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Expansion of *Puccinellia distans* (L.) Parl. in the Area of Lublin

Ekspansja mannicy odstającej — *Puccinellia distans* (L.) Parl. na terenie miasta
Lublina

INTRODUCTION

The natural reach of *Puccinellia distans* occurrence covers the vast Euro-Asiatic area being already brought, for example, to North America and the Far East (1, 14). The occurrence of this plant is associated with the habitat which is naturally or secondarily strongly salted. It is a small tufty and very fertile plant. In the winter period, the overground parts of this plant die out completely or only partly. *Puccinellia distans* is considered to be a collective, critical and changeable species divided into several species or sub-species (4, 11). Its taxon, subsp. *distans* is regarded as the most expansive.

At home, *Puccinellia distans* occurs as a natural native plant (salt impregnated apophyte) or as a brought one (agresto-epekophyta). As the native species, it occurs in a few regions of south, central-western and north-western Poland, on the salty habitats of continental and seaside well-heads (14, 16). It has been successively brought to our country and spread on the secondarily salted habitats of different types including meadows, waste-heaps, gravel dumping ground, trans-shipping stations, railway lines and road sides.

In Poland, the early report of *Puccinellia distans* in the urbanized region goes back to the first half of the 19th century (14), while it was most expansively brought to the secondarily salted habitats as late as the decade between 1980 and 1990. This results mainly from the progressing salinity of the urbanized regions and edges of the main transport routes being due to the more and more popular way of removing glaze from the road surface and removing snow by means of spilling salt (mainly NaCl and CaCl₂). According to the data by Jackowiak (14), *Puccinellia distans* occurs much more frequently on the introduced habitats than on the natural ones and the range of this species covers with great speed greater and greater areas of the country.

THE NATURAL ENVIRONMENT OF LUBLIN

At present, the area of Lublin is about 148 km² and it is inhabited by approximately 352,000 people. It lies on the rolling area of the Lublin Upland, at the height of 170–220 m a.s.l. The city developed on the Bystrzyca river, at the crossing of its two tributaries, Czerniejówka and Czechowianka. In the outskirts there are a few natural forest complexes and one large reservoir on the Bystrzyca (Fig. 1).

The oldest rock bedding in the Lublin area is made up of cracked marls of limestone-silty type (7). These cretaceous rocks are directly covered by loesses or different types of boulder-clays, sand and gravels (30, 31). The first form of these four pleistocene sediments dominates spatially in the western part of Lublin, while the three latter dominate in the eastern part. In this situation, the border between the eastern and western parts of the city goes along the Bystrzyca valley (Fig. 1).

As for the general climatic conditions (7, 33), Lublin is an urban agglomeration characterized by rather high mean yearly air temperature (7.4°C) and not very high mean yearly sum of atmospheric falls (576 mm). The mean yearly insolation is 4.5/24 hrs. The winds from the western sector are the most dominating and those from the eastern sector the least. In view of a quite great geomorphological differentiation of the region, the microclimate conditions present correspondingly a great spatial differentiation. It is worth mentioning that the area of the city lacks the natural habitats for *Puccinellia distans*, the type of salty or salty-sulfate well-heads.

The natural environment of Lublin, as other big Polish towns, is subjected to successive contamination by fumes and industrial emissions (29, 30). Since the turn of 1960s and 1970s a particular threat for Lublin environment has been removing the snow and glaze from the streets and squares by means of sand mixed with salt compounds, mainly NaCl, MgCl₂ and CaCl₂ (30). Washing out the accumulated salts from the surface layer of the ground is made difficult in Lublin because of relatively low precipitations.

SCOPE AND METHODS OF THE INVESTIGATIONS

The paper characterizes the present state of the occurrence of *Puccinellia distans* in the Lublin area. Attention was paid to the spatial distribution of the plant, its habitat conditions and phytosociological and soil conditions. Intensive field studies of the habitats with *Puccinellia distans* were conducted in the whole vegetation period of 1991 in all potential habitats and sites. The studies made it possible to prepare a map of the present habitats of *Puccinellia distans* in the area of the Lublin city (Fig. 1).

The studies on the communities with *Puccinellia distans* were conducted according to generally accepted principles of phytosociology (22). In the tables of phytosociological

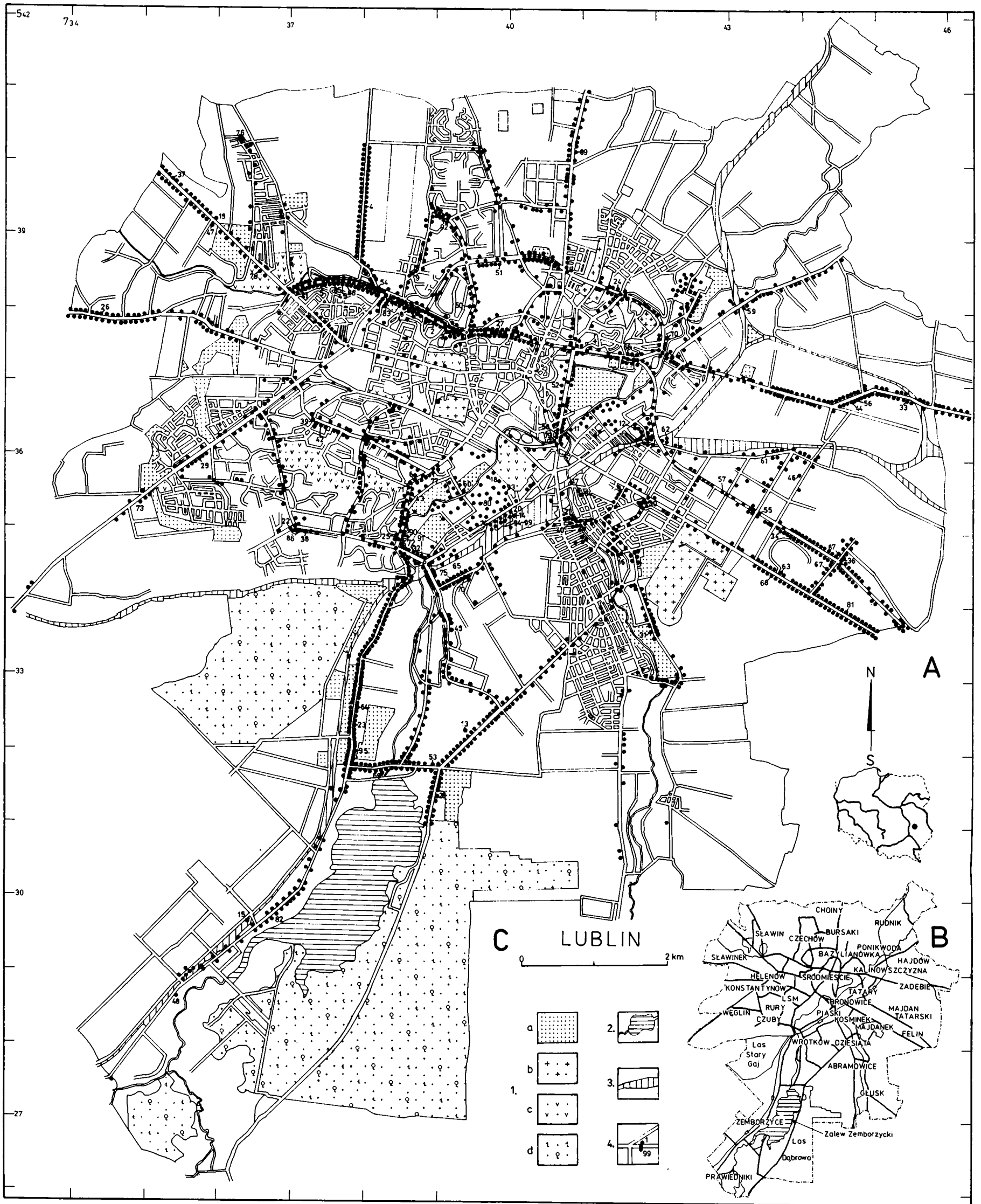


Fig. 1. Situation maps of the Lublin city: A — location of Lublin on the map of Poland; B — the city's districts against the more important streets and other objects; C — plan of the city: 1 — gardens (a), cemeteries (b), parks (c), natural forest complexes (d); 2 — water network; 3 — railway lines; 4 — sites with *Puccinellia distans*; notes: in the case of point 4, the situation of the localities of the plant occurring on both road sides, roundabouts and green belts was presented; 1–99 — sites of 99 phytosociological records made in the communities with *Puccinellia distans* (Table 1–5)

communities with *Puccinellia distans* with 99 phytosociological records (Tables 1-6), the coverage of the species was given in a 5-degree scale, with the additional labelling of the plants with the coverage smaller than 1-5% (+) and the plants occurring occasionally in 1-3 specimens (r).

