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DYNAMICS OF XEROTHERMIC PLANT SPECIES IN THE UPPER RIVER PŁONIA VALLEY (NW POLAND)

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SYNOPSIS

This work was aimed at analyzing the dynamics of xerothermic species present in the upper Płonia River valley, that is at exploring their current distribution compared to the historical data, identifying their habitat preferences, and unraveling their responses to environmental changes. Floristic surveys were conducted in 1998-2002. More than 35% of xerotherms consists at present of very rare and rare species. Some of the most sensitive species disappeared. As few as 7 species can be regarded as wide-spread and common. In addition to dry meadows on forest-free slopes those species inhabit also anthropogenically altered habitats. The analysis of the habitat spectra of rare species showed that, in some cases, anthropogenic habitats are the only sites of those species. There are also species which are found almost exclusively in dry grasslands.

INTRODUCTION

Semi-natural and natural non-forest assemblages, including xerothermic calcareous grasslands, belong at present to the most vulnerable European ecosystems. Aggregations of thermophilous vegetation in Pomerania are relics of steppe flora migration routes dating back to the early glacial and climatic optimum. They have persisted until present owing to the specific conditions prevalent on steep south- or south-west-exposed river valley slopes, frequently calcium carbonate-rich (Czubiński, 1950). Today, nearly all the remaining dry calcareous grasslands are semi-natural. A historical analysis showed their maximum spread to have occurred between the fifteenth and twentieth century, during extensive sheep flock migrations and transhumances. However, those grasslands developed as a result of different types of land-use, such as alternate husbandry and three-field rotation system as well as hayseed sowing (Poschlod & Wallisdevries, 2002). Without doubt, dry

calcareous grasslands belong to the most speciose habitats in central Europe (Wallisdevries at al., 2002).

During floristic surveys conducted in 1998-2002 in the Barlinek-Gorzów Landscape Park (Pomerania, NW Poland), a particular attention was paid to a group of xerothermic species in the northern part of the Park, in the upper part of the River Płonia valley. Interesting assemblages of xenothermic calcareous grasslands in that area were explored in the 1930s by LIBBERT (1938). Unfortunately, the number and extent of dry calcareous grasslands decreased tremendously during the twentieth century due to abandonment and afforestation, as reported by BACIECZKO (1995). Some of the most sensitive species disappeared, whereas others, capable of apophytism, managed to adapt to anthropogenic habitats, and were even able to use them for their dispersal (Myśliwy, 2003).

This work was aimed at analysing the dynamics of xerothermic species present in the upper part of the River Płonia valley, that is at exploring their current distribution compared to the historical data, identifying their habitat preferences, and unravelling their responses to environmental changes (ecological succession, human activities).

According to physicogeographical regionalization of Poland, the study area belongs to the Myślibórz Lakeland mesoregion. It features a set of glacial forms related to the southernmost border of the Vistulian glaciation's Pomeranian stage (Kondracki, 2000). The area forms the northern part of the Barlinek-Gorzów Landscape Park (BGLP) which covers a fragment of the River Płonia valley whose steep slopes are incised by numerous gullies and ravines. The average annual precipitation and the mean annual temperature in the area are about 500-600 mm and 8.1ºC, respectively. The growing period extends for about 200-220 days (Koźmiński & Michalska, 2001).

MATERIALS AND METHODS

The surveys were conducted based on a cartogram map with 1 km side length quadrants, equivalent to stands. The quadrant grid was developed by decimal expansion of the grid used in the "Distribution Atlas of Vascular Plants in Poland" (Zając, 1978) and contains a total of 50 quadrants. The data collected took the form of floristic lists from all habitat types found in individual quadrants. The habitat classification used was based on that of EUNIS (Davies et al., 2004). The xerotherms include both the characteristic species of the classes *Festuco-Brometea* and *Trifolio-Geranietea* and lower divisions of those classes (Matuszkiewicz, 2002) as well as those species which find the optimum of their distribution in xerothermic assemblages (Zarzycki et al., 2002). All in all, 1659 floristic records were amassed for the 108 species, the total number of records including 1218 supplied by the

