of *Festuco-Brometea* are significantly higher. A rapid development of shrub species of *Rhamno-Prunetea* class could also be observed. The ridge area of the quarry is predominantly occupied by numerous *Cornus sanguinea* (S = V, D = 1625), *Rosa canina* (S = V, D = 738), *Cerasus fruticosa* (S = IV, D = 225) and other shrub species. These taxa inhabit almost all layers of the community, especially layer b and most probably in a few dozen years the area will be occupied by phytocenoses of *Rhamno-Cornetum sanguinei* and *Pruno-Ligustretum*, which are currently surrounding the excavation of the quarry from the south and north.