The syntaxonomic belonging of plant species occurring in the studied communities with *Puccinellia distans* was determined according to the earlier published data on this subject; especially by Oberdorfer (20) and Matuszkiewicz (18) and in few cases according to other authors (24, 32) and the author's own opinion.

The distinguished communities with *Puccinellia distans* were treated according to the latest phytosociological system of carpet communities published by Tüxen (32) and Rivas-Martinez (24). So far, a similar phytosociological taxonomy of the discussed type of carpet communities was applied only by the botanists from the Poznań centre (12, 13, 23).

The terminology of the plants enumerated in the present paper is the same as given earlier (21, 28).

The soils were studied in nine most representative patches of seven definite forms of communities with *Puccinellia distans*. For comparative purpose, the soil samples were simultaneously taken from two different places of the same patch of a definite community with *Puccinellia distans*: first, in the central part, which is the most representative for the community (profile a), and next in the marginal part from the place of rapid disappearance of the community (profile b). The soil samples were taken at the beginning of November 1991. Laboratory examinations of the soils were carried out at the Regional Chemical-Agricultural Station in Lublin using the methods listed by Czuba (2). In the collected 54 soil samples in 18 outcrops from three definite levels there was determined mechanical composition employing Cassagrande's method modified by Prószyński and the universal method by means of 0.03n CH₃COOH extract; the content of humus (by Tiurin's method), pH, NO₃, Cl (potentiometrically), K, Ca, Na, Mg (photometrically), P (by colometric method) and the general salinity (conductometrically). The results of the soil analyses are presented in Table 7.

A similar scope of examinations of the expansion of *Puccinellia distans* in the urban secondarily salted habitats was used earlier in the regions of Cracow (19) and in the area of the Poznań city (12).

The specification of the sites of phytosociological records includes following abbreviations of the names of Lublin districts given in Fig. 1: Ba — Bazylianówka, Be — Bronowice, Bi — Bursaki, Cz — Czechów, Czy — Czuby, Fn — Felin, Hw — Hajdów, He — Helenów, Ka — Kalinowszczyzna, Kk — Kośminek, LSM — Lublin Housing Co-operative, Mk — Majdanek, MT — Majdan Tatarski, Pa — Ponikwoda, Ry — Rury, Sn — Sławin, Sk — Sławinek, SM — Old Town, Śe — City Centre, Ty — Tatary, Wn — Węglin, Ww — Wrotków, Za — Zadębie, Ze — Zemborzyce.

THE OCCURRENCE OF *PUCCINELLIA DISTANS* IN THE AREA OF LUBLIN

The earliest herbarial specimens of *Puccinellia distans* from the Lublin macro-region come from: Lublin and Zemborzyce (leg. D. Fijałkowski 1960 and 1961), Chełm (leg. D. Fijałkowski 1963) and Zamość (leg. D. Fijałkowski 1979). It should be finally assumed that this plant, according to its herbarial specimens and data from literature (5-9, 14) settled

in the Lublin area in the years 1960–1978 only in two rather numerous sites. They were found on railway lines; first at the central railway station in Lublin and then at the railway station at Zemborzyce. It is also interesting that *Puccinellia distans* is still growing in these two sites but it is very rare and occurs almost exclusively in the outskirts of railway lines or the neighbouring trans-shipping stations.

It is interesting to note that the paper by Fijałkowski (7) published in 1967 on synantropous vegetation of Lublin gives no mention whatsoever of the occurrence of *Puccinellia distans* in the phytosociological records provided in that work. The above-mentioned author in his two successive works published in the end of the seventies on the synanthropic plants of the Lublin Region (8) and on plant communities of the Lublin rivers (9) presents 4 phytosociological records of the well-formed *Puccinellietum distantis* association; out of these 3 come from Lublin and 1 — from Chełm. As follows from the author's own studies, *Puccinellia distans* belongs to the group of most commonly imported plants in the Lublin area (Fig. 1). It occurs commonly, individually or in groups. It creates different ranks of plant communities belonging almost exclusively to a group of "carpet" communities from the classes of *Molinio-Arrhenatheretea* and *Polygono-Poëtea annuae* (Tables 1–6). It is spread almost only on ruderal grounds, strongly salted, with loose vegetation, of different granulometric composition and of very changeable periodical moisture and drying up (Table 7). Both in the Lublin area and anywhere else, this plant radically avoids any shaded habitats (14, 19).

The data presented above about the earliest occurrence of *Puccinellia distans* in the Lublin area point to the fact that intensified expansion of *Puccinellia distans* within the city occurs not earlier than in the years 1980–1990. As in other regions of Poland and abroad, its spread is connected with progressing salinity of the bedding, which results from mass removal of snow and glaze from the streets and squares by means of sand mixed with different salts, mainly NaCl, CaCl₂ and MgCl₂ (14, 17, 19, 25). That is the reason why in the Lublin area *Puccinellia distans* is mostly spread on the most salted borders of roads, roundabouts and green belts. It grows scattered or in groups most often right at the kerbs, forming characteristic, not very wide sward runs of different density. It is less frequent on weathered and deep cracks of kerbs and pavements (Figs. 2 and 3). It appears in a scattered form only at some trans-shipping stations and the edges of sports grounds. It was occasionally observed on railway lines (Fig. 1).

The lack of *Puccinellia distans* in some parts of salted road edges in Lublin (Fig. 1) is essentially connected with mechanical destruction of its

specimens for example through treading, mowing or weeding. It is possible that this plant has not been able to settle for good on a number of these sites.

Beginning with the peripheral parts of Lublin towards the administrative borders of the city, the occurrence of *Puccinellia distans* is limited to less and less numerous and scattered sites grouped mainly on sites of large roads (Fig. 1). In this situation, a rapid drop of the number of the sites of *Puccinellia distans* is related to smaller and smaller salinity of the area.

PLANT COMMUNITIES WITH *Puccinellia distans* IN THE AREA OF THE LUBLIN CITY

Phytosociological taxonomy

Phytosociological taxonomy of the communities with *Puccinellia distans* distinguished within the city of Lublin is as follows:

Class: *Molinio-Arrhenatheretea* Tx. (1937) 1970

order: *Trifolio fragiferi-Agrostietalia* (Oberd. 1967) Tx. 1970

alliance: *Agropyro-Rumicion crispi* Nordh. 1940

association: 1. *Potentilletum anserinae* Rapaics 1927

sub-association: 1.1. *P. a. puccinellietosum* Jackowiak 1984

variant: 1.1.1. typical

variant: 1.1.2. with *Polygonum aviculare*

order: *Plantaginetaalia majoris* Tx. et Prsg. 1950

alliance: *Lolio-Plantaginion* Siss. 1969

association: 2. *Lolio-Plantaginetum* (Beg. 1930) Siss. 1969

sub-association: 2.1. *L.-P. puccinellietosum* Tx. 1970

variant: 2.1.1. with *Plantago major*

facie: 2.1.1.1. with *Plantago major* and *Puccinellia distans*

facie: 2.1.1.2. typical with *Puccinellia distans* and *Plantago major*

variant: 2.1.2. with *Puccinellia distans*

facie: 2.1.2.1. sward-like with *Puccinellia distans*

facie: 2.1.2.2. ruderal with *Puccinellia distans* and *Artemisia vulgaris*

form: 2.1.3. with *Lolium perenne*

form: 2.1.4. with *Medicago lupulina*

form: 2.1.5. with *Achillea millefolium*

Class: *Polygono-Poëtea annuae* Riv.-Mart. 1975

order: *Polygono-Poëtaalia annuae* Tx. 1972

alliance: *Matricario-Polygonion avicularis* (Br.-Bl. 1931, Riv.-Mart. 1975)