author's field surveys and 441 found in the literature and unpublished reports. The floristic lists were compiled to form a database developed using the Profit 2.0 software package (Balcerkiewicz & Sławnikowski, 1998). To illustrate their frequencies of occurrence, the species were arranged in a series following frequency classes. Individual classes were identified from the ranges of frequency of occurrence of a species relative to the total number of cartogram fields (Table 1). Names of the vascular plant species follow MIREK et al. (2002). Those species considered rare and threatened in the Western Pomerania and in Poland were listed according to ŻUKOWSKI and JACKOWIAK (1995) and ZARZYCKI and SZELĄG (2006).

RESULTS AND DISCUSSION

A total of 108 xerothermic plant species were recorded, at present or in the past, in the upper River Płonia valley. The densest aggregations of those plants were observed near Janowo (AC2774, AC2785) and Żydowo (AC2786), SE of Niepołcko (AC2776), and near Laskówko (AC2745) (Fig. 1). The xerothermic plant assemblage near Janowo, SW of the largest gully in the area, where BACIECZKO (1997) recorded the presence of, i.a., *Pulsatilla pratensis*, *Stachys recta*, *Lychnis viscaria*, and *Anthericum ramosum*, has been suggested as deserving legal protection in the form of nature reserve. However, no steps towards that status have been taken. Meanwhile, afforestation of the Janowo gully slopes as well as succession proceeding in areas that are not being used pose a great hazard to the xerothermic vegetation, some rare species having already disappeared.

The list of xerotherms contains three species that are alien to the Pomeranian flora: the archaeophyte *Camelina microcarpa* subsp. *sylvestris*; the kenophyte *Onobrychis viciifolia*; and the diaphyte *Potentilla recta* (not found in the recent surveys). *Camelina microcarpa* subsp. *sylvestris*, *Cruciata gabra*, *Onobrychis viciifolia*, *Ononis repens*, and *Plantago media* were recorded for the first time in the area. The surveys failed to confirm the presence of 38 species reported to have been present in the area (Table 1), including 32 which had most probably lost all their stands in BGLP. Some of those species were last seen by LIBBERT (1932, 1935, 1938, 1941), including *Anemone sylvestris*, *Asperula tinctoria*, *Melampyrum arvense*, *Orchis militaris*, *Oxytropis pilosa*, *Prunella grandiflora*, *Scabiosa columbaria*, and *Thesium linophyllon*, others being spotted in the area in the 1980s and 1990s (i.a., *Achillea collina*, *Koeleria macrantha*, *Phleum phleoides*, *Pulsatilla pratensis*, *and Scorzonera purpurea* (Bacieczko, 1995).

A large group of xerotherms (more than 35%) consists at present of very rare and rare species (Table 1). The number of stands of some of them is clearly lower than that recorded in the literature (Table 2). Disappearance of stands of selected

species was illustrated in cartogram maps (Fig. 2). As few as 7 species can be regarded as wide-spread and common. These are: *Galium mollugo* agg. (40 stations), *Hypericum perforatum* (37), *Agrimonia eupatoria* (33), *Astragalus glycyphyllos* (33), *Arenaria serpyllifolia* (29), *Allium oleraceum* (27), and *Primula veris* (26). In addition to dry meadows on forest-free slopes and, less frequently forests, those species inhabit also anthropogenically altered habitats, such as the *Prunetalia-spinosae*, balks, forest fringes, road sides, and railroad fringes (Table 3). A question remains whether those habitats support also rare and disappearing xenothermic species. To answer the question, the habitat spectra of those species were analysed. The analysis showed that, in some cases, anthropogenic habitats are the only sites of those species. For example, *Thalictrum minus* was recorded only in the *Prunetalia-spinosae*, *Stachys recta* was found only in a *Robinia* forest, *Veronica praecox* occurred only in a *Robinia* forest and in a balk, *Ononis repens* was recorded only in a balk, while *Cruciata glabra* occurred only on a disused railway track. For some other species, e.g., *Achillea pannonica*, *Alyssum montanum*, *Astragalus cicer*, *Medicago minima*, and *Vincetoxicum hirundinaria*, anthropogenic habitats have important share in habitat spectrum (Fig. 3). There are also species which are found exclusively, or almost exclusively, in dry grasslands, e.g., *Carex caryophyllea*, *C. praecox*, *Campanula sibirica*, *Saxifraga tridactylites*, *Veronica spicata*, *Vicia dumetorum* (Fig. 3).