association: 3. *Polygono-Matricarietum discoideae*

sub-association: 3.1. *P.-M. d. puccinellietosum* Gütte (1966) 1972

variant: 3.1.1. with *Polygonum aviculare*

facie: 3.1.1.1. with *Polygonum aviculare* and *Puccinellia distans*

facie: 3.1.1.2. typical with *Puccinellia distans* and *Polygonum aviculare*

form: 3.1.2. with *Plantago pauciflora*

form: 3.1.3. with *Sisymbrium loeselii*

form: 3.1.4. with *Lepidium ruderales*

THE FLORISTIC STRUCTURE AND HABITAT REQUIREMENTS

1.1. *Potentilletum anserinae puccinellietosum*

The sub-association under discussion is built mainly of *Potentilla anserina* and *Puccinellia distans*. Two variants can be distinguished within it. The first, typical variant is characterized by undivided domination of *Puccinellia distans* and *Potentilla anserina* and relatively slight differentiation of the general species composition of the plants. The other variant with *Polygonum aviculare* is distinguished by a little richer floristic composition and common domination of *Potentilla anserina* and *Puccinellia distans* with *Polygonum aviculare*.

Both variants characterized here occur with almost the same frequency on flat and a little lowered road sides. These are the habitats, which are distinguished by fairly big moistening and abundance of mud and humus sediments. These communities are rare in the area of Lublin. Phytosociological records are provided of all the found areas of this sub-association.

Phytosociological record (Table 1): 1. Be, Zamojska Street, a little hollow loess side of the roundabout, moist up, sandy with coal dust, 2. Śe, Al. Tysiaclecia Street, slightly hollow loess side, moist up, sandy. 3. Śe, Al. Tysiaclecia Street, sloping loess sides, mesophyllous, sandy and gravelly. 4. Czw, Poligonowa Street, flat loess side, mesophyllous up, poorly sandy. 5. Sk, Al. Tysiaclecia Street, flat loess sides, mesophyllous up, sandy. 6. LSM, Nadbystrzycka Street, sloping loess sides, mesophyllous up, sandy and gravelly. 7. Ty, Mełgiewska Street, slightly hollow sides of the green belt front, clayey, mesophyllous up. 8. Sk, Al. Tysiaclecia Street, flat loess sides, mesophyllous up, sandy, slightly muddy. 9. Czw, Koncertowa Street, sloping loess sides, mesophyllous up, sandy. 10. Ka, M. Smorawińskiego Street, slightly hollow loess sides, moist up, sandy with gravel.

2.1. *Lolio-Plantaginetum puccinellietosum*

On the basis of the dominating plants, the general floristic composition and the habitat conditions, the sub-association named above was divided into two variants in four facies and three forms of communities with indistinct phytosociological rank.

2.1.1. Variant with *Plantago major*, two facies are quite clearly distinguished here. The first one is characterized by considerable quantitative prevalence of *Plantago major* over *Puccinellia distans*. The other presents almost identical degree of co-dominance of *Puccinellia distans* with *Plantago major* or there is a slight quantitative dominance of *Puccinellia distans* over *Plantago major*.

Both these facies occur quite often in the area of Lublin and on similar habitats. Most frequently, these are strongly trodden or run over road

Table 1. Sub-association: 1.1. — *Potentilletum anserinae puccinellietosum* in variants: 1.1.1. — typical, 1.1.2. — with *Polygonum aviculare*

No of community	1.1.									
	1.					2.				
No of record	1	2	3	4	5	6	7	8	9	10
Date	91-07-28	91-05-17	91-07-26	91-08-17	91-07-26	91-07-16	91-07-21	91-09-18	91-08-16	91-09-21
Area of plot in m ²	4	6	6	8	8	8	2	4	4	8
Cover the layer in %	90	100	100	100	100	100	100	100	100	100
	d									
Number of species in record	6	8	9	9	11	10	9	12	13	12
I. Ch: <i>Puccinellion maritimae</i> <i>Puccinellia distans</i> 5 5 5 4 5 3 4 3 3 5 V II. Ch: a - <i>Koelinio-Arrhenatheretea</i> , <i>Arrhenatheretalia</i> , b - <i>Trifolium fragiferi-Agrostietalia</i> , <i>Agropyro-Rumicetum</i> <i>crispi</i> , c - <i>Plantaginetalia majoris</i> , <i>Lolio-Plantaginatum</i> a <i>Achillea millefolium</i> + r + r + III a <i>Taraxacum officinale</i> + 1 + + + + IV a <i>Trifolium repens</i> + r + II a <i>Leontodon autumnalis</i> + + r II b <i>Potentilla anserina</i> 4 4 5 5 5 5 5 5 3 V b <i>Agrostis stolonifera</i> + + 2 1. + . 1 III c <i>Plantago major</i> + + + 1 + + + IV c <i>Lolium perenne</i> 2 . . . + . . . II III. Ch: <i>Polygono-Poëtea annuae</i> , <i>Polygono-Poëta</i> <i>annuae</i> , <i>Matricario-Polygonion avicularis</i> <i>Polygonum aviculare</i> + + + r r 2 2 2 2 V <i>Matricaria discoidea</i> + + . r . + II IV. Ch: a - <i>Bidentetea tripartiti</i> , b - <i>Agropyretea inter-</i> <i>medi-repentis</i> , c - <i>Artemisietea vulgaris</i> b <i>Agropyron repens</i> + . . r 2 2 II c <i>Pastinaca sativa</i> + r I c <i>Picris hieracioides</i> 2 I V. Ch: a - <i>Scalietea</i> , b - <i>Chenopodietea</i> b <i>Echinochloa crus-galli</i> + r + + II VI. Inne /others/: a - <i>synantropijne /synanthropic/</i> , h - Ch: <i>Festuco-Brometea</i> a <i>Plantago pauciflora</i> + 2 . I a <i>Medicago lupulina</i> r . . . + . I a <i>Agrostis vulgaris</i> + + I										
Species occurring in 1 record: II. c - <i>Bryum argenteum</i> 10/x; IV. a - <i>Bidens cernuus</i> 10/+; b - <i>Cirsium arvense</i> 7/+. <i>Tussilago farfara</i> 7/+; c - <i>Melilotus officinalis</i> 2/1, <i>A-</i> <i>triplex tataricum</i> 9/2. V. a - <i>Matricaria chamomilla</i> 5/+; b - <i>Chenopodium album</i> 3/r, <i>Sonchus oleraceus</i> 9/+. <i>Polygonum</i> <i>persicaria</i> 10/+. VI. a - <i>Senecio vulgaris</i> 10/+; b - <i>Arte-</i> <i>misia campestris</i> 4/+.										

sides and city squares, dry or mesophyllous ones of different granulometric composition.