In the absence of active protection involving continuation of traditional land use, dry calcareous grasslands are gradually transformed into shrub and forest communities, with the accompanying effect of a drastic species richness decline (Dzwonko & Loster, 1998; Bąba, 2004). Extensive grazing (preferably by sheep) protects those grasslands from being overgrown by blackthorn, *Robinia*, or maytrees, and contributes to destruction of the accumulated layer of dead grass, and thus creates sites amenable to colonisation by xerothermic plants. It is also recommended to cut away trees and shrubs shadowing the valuable dry calcareous grasslands (Jermaczek & Pawlaczyk, 1999). From a conservation point of view, mowing and mulching in August seem to provide useful management alternatives to low-intensity grazing, because species composition remains similar (Kahmen et al., 2002).

CONCLUSIONS

Communities of xerothermic calcareous steppe-like grasslands occasionally found in Pomerania, at sites characterised by a particular combination of habitat conditions, below to the most endangered habitats, as indicated by a high contribution of extinct, lost, and rare species. A high habitat diversity in a landscape acts in favour of conservation of stands of some xerothermic species because they

have managed to adapt to certain types of anthropogenic habitats. Xerothermic plants may be supported by, e.g., the *Prunetalia-spinosae*, balks, forest fringes, road sides, and abandoned railway tracks. However, many specialised xerotherms persist only in dry calcareous grasslands. In the absence of traditional use of those areas, such species are threatened by extinction.

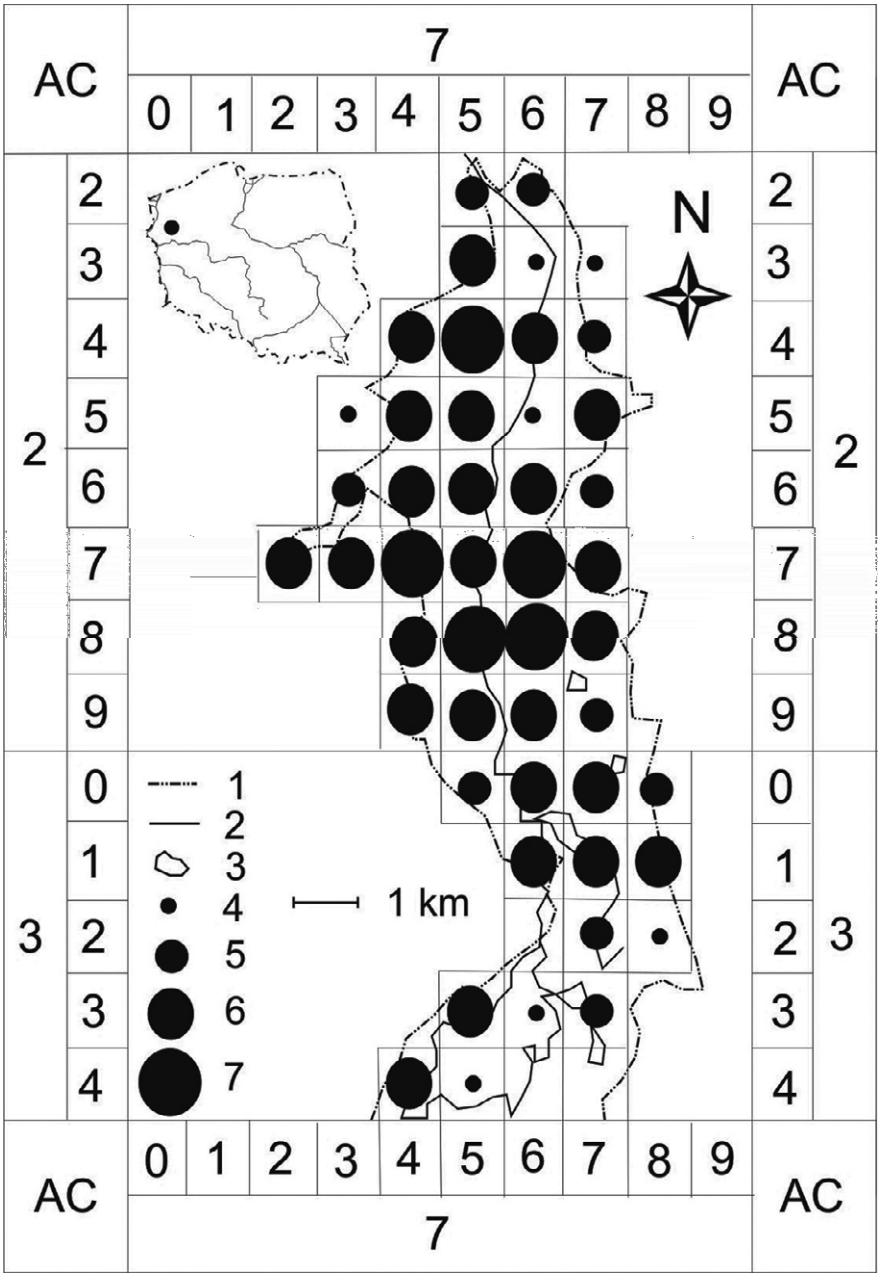

Figure 1: Density of present localities of xerothermic plant species in the area of upper Płonia river valley, with ATPOL grid square (Zając, 1978).
Explanations: 1 – border of study area, 2 – Płonia river, 3 – lakes, 4 – 1-3 species, 5 – 4-9 species, 6 – 10-27 species, 7 – 28-37 species.