Phytosociological record (Table 2): 11. Be, at a dam of the Bystrzyca river, flat road sides, clayey, trodden, dry up, gravelly-sandy. 12. Be, corner of the Łęczyńska and Krzemionki Streets, littered, clayey square, dry up, clinker — gravelly, sandy. 13. Ww, at Zemborzycza Street, in the gate of go-cart track, flat, driven up clayey square, dry up, gravelly-sandy. 14. Ww, at Krochmalna Street, trans-shipping station of the Polish State Railways, flat clayey square, compact, dry up, gravelly with concrete pieces and

Table 2. Sub-association: 2.1. — *Lolio-Plantagnetum puccinellietosum* in variant: 2.1.1. — with *Plantago major* in facies: 2.1.1.1. — with *Plantago major* and *Puccinellia distans*, 2.1.1.2. — typical with *Puccinellia distans* and *Plantago major*

No of community	2.1.1.		2.1.1.
	1.	2.	
No of record	11	12	25
Date	91-09-22	91-09-22	91-07-10
Area of plot in	16	18	3
Cover the layer in %	80	90	100
Number of species in record	24	10	9
I. Ch: <i>Puccinellion maritimae</i>			
<i>Puccinellia distans</i>	1	1	5
II. Ch: a - <i>Molinio-Arrhenatheretea</i> , <i>Arrhenatheretalia</i> , b - <i>Trifolium fragiferi-Agrostietalia</i> , <i>Agropyro-Rumicion crispi</i> , c - <i>Plantagnetalia majoris</i> , <i>Lolio-Plantagnetum</i>			
a <i>Trifolium pratense</i>	+	+	I
a <i>Leontodon autumnalis</i>	+	+	I
a <i>Trifolium repens</i>	+	+	III
a <i>Taraxacum officinale</i>	+	+	IV
a <i>Achillea millefolium</i>	+	1	II
b <i>Potentilla anserina</i>	+	+	I
b <i>Agrostis stolonifera</i>	+	+	III
c <i>Lolium perenne</i>	1	1	III
c <i>Plantago major</i>	3	3	3
III. Ch: <i>Polygono-Poëtea annuae</i> , <i>Polygono-Poëstalia annuae</i> , <i>Matricario-Polygonion avicularis</i>			
<i>Bryum argenteum</i>	1	3	III
<i>Lepidium ruderales</i>	+	2	III
<i>Poa annua</i>	+	+	IV
<i>Polygonum aviculare</i>	1	1	V
<i>Matricaria discoidea</i>	+	+	IV
IV. Ch: a - <i>Bidentetea tripartiti</i> , b - <i>Artemisietea vulgaris</i>			
a <i>Chenopodium glaucum</i>	+	+	I
a <i>Bidens tripartiti</i>	+	+	I
b <i>Melilotus officinalis</i>	+	+	I
b <i>Tanacetum vulgare</i>	+	+	I
b <i>Daucus carota</i>	+	+	I
b <i>Melilotus albus</i>	+	+	I
b <i>Artemisia vulgaris</i>	+	+	V
V. Ch: a - <i>Secalietea</i> , b - <i>Chenopodietea</i>			
a <i>Matricaria chamomilla</i>	+	+	I
a <i>Tripleurospermum inodorum</i> ..	+	+	II
b <i>Echinochloa crus-galli</i>	+	+	I
b <i>Atriplex patulum</i>	+	+	I
b <i>Lactuca scariola</i>	+	+	I
b <i>Sisymbrium loeselii</i>	+	+	I
VI. Inne /others/: a - <i>synantropijne /synanthropic/</i> , b - <i>Ch: Sedo-Scleranthetea</i>			
a <i>Erigeron canadensis</i>	+	+	II
a <i>Medicago lupulina</i>	+	+	III
a <i>Plantago pauciflora</i>	2	1	III
b <i>Ceratodon purpureus</i>	+	+	I
Species occurring in 1 record: II. a - <i>Plantago lanceolata</i> 14/+, b - <i>Rorippa silvestris</i> 22/r, <i>Rumex crispus</i> 22/r; IV. a - <i>Chenopodium rubrum</i> 17/5, b - <i>Arctium tomentosum</i> 11/+, <i>Atriplex tatarica</i> 11/+, <i>Malva silvestris</i> 12/+, V. b - <i>Sonchus oleraceus</i> 11/+, <i>S. asper</i> 12/+, <i>Atriplex nitens</i> 13/r, <i>Chenopodium album</i> 14/+, <i>Galinsoga parviflora</i> 14/+, <i>G. quadriradiata</i> 15/+, <i>Descurainia sophia</i> 14/+, VI. a - <i>Trifolium hybridum</i> 11/+, <i>Agrostis vulgaris</i> 21/+, <i>Odontites rubra</i> 22/+, b - <i>Brachytheclium albicans</i> 12/+.			

pieces of brick. 15. Ze, station of the Polish State Railways, flat trans-shipping station, loess, compact, dry up, deeply gravelly-sandy. 16. Kk, Wilcza Street, flat clayey sides, mesophyllous up, sandy-gravelly. 17. Kk, near Kręta Street, at an old building, flat loess square, compact, dry up, deeply clinker-gravelly. 18. Ww, on the Bystrzyca river, area of sediment traps belonging to the sugar factory, flat top of a dam, compact, clinker-gravelly-sandy. 19. Sn, near Al. Warszawska Street, flat loess road side, trodden, mesophyllous up, sandy-gravelly. 20. Ww, at Krochmalna Street, trans-shipping station of the Polish State Railways, flat clayey square, compact, dry up, deeply clinker-gravelly with brick pieces. 21. Kk, Piaskowa Street, flat clayey side, trodden, dry up, poorly gravelly-sandy. 22. Czy, Jana Pawła II Street, flat side of a green belt, loess, dry up, gravelly-sandy. 23. Ww, Janowska Street, flat loess side, trodden, dry up, sandy-gravelly. 24. Ka, M. Smorawińskiego Street, flat loess side, trodden, dry up, sandy-gravelly. 25. Czy, Nadbystrzycka Street, flat side of a green belt, loess, dry up, gravelly-sandy-clinker one.

2.1.2. Typical variant. What strikes most of all here is clear domination of *Puccinellia distans* over all the other co-existing plants. Two community forms can be distinctly seen here and they are temporarily determined in the rank of facies: grassland with *Puccinellia distans* and ruderal with *Puccinellia distans* and *Artemisia vulgaris*. As for the general physiognomy the former presents compact sward of *Puccinellia distans* with individual or scarce other plants. The other facies is already distinguished by a little smaller compactness of *Puccinellia distans* and much bigger quantity and species composition of other plants. A special attention should be directed to frequent occurrence of high ruderal and segetal plants, especially *Artemisia vulgaris*, *Daucus carota*, *Melilotus albus*, *Atriplex patulum* and *Tripleurospermum inodorum*. Both the facies mentioned here are very common in the area of Lublin. The grassland facies with *Puccinellia distans* occurs mainly on relatively newly piled road sides with frequently and carefully mown grassland. The ruderal facies with *Puccinellia distans* and *Artemisia vulgaris* is most characteristic of old, ruderal gravelly-sandy-clayey sides of roads and squares.

Phytosociological record (Table 3): 26. He, Nałęczowska Street, flat clayey edge, mesophyllous, sandy. 27. Śe, Al. Tysiąclecia Street, slightly sloping loess edge, mesophyllous up, sandy-gravelly. 28. Ww, Osmolińska Street, flat loess edge, mesophyllous up, sandy with coal gravel. 29. Wn, Al. Kraśnicka Street, flat loess edge, mesophyllous up, sandy with gravel. 30. Kk, Krańcowa Street, slightly sloping edge of a green belt, clayey, dry up, sandy. 31. Mk, Wyzwolenia Street, flat clayey edge, mesophyllous up, sandy-clayey. 32. Ww, Krochmalna Street, flat loess edge, mesophyllous up, sandy-gravelly. 33. Za, Mełgiewska Street, slightly sloping clayey edge, mesophyllous up, sandy-gravelly. 34. Fn, Al. W. Witosa, slightly hollow clayey edge, wet up, sandy. 35. Ww, Janowska Street, slightly sloping loess edge, sandy with gravel. 36. Fn, Al. W. Witosa, flat clayey edge, dry up, sandy-gravelly. 37. Sn, Al. Warszawska Street, sloping loess side, dry up, sandy. 38. Czy, Jana Pawła II Street, slightly sloping loess side, mesophyllous up, sandy with gravel. 39. Ry, Wileńska Street, slightly hollow edge of the roundabout, loess one,