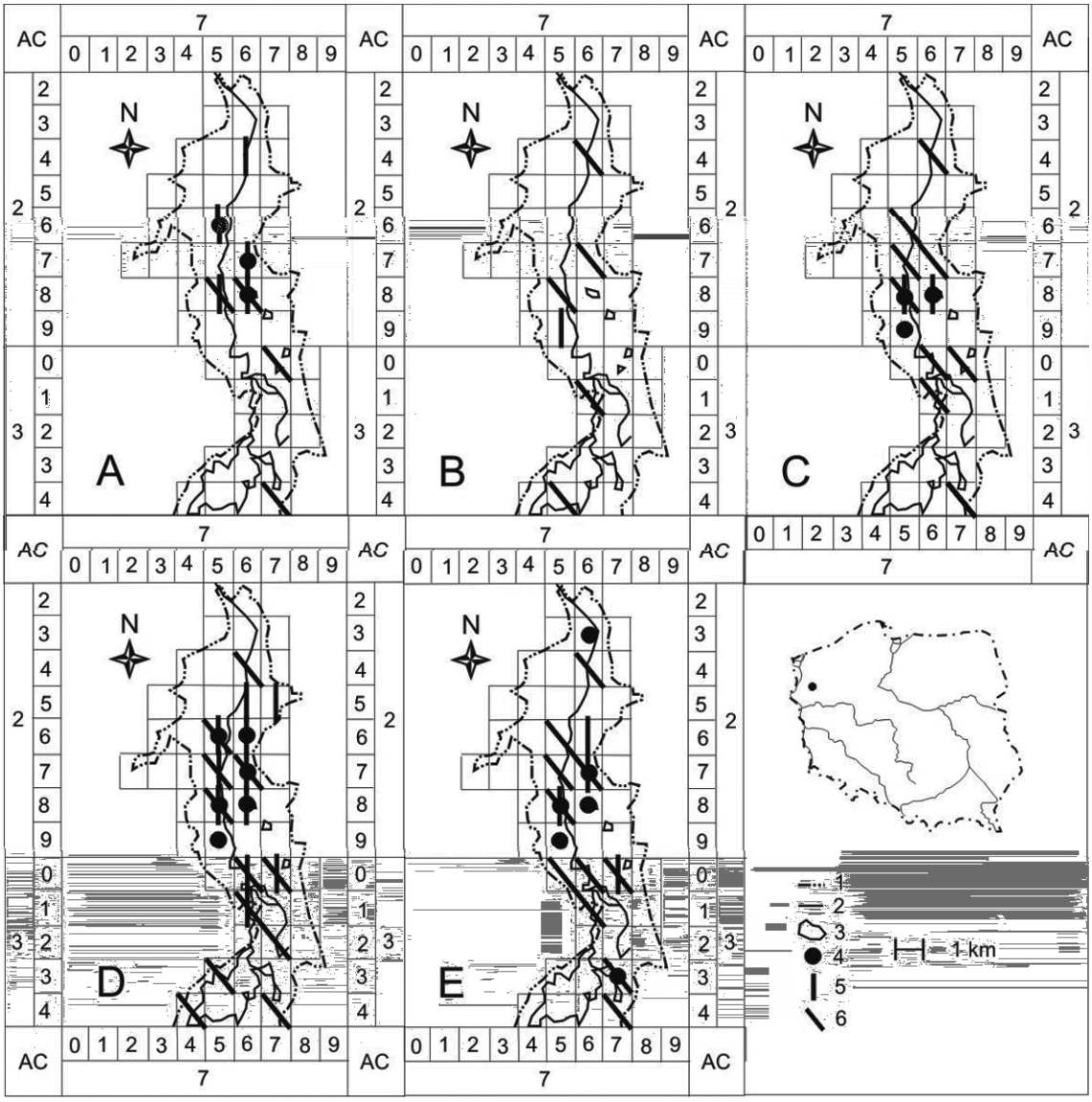

Figure 2: Distribution maps of selected xerothermic plant species in the area of upper Płonia river valley, with ATPOL grid square (Zając, 1978): A – *Stachys recta*, B – *Campanula sibirica*, C – *Pulsatilla pratensis*, D – *Petrorhagia prolifera*, E – *Phleum phleoides*.

Explanations: 1 – border of study area, 2 – Płonia river, 3 – lakes, 4 – recent stands, 5 – stands found in the 1980s and 1990s, 6 – stands found in the 1930s and 1940s.

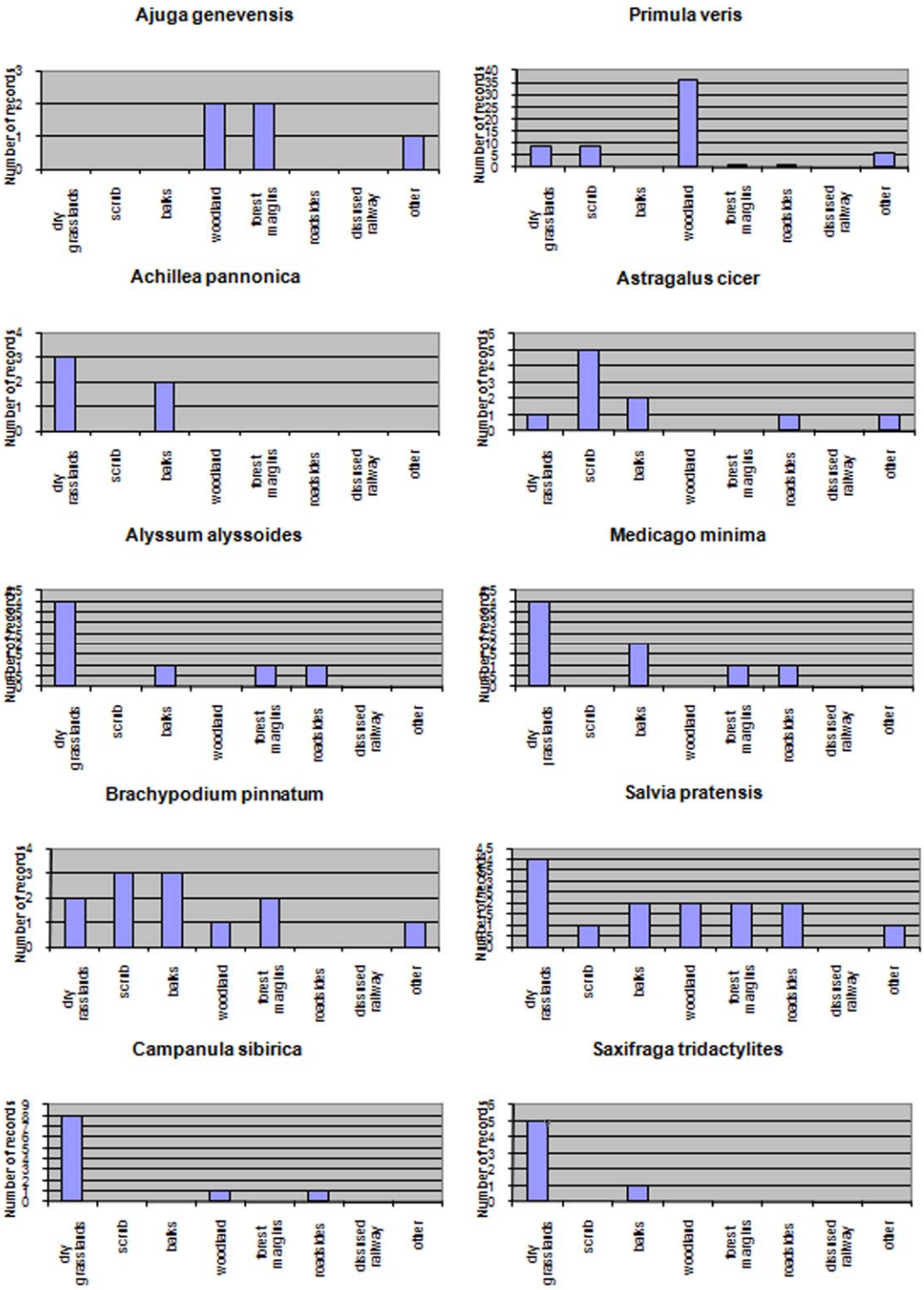

Figure 3: Habitat spectra of selected xenothermic species.

Table 1: Frequency of xerothermic plant species occurring in the area of upper Płonia river valley.

Frequency	Frequency class	% of cartogram fields	No of stations	No of species	Share [%]
Not found	-	0	0	38	35.2
Very rare	I	0.1-4.0	1-2	20	18.5
Rare	II	4.1-12.0	3-6	18	16.7
Frequent	III	12.1-25.0	7-12	16	14.8
Common	IV	25.1-50.0	13-25	9	8.3
Very common	V	50.1-75.0	26-37	6	5.6
Abundant	VI	75.1-100.0	38-50	1	0.9

Table 2: Disappearance of the selected xerothermic plant species stations in the upper Płonia River valley.