moist up, sandy-gravelly. 40. Kk, Pawia Street, slightly hollow clayey side, mesophyllous up, gravelly-sandy. 41. Sk, Al. Tysiąclecia Street, slightly hollow loess side, moist up, sandy with coal dust. 42. Ry, Zana Street, flat loess side, mesophyllous up, sandy-gravelly. 43. LSM, Nadbystrzycka Street, flat loess side, mesophyllous up, sandy-gravelly. 44. Za, Mełgiewska Street, flat clayey side, dry up, gravelly-sandy; 45. Sk, Al. Tysiąclecia Street, slightly hollow and sloping loess side, moist up, sandy with coal dust. 46. MT, A. Grygowa Street, flat loess side, dry up, sandy with gravel and clinker. 47. Sn, Al. Warszawska Street, slightly hollow loess side, moist up, gravelly-sandy with silty alluvial deposit. 48. Ze, Krężnicka Street, flat loess side, mesophyllous up, sandy with gravel. 49. Ww, Diamentowa Street, flat clayey side, mesophyllous up, sandy with gravel. 50. Ba, Kompozytorów Polskich Street, flat loess side, mesophyllous up, sandy-gravelly. 51. Ba, M. Smorawińskiego Street, flat loess side, sandy-gravelly up with coal dust. 52. SM, Al. Unii Lubelskiej Street, slightly convex loess side, mesophyllous up, poorly sandy. 53. Ww, Żeglarska Street, flat clayey side, dry up, sandy with gravel. 54. Sk, Al. Tysiąclecia Street, slightly hollow edge of a green belt mesophyllous up, sandy with gravel and clinker. 55. MT, Al. W. Witosa, flat edge of a green belt, clayey, mesophyllous up, sandy with silty alluvial deposit and with gravel. 56. Za, Mełgiewska Street, slightly hollow clayey edge mesophyllous up, gravelly-sandy with coal dust. 57. MT, Al. W. Witosa flat edge of a green belt, clayey, dry up, gravelly-sandy. 58. SM, Al. Unii Lubelskiej slightly hollow loess edge, moist up, poorly sandy-gravelly. 59. Hw, Turystyczna Street, flat clayey side, dry up, sandy with clinker and gravel. 60. LSM, at Wapienna Street, flat top of a dam on the Bystrzyca river, dry, gravelly-clinker-sandy one. 61. MT, Chemiczna Street, slightly hollow clayey side, mesophyllous up, sandy-gravelly. 62. Ty, at Chemiczna Street, flat littered clayey square, dry up, gravelly-sandy. 63. Fn, Droga Męczenników Majdanka Street, slightly hollow clayey side, mesophyllous up, gravelly-sandy. 64. Ww, Janowska Street, flat loess side, dry up, poorly sandy-gravelly. 65. Ww, Wrotkowska Street, slightly convex clayey side, dry up, sandy-gravelly with clinker. 66. Ka, Al. Tysiąclecia Street, strongly hollow loess side, moist up, sandy-clayey-gravelly. 67. Fn, Doświadczalna Street, slightly hollow clayey side, moist up, clayey one with gravel and sand.

Apart from the two earlier described variants in four facies, three other very rare communities were included in the sub-association of *Lolio-Plantaginietum puccinellietosum*. Temporarily, they were defined as distinct forms of sub-association communities:

- 2.1.3. with *Lolium perenne*,
- 2.1.4. with *Medicago lupulina*,
- 2.1.5. with *Achillea millefolium*.

The plant species enumerated here clearly have individual quantity prevalence both over *Puccinellia distans* and other plants occurring in these three forms of communities. The three forms of sub-association *L.-P. puccinellietosum* characterized here were found on almost the same habitat types as it is the case most often for example in the variant with *Plantago major*.

Phytosociological record (Table 4): 68. Mk, near Droga Męczenników Majdanka Street, slightly hollow side of a cart track, clayey, dry up, gravelly-sandy. 69. Ww,

Table 7. Some granulometric and chemical properties of the soils examined in the area of Lublin, among the communities with *Puccinellia distans* (Table 1-6)

Number of profile community records	Depth of horizon in cm	Content of humus in %	Content in mg/l										salinity in g KCl/l	Earth parts in %						Mechanical composition ^x
			pH																	
			H ₂ O/deat.	In KCl	H-NO ₃	P	K	Ca	Mg	Na	Cl	1-0,1		0,1-0,05	0,05-0,02	0,02-0,006	0,006-0,002	< 0,002		
1 a 1.1.2.	0-10	3,19	7,7 7,3	14 30	80 5610	80 100	37	0,06	18 63	11 16	6 3	1	Ab							
	20-30	-	8,6 7,3	17 30	30 4600	85 1150	329	0,96	11 3	13 46	20 3	15	Bd							
	50-60	-	8,6 7,5	19 30	20 5000	85 1120	632	1,74	8 3	14 46	19 3	15	Bd							
1 b 9	0-10	3,61	7,9 7,2	17 30	160 5500	110 300	67	0,30	13 35	12 32	11 4	6	Cb							
	20-30	-	8,3 7,4	16 30	30 5230	110 770	255	0,96	13 7	13 44	18 6	12	Bd							
	50-60	-	8,0 7,3	18 30	20 5410	130 900	620	1,35	29 8	13 44	17 6	12	Bd							
2 a 2.1.1.1.	0-10	6,35	7,4 7,2	16 120	160 5610	180 100	107	0,45	33 52	14 13	13 5	3	Af							
	20-30	-	8,1 7,3	17 100	120 5630	120 490	80	0,42	50 58	8 16	10 3	5	Ae							
	50-60	-	8,0 7,7	15 40	140 5400	150 610	123	0,96	37 64	8 12	9 5	5	Ae							
2 b 17	0-10	3,31	7,6 7,3	15 110	110 5610	180 90	60	0,30	38 62	9 11	10 6	2	Ae							
	20-30	-	8,1 7,3	17 40	70 5620	170 280	39	0,30	46 67	11 9	7 3	3	Ac							
	50-60	-	8,2 7,3	17 40	80 5300	150 650	74	0,42	71 67	10 9	8 4	2	Ac							
3 a 2.1.1.2.	0-10	3,63	7,8 7,2	18 160	50 5800	105 180	75	0,18	7 61	11 16	8 2	2	Ad							
	20-30	-	8,3 7,3	18 160	50 5800	110 613	100	0,45	25 19	11 36	20 8	6	Bd							
	50-60	-	8,0 7,3	21 140	50 5700	105 550	270	0,60	35 23	13 34	16 7	7	Ba							
3 b 21	0-10	3,49	7,6 7,2	15 140	50 5640	100 88	52	0,18	33 57	13 17	9 2	2	Ad							
	20-30	-	8,3 7,4	20 130	50 5700	130 410	96	0,33	12 18	12 33	19 10	8	Ba							
	50-60	-	8,1 7,4	22 140	50 5830	125 508	190	0,42	16 19	10 37	19 8	7	Ba							
4 a 2.1.2.1.	0-10	2,92	8,3 7,3	17 120	55 5620	100 380	100	0,33	6 35	15 27	12 4	7	Cb							
	20-30	-	8,5 7,4	22 120	20 5460	110 1040	620	1,20	17 13	11 40	17 6	13	Bo							
	50-60	-	8,5 7,5	20 120	20 5500	115 1180	1620	1,35	25 21	11 32	17 7	12	Bo							
4 b 27	0-10	1,96	8,6 7,3	18 140	80 5620	110 612	120	0,45	8 26	9 37	15 4	9	Ba							
	20-30	-	8,6 7,5	17 130	90 5520	140 540	80	1,33	14 7	11 47	18 5	12	Bb							
	50-60	-	8,5 7,4	18 120	110 5530	145 510	106	0,33	14 3	16 45	18 5	13	Bb							
5 a 2.1.2.2.	0-10	2,14	8,3 7,6	17 140	50 5630	105 350	154	0,45	17 54	13 16	8 4	5	Af							
	20-30	-	8,2 7,7	21 170	75 5610	120 650	566	0,84	22 34	11 28	16 7	4	Cb							
	50-60	-	8,2 7,7	26 170	80 5710	130 652	690	0,60	20 35	11 28	14 5	7	Cb							
5 b 64	0-10	2,22	7,8 7,4	19 100	110 5630	210 300	318	0,75	15 33	13 26	13 7	8	Cb							
	20-30	-	7,7 7,7	24 100	130 6100	250 360	760	0,84	15 29	11 28	19 8	5	Cb							
	50-60	-	7,9 7,8	24 140	160 5830	210 140	560	0,60	11 28	11 29	19 9	4	Cb							
6 a 2.1.2.2.	0-10	0,55	7,8 7,5	16 90	85 5610	100 70	36	0,18	7 70	9 11	4 2	4	Ab							
	20-30	-	8,0 7,7	15 130	70 5620	100 75	44	0,18	33 68	8 12	5 3	4	Ac							
	50-60	-	8,3 7,8	15 40	80 5620	130 160	36	0,18	21 69	12 9	5 2	3	Ab							
6 b 66	0-10	0,87	8,4 7,8	16 130	80 5630	90 210	39	0,18	20 72	8 9	6 3	2	Ac							
	20-30	-	8,3 7,8	15 120	50 5620	95 214	59	0,33	20 68	10 10	6 2	4	Ac							
	50-60	-	8,5 8,3	17 120	25 5900	105 300	53	0,33	31 73	7 9	6 2	3	Ac							
7 a 3.1.1.1.	0-10	1,86	8,4 7,5	15 50	80 5200	100 740	218	0,60	12 27	14 36	14 4	5	Cb							
	20-30	-	8,5 7,6	16 30	70 5230	90 720	295	0,75	13 28	12 34	14 5	7	Cb							
	50-60	-	8,6 7,5	19 30	60 5180	90 750	185	0,60	15 31	11 31	16 4	7	Cb							
7 b 76	0-10	2,76	8,1 7,3	16 45	90 5230	120 650	204	0,72	80 23	13 35	16 6	7	Cb							
	20-30	-	8,7 7,6	16 30	50 5400	100 740	194	0,75	1 1	18 49	17 3	12	Bb							
	50-60	-	8,8 7,5	15 40	60 5200	120 770	97	0,45	2 1	16 49	18 4	12	Bb							
8 a 3.1.1.1.	0-10	3,33	7,8 7,3	16 130	100 5600	85 98	51	0,18	29 67	9 11	7 4	2	Ac							
	20-30	-	8,3 7,4	16 130	55 5630	110 450	57	0,33	64 63	8 13	8 6	2	Ae							
	50-60	-	8,1 7,5	20 120	80 5600	130 770	222	0,75	31 56	10 15	10 5	4	Ae							
8 b 79	0-10	3,31	7,8 7,3	16 120	95 5630	110 155	49	0,18	21 64	12 11	7 3	3	Ac							
	20-30	-	8,1 7,7	17 110	20 5800	100 310	168	0,33	25 78	6 8	3 2	3	Ab							
	50-60	-	8,3 7,7	14 100	10 5600	80 200	126	0,30	23 84	7 4	1 2	2	Aa							
9 a 3.1.4.	0-10	13,70	7,3 7,5	24 50	450 5230	250 90	120	1,35	73 47	16 15	12 6	4	Cb							
	20-30	-	8,3 7,7	22 80	1620 5600	220 150	140	1,05	49 64	8 11	10 5	2	Ae							
	50-60	-	7,7 7,1	17 50	2300 2620	120 92	85	0,75	44 69	9 8	8 4	2	Ae							
9 b 96	0-10	16,47	6,8 6,9	22 110	360 6000	120 90	42	1,35	50 51	15 17	11 4	2	Af							
	20-30	-	7,3 7,3	22 60	320 6980	160 160	41	1,74	51 35	13 20	23 7	2	Ca							
	50-60	-	7,1 7,2	28 120	480 6730	300 750	432	2,40	61 56	10 11	15 5	3	Ca							