Name of species	Stations		
	according to Libbert	found in the 1980s and 1990s	present-day stations
Anemone sylvestris	Dobrzysław, Chrapowo Settlement, Żydowo (1938), Janowo (1932, 1938), Niepołcko (1935, 1938)	-	-
Arabis hirsuta	Równo (1941)	-	-
Asperula tinctoria	Barlinek, Wapienne Lake (1941), Dobrzysław (1935, 1938)	-	-
Campanula glomerata	Janowo (1935)	-	-
Carex praecox	Janowo, Niepołcko (1938), Barlinek (1941)	Osina (Bacieczko 1991)	0.5 km E from Osina
Geranium sanguineum	Płonia valley (1941)	-	-
Helianthemum nummularium subsp. *obscurum*	Janowo (1938), Laskówko (1932)	-	-
Sanguisorba minor	Janowo, Niepołcko (1938), Laskówko (1932, 1938)	Janowo (Filipek 1974), Równo (Bacieczko 1997)	1 km E from Równo, 1 km S from Wilcza Góra
Thymus pulegioides	Barlinek, Janowo, Niepołcko, Żydowo (1938), Laskówko (1932, 1938)	Janowo (Filipek 1974)	0.5 km SE from Janowo, 0.5 km E from Moczkowo
Veronica spicata	Barlinek, Chrapowo Settlement, Janowo (1938), Równo (1932)	Janowo (Filipek 1974, Bacieczko 1997)	0.5 km E from Osina
Viscaria vulgaris	Barlinek (1938, 1941), Janowo (1938), Płonia valley (1941)	Barlinek (Bacieczko 1991), Janowo (Bacieczko 1991, 1997)	0.5 km E from Osina

Table 3: The presence of xerothermic plant species in different types of habitats in the upper Płonia River valley.

No	Habitat	EUNIS habitat type	Presence of xerothermic species		The most numerous xerothermic species (No of records)
			No of species	No of records	
1.	Water-fringing vegetation by lakes, ponds, mid-field water bodies and drainage ditches	C3 Litoral zone of inland surface waterbodies	11	28	*Astragalus glycyphyllos* (5), *Galium mollugo* agg. (5), *Allium oleraceum* (4), *Agrimonia eupatoria* (3), *Bromus inermis* (3)
2.	Dry grasslands	E1 Dry grasslands	55	341	*Hypericum perforatum* (26), *Galium mollugo* agg. (21), *Pimpinella saxifraga* (20), *Senecio jacobea* (20), *Astragalus glycyphyllos* (19), *Arenaria serpyllifolia* (18), *Agrimonia eupatoria* (17), *Artemisia campestris* (15), *Falcaria vulgaris* (15)
3.	Mesic and wet grasslands	E2 Mesic grasslands E3 Seasonally wet and wet grasslands	22	61	*Galium mollugo* agg. (21), *Hypericum perforatum* (7), *Vicia sepium* (4), *Agrimonia eupatoria* (3), *Astragalus glycyphyllos* (3), *Bromus inermis* (3), *Senecio jacobea* (3)
4.	Forest margins (forest fringes)	E5 Woodland fringes and clearings and tall forb stands	33	73	*Allium oleraceum* (6), *Hypericum perforatum* (6), *Galium mollugo* agg. (6), *Agrimonia eupatoria* (4)
5.	Forest-dividing lines		15	30	*Galium mollugo* agg. (6), *Agrimonia eupatoria* (4), *Hypericum perforatum* (4), *Senecio jacobea* (3)
6.	Rural settlements	E5.6 Anthropogenic forb-rich habitats	13	18	*Galium mollugo* agg. (3), *Agrimonia eupatoria* (2), *Campanula rapunculoides* (2)
7.	*Prunetalia spinosae* scrub	F3.1 Temperate thickets and scrub	22	116	*Agrimonia eupatoria* (13), *Allium oleraceum* (11), *Galium mollugo* agg. (11), *Falcaria vulgaris* (9), *Hypericum perforatum* (9), *Primula veris* (9), *Astragalus glycyphyllos* (8), *Campanula rapunculoides* (8)
8.	Broadleaved deciduous woodland	G1 Broadleaved deciduous woodland	22	98	*Primula veris* (18), *Allium vineale* (10), *A. oleraceum* (9), *Galium mollugo* agg. (8), *Astragalus glycyphyllos* (7), *Agrimonia eupatoria* (6), *Campanula rapunculoides* (6), *Viola hirta* (5)