Abbreviations of the soils mechanical composition: A — sand: loose (a), poorly loamy (b), light loamy (c), silty light loamy (d), strong loamy (e), silty strong loamy (f); B — silt: sandy (a), ordinary (b), clayey sandy (c), clayey (d); C — clay: light (a), light silty (b).

Note: proportional content of skeleton parts are approximate and independent of the exact proportional content of sallow parts

near Żeglarska Street, flat loess square dry up, clinker-sandy-gravelly. 70. Ww, near Wrotkowska Street, flat clayey square, dry up, sandy-gravelly. 71. LSM, Nadbystrzycka Street, sloping side of a green belt, loess one, dry up, sandy with gravel.

3.1. *Polygono-Matricarietum discoideae puccinellietosum*

One variant in two facies and three forms of communities of indistinct phytosociological rank were distinguished in this sub-association.

3.1.1. Variant with *Polygonum aviculare*. It is principally built of two co-dominating plants in definite quantitative relations which in this way form quite clearly distinguished facies. In the first, one can observe clear quantitative prevalence of *Polygonum aviculare* over *Puccinellia distans*, while in the other there is a slight cover domination of *Puccinellia distans* over *Polygonum aviculare*. In certain area of these two facies, few other species have quite a big share except those enumerated dominants and those more frequent include: *Plantago major*, *Poa annua* and *Agrostis stolonifera*, while those rare ones include *Agropyron repens* and *Plantago pauciflora*.

In the area of Lublin both these facies are quite frequent on the habitats which do not differ from the most common habitats for all the communities with *Puccinellia distans*.

Phytosociological record (Table 4): 72. Ww, Krochmalna Street, outside the pavement, flat loess square, mesophyllous up, gravelly-sandy one. 73. Wn, Al. Kraśnicka Street, flat loess side, mesophyllous up, poorly sandy. 74. Ww, at Krochmalna Street, trans-shipping station of the Polish State Railways, one a side railway line, dry one, sandy-gravelly with brick pieces. 75. Ww, Wrotkowska Street, slightly convex clayey side, mesophyllous up, sandy. 76. Sn, Zbożowa Street, flat loess side of a roundabout, mesophyllous up, sandy-gravelly. 77. LSM, Nadbystrzycka Street, sloping loess side, mesophyllous up, poorly sandy. 78. Sn, Al. Warszawska Street, flat loess side, mesophyllous up, gravelly-sandy. 79. Be, Al. Unii Lubelskiej Street flat, loess side, mesophyllous up, poorly sandy. 80. Ww, on the Bystrzyca river, the area of sediment traps belonging to the sugar factory, edge of a flat top of a dam, dry, gravelly-sandy one. 81. Fn, Droga Męczenników Majdanka Street, flat clayey side, mesophyllous up, sandy, gravelly-clinker one. 82. Ze, Krężnicka Street, sloping loess side, mesophyllous up, sandy-gravelly one. 83. Se, Puławska Street, flat loess side, mesophyllous up, sandy-gravelly. 84. Kk, at Kręta Street, near an old building, flat loess square, dry up, deeply gravelly-clinker one. 85. Sk, Al. Tysiąclecia Street, slightly hollow loess side, moist up, sandy-gravelly. 86. Czy, Jana Pawła II Street, flat loess side, mesophyllous up, sandy-gravelly. 87. Fn, Krępiecka Street, slightly hollow clayey side, boggy up, clayey-sandy-gravelly one. 88. Sk, Al. Tysiąclecia Street, flat side of a green belt, loess one, mesophyllous up, sandy-gravelly. 89. Bi, Al. Spółdzielczości Pracy Street, slightly convex loess side, mesophyllous up, gravelly-sandy one. 90. Czy, Nadbystrzycka Street, flat clayey side, mesophyllous up, gravelly-sandy one. 91. Czy, Krochmalna Street, flat clayey side, mesophyllous up, gravelly-sandy one.

Table 4. Sub-association: 2.1. — *Lolio-Plantaginietum puccinellietosum* in the forms: 2.1.3. — with *Lolium perenne*, 2.1.4. — with *Medicago lupulina*, 2.1.5. — with *Achillea millefolium*

No of community	2.1.			2.1.
	3.	4.	5.	
No of record	68	69	71	Frequency
Date	91-07-15	91-08-08	91-08-06	
Area of plot in m ²	20	25	8	
Cover the layer in %	90	100	90	
Number of species in record	13	20	12	
I. Ch: Puccinellion maritimae				
Puccinellia distans	1	1	3	4
II. Ch: a - Molinio-Arrhenatheretea, Arrhenatheretalia, b - Trifolium fragiferi-Agrostietalia, c - Plantaginietalia majoris, Lolio-Plantaginietum				
a Trifolium repens	r	+	+	4
a Achillea millefolium	1	2	2	5
a Taraxacum officinale	.	+	.	2
a Avenastrum pratense	r	.	.	1
a Dactylis glomerata	r	.	.	1
a Plantago lanceolata	.	+	.	1
a Bromus mollis	.	+	.	1
b Agrostis stolonifera	1	.	2	2
b Potentilla anserina	.	.	+	1
c Lolium perenne	3	1	.	2
c Plantago major	.	+	2	1
4	.	.	.	4
III. Ch: Polygono-Poëtea annuae, Polygono-Poëtalialis annuae, Matricario-Polygonion avicularis				
Capsella bursa-pastoris	r	r	.	2
Polygonum aviculare	.	+	+	4
Matricaria discoidea	.	+	+	2
Lepidium ruderales	.	+	+	2
Bryum argenteum	.	.	+	1
IV. Ch: Artemisietea vulgaris				
Tanacetum vulgare	.	+	2	2
Daucus carota	.	+	.	2
Artemisia vulgaris	.	+	.	2
Melilotus albus	.	.	.	1
Cichorium intybus	.	+	.	1
Pastinaca sativa	.	.	.	1
Melilotus officinalis	.	.	+	1
V. Ch: a - Secalietea, b - Chenopodietea				
a Apera spica-venti	.	+	.	2
a Tripleurospermum inodorum	r	+	.	3
a Matricaria chamomilla	.	+	.	1
b Chenopodium album	.	.	+	2
b Sonchus oleraceus	.	.	.	1
b Galinsoga parviflora	.	.	.	1
VI. Other: a - synanthropic, b - Ch: Sedo-Scleranthetea				
a Medicago lupulina	.	4	3	+
a Plantago pauciflora	.	.	+	+
3	.	.	.	3
b Odontites rubra	.	1	.	1

Besides, three very rare communities have been included in the sub-association *P.-M.d. puccinellietosum*. They have been temporarily defined as distinct forms of the sub-association:

3.1.2. with *Plantago pauciflora*,

3.1.3. with *Sisymbrium loeselii*,

3.1.4. with *Lepidium ruderales*.

Table 5. Sub-association: 3.1. — *Polygono-Matricarietum discoideae puccinellietosum* in variant: 3.1.1. — with *Polygonum aviculare* and *Puccinellia distans* in facies: 3.1.1.1. — with *Polygonum aviculare* and *Puccinellia distans*, 3.1.1.2. — typical of *Puccinellia distans* and *Polygonum aviculare*

No of community	3.1.1.																			Presence	
	1.									2.											
No of record	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	
Data	91-08-10	91-07-29	91-08-05	91-08-06	91-08-17	91-07-30	91-07-11	91-09-03	91-09-01	91-07-15	91-08-09	91-07-26	91-08-31	91-07-26	91-07-29	91-09-23	91-07-26	91-07-13	91-07-10	91-07-10	
Area of plot in m ²	8	8	8	5	4	4	100	4	8	4	6	10	20	12	10	10	20	10	6	6	
Cover the layer in %	100	100	100	100	100	100	100	100	90	100	100	100	100	100	100	100	100	100	70	90	
Number of species in record	10	14	15	8	7	12	14	17	22	11	13	14	12	12	10	14	17	15	11	16	
I. Ch: Puccinellion maritimas																					
Puccinellia distans	1	1	2	3	3	3	3	3	1	5	5	5	5	4	4	4	5	5	3	3	V
II. Ch: a - Molinio-Arrhenatheretea, Arrhenatheretalia, b - Trifolium fragiferi-Agrostietalia, Agropyro-Rumicion crispi, c - Plantaginietalia majoris, Lolio-Plantaginietum																					
a Plantago lanceolata	.	+	I
a Trifolium repens	I
a Achillea millefolium	.	+	II
a Taraxacum officinale	.	r	.	r	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
a Bromus mollis	I
a Leontodon autumnalis	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
b Potentilla anserina	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
b Agrostis stolonifera	II
c Lolium perenne	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
c Plantago major	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	V
III. Ch: Polygono-Poëtea annuae, Polygono-Poëstalia annuae, Matricario-Polygonion avicularis																					
Matricaria discoidea	.	+	IV
Polygonum aviculare	5	5	5	5	5	5	5	5	4	5	4	5	5	5	4	3	3	3	3	V	
Poa annua	II
Lepidium ruderales	II
Bryum argenteum	I
IV. Ch: a - Bidentetea tripartiti, b - Agropyretea intermedi-repentis, c - Artemisietea vulgaris																					
a Bidens tripartita	I
a Chenopodium rubrum	I
b Agropyron repens	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II
c Artemisia vulgaris	III
c Atriplex tataricum	I
c Pastinaca sativa	I
c Melilotus albus	I
V. Ch: a - Secalietea, b - Chenopodietea																					
a Tripleurospermum inodorum	II
a Matricaria chamomilla	II
b Echinochloa crus-galli	I
b Sisymbrium loeselii	I
b Atriplex patulum	II
b Chenopodium album	II
b Polygonum persicaria	I
VI. Inne /others/: synantropijne /synanthropic/																					
Amaranthus retroflexus	I
Erigeron canadensis	I
Plantago pauciflora	I
Agrostis vulgaris	I
Brassica napus	I
Species occurring in 1 record: III - Capsella bursa-pastoris 78/+. VI. b - Cirsium arvense 80/+, Convolvulus arvensis 91/+, Tussilago farfara 91/+, c - Daucus carota 86/+, Tanacetum vulgare 87/+, Arctium tomentosum 88/r, Melilotus officinalis 85/r, Iva xanthifolia 91/+. V. a - Viola arvensis 74/+, b - Descurainia sophia 74/+, Galinsoga quadriradiata 80/+, Sonchus asper 84/+, S. oleraceus 88/+, Atriplex nitens 88/+, Erysimum cheiranthoides 88/+, c - Senecio vulgaris 74/+, Artemisia annua 80/+, Polygonum convolvulus 85/+, Medicago lupulina 88/+.																					

In those three communities, one observes rather big share of *Puccinellia distans* both with the three mentioned plants and with some others. To give an example, in the communities with *Plantago pauciflora* and *Sisymbrium loeselii*, there is quite a big proportion of *Puccinellia distans* and *Polygonum aviculare* and in the latter community, mentioned as the third one, there is also *Bryum argenteum*. On the other hand, in the community with co-dominating *Lepidium ruderales* and *Puccinellia distans*, the quantitative share of other plants is only slight. In some areas of the third community, a greater degree of density is reached only by *Amaranthus retroflexus* or *Polygonum aviculare*.

In the area of Lublin these are the least frequently encountered forms of communities of *P.-M.d. puccinellietosum* sub-association. These communities occur on specific types of habitats. Most often these are the regions with the surface built of gravel mixed with pieces of concrete, lime, rubble, bricks and plaster.

Phytosociological record (Table 5): 92. CzW, extension of Kompozytorów Polskich Street, flat loess side, mesophyllous up, sandy, with gravel. 93. Ww, on the Bystrzyca river the area of sediment traps belonging to the sugar factory, flat top of a dam, dry, deeply sandy-gravelly one; with lime rubble. 94. Ww, at Krochmalna Street, trans-shipping station of the Polish State Railways between the railway line and the pavement, flat clayey square dry up, deeply gravelly-sandy-clinker one with pieces of concrete and glass. 95. Ww, at Krochmalna Street, trans-shipping station of the Polish State Railways, near a railway line slightly sloping clayey square, dry up deeply clinker-gravelly one with concrete pieces. 96. Ww, at Krochmalna Street, trans-shipping station near a railway line, flat clayey square, dry up, deeply gravelly-clinker one with pieces of concrete and brick. 97. Ww, at Krochmalna Street, trans-shipping station of the Polish State Railways between a railway line, flat clayey square, dry up, deeply gravelly-sandy one with pieces of concrete and brick. 98. Ww, at Krochmalna Street, trans-shipping station of the Polish State Railways near a railway line, slightly sloping clayey square, dry up, deeply clinker-gravelly-sandy one with pieces of concrete, plaster and brick. 99. Ww, at Krochmalna Street, trans-shipping station of the Polish State Railways, between railway lines flat clayey square, dry up, deeply gravelly-sandy-clinker one with brick pieces.