9.	Robinia pseudacacia or Populus sp. plantations	G1.C Highly artificial broadleaved deciduous forestry plantations	19	26	*Allium oleraceum* (3), *Hypericum perforatum* (3), *Primula veris* (3), *Viola hirta* (2)
10.	Pine woodland	G3 Coniferous woodland	23	70	*Hypericum perforatum* (10), *Primula veris* (10), *Galium mollugo* agg. (8), *Agrimonia eupatoria* (5), *Astragalus glycyphyllos* (5), *Senecio jacobea* (5), *Pimpinella saxifraga* (4)
11.	Mixed deciduous and coniferous woodland	G4 Mixed deciduous and coniferous woodland	21	39	*Primula veris* (5), *Hypericum perforatum* (4), *Allium oleraceum* (3), *A. vineale* (3), *Astragalus glycyphyllos* (3), *Galium mollugo* agg. (3), *Viola hirta* (3)
12.	Lines of trees	G5.1 Lines of trees	13	30	*Astragalus glycyphyllos* (4), *Galium mollugo* agg. (4), *Hypericum perforatum* (4), *Campanula rapunculoides* (3), *Agrimonia eupatoria* (2), *Allium oleraceum* (2)
13.	Clearings	G5.84 Herbaceous clearings	21	30	*Hypericum perforatum* (4), *Agrimonia eupatoria* (2), *Allium oleraceum* (2), *Astragalus glycyphyllos* (2), *Fragaria viridis* (2), *Galim mollugo* agg. (2), *Verbascum lychnitis* (2)
14.	Unsurfaced pathways	H5.61 Unsurfaced pathways	6	6	*Agrimonia eupatoria* (1), *Astragalus cicer* (1), *A. glycyphyllos* (1), *Galium mollugo* agg. (1), *Pimpinella saxifraga* (1), *Senecio jacobea* (1)
15.	Arable land	I1 Arable land and market gardens	4	8	*Consolida regalis* (22), *Viola arvensis* (22), *Papaver rhoeas* (21), *Capsella bursa-pastoris* (18), *Thlaspi arvense* (18), *Euphorbia helioscopia* (17)
16.	Fallows		5	8	*Arenaria serpyllifolia* (2), *Hypericum perforatum* (2), *Senecio jakobea* (2), *Astragalus glycyphyllos* (1), *Falcaria vulgaris* (1)
17.	Balks (mid-field boundary strips)		31	115	*Galium mollugo* agg. (14), *Falcaria vulgaris* (11), *Hypericum perforatum* (9), *Medicago falcata* (9), *Agrimonia eupatoria* (8), *Campanula rapunculoides* (7), *Pimpinella saxifraga* (7)
18.	Village parks	I2.23 Small parks and city squares	3	3	*Allium vineale* (1), *Primula veris* (1), *Viola hirta* (1)

19.	Disused railway	J4.1 Disused road, rail and other constructed hard-surfaced areas	23	46	*Galium mollugo* agg. (5), *Sedum maximum* (5), *Agrimonia eupatoria* (3), *Artemisia campestris* (3), *Hypericum perforatum* (3), *Pimpinella saxifraga* (3), *Potentilla arenaria* (3)
20.	Roads and roadsides	J4.2 Road networks	31	72	*Pimpinella saxifraga* (7), *Artemisia campestris* (5), *Galium mollugo* agg. (5), *Arenaria serpyllifolia* (4), *Astragalus glycyphyllos* (4), *Medicago falcata* (4)

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