PHYTOSOCIOLOGICAL STRUCTURE
AND THE SOILS OF THE CHARACTERIZED COMMUNITIES
WITH *Puccinellia distans* AND THEIR GENERAL DISTRIBUTION

The communities with *Puccinellia distans* characterized for the area of Lublin belong to 3 associations which are locally formed in 3 sub-associations, 5 variants and 12 facies and community forms (Tables 1-6).

Totally, these communities are made up of 87 vascular plant species and 3 species of bryophytes; their syntaxonomic belonging is shown in

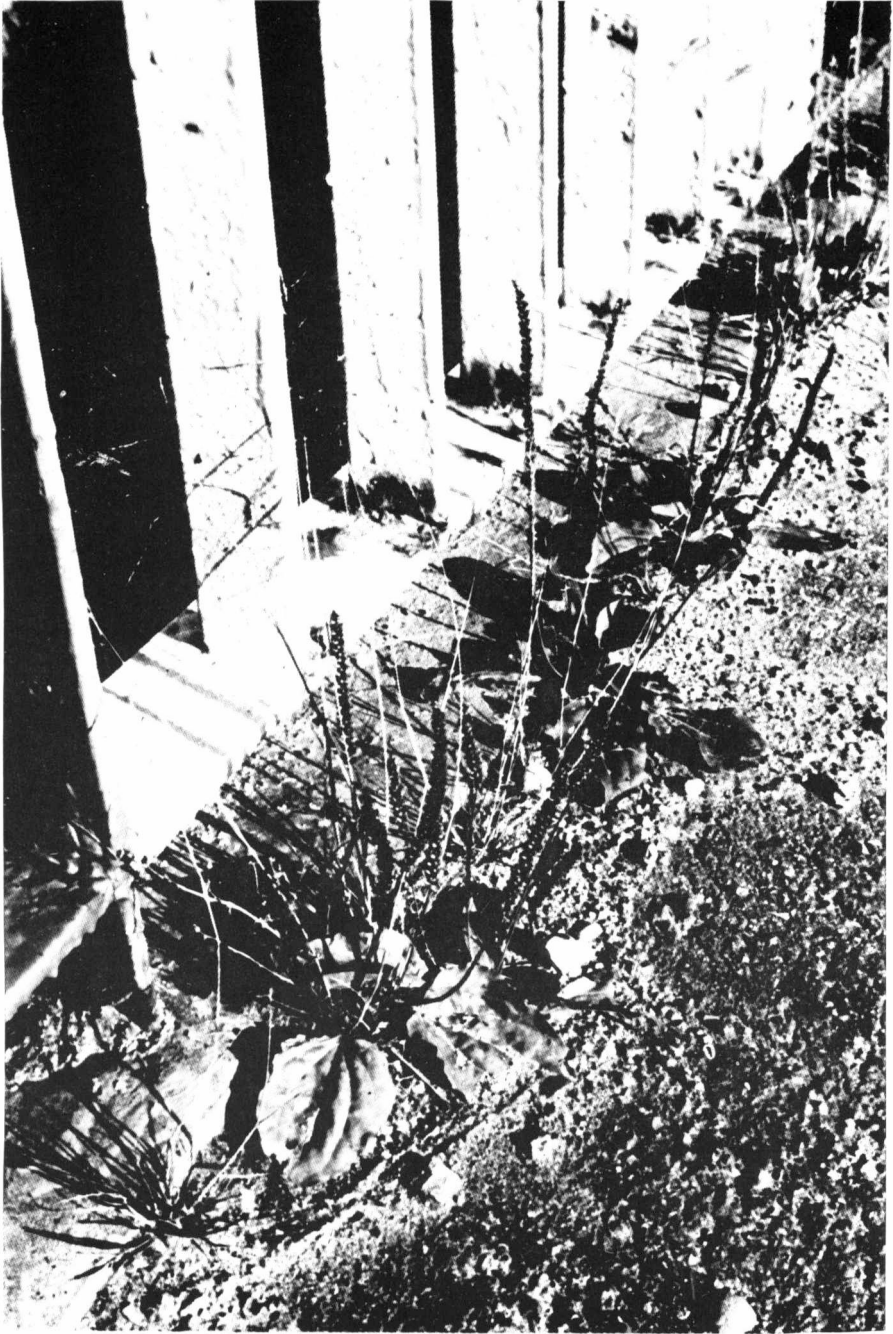


Fig. 2

Florian Świąc

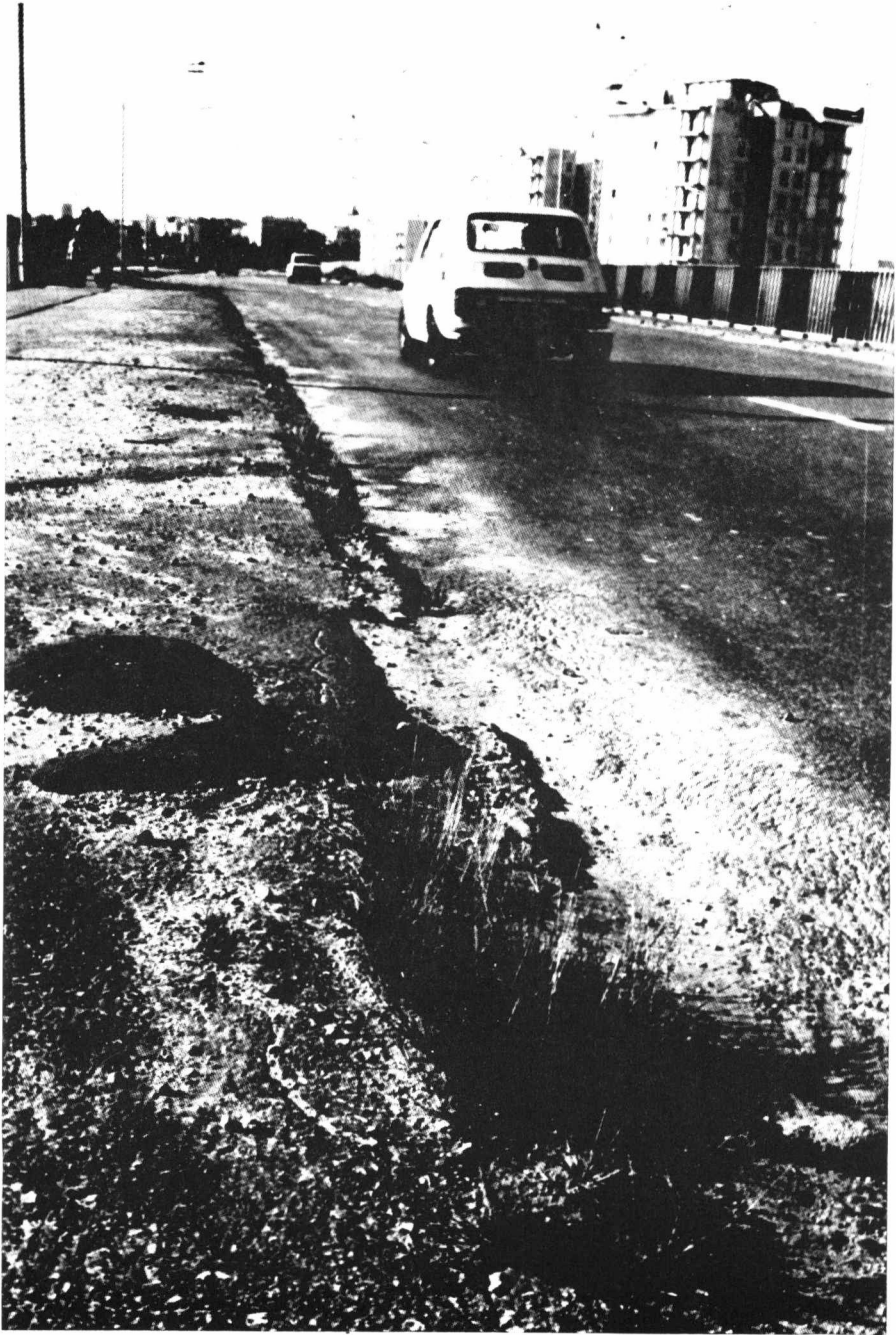


Fig. 3

Florian Świąś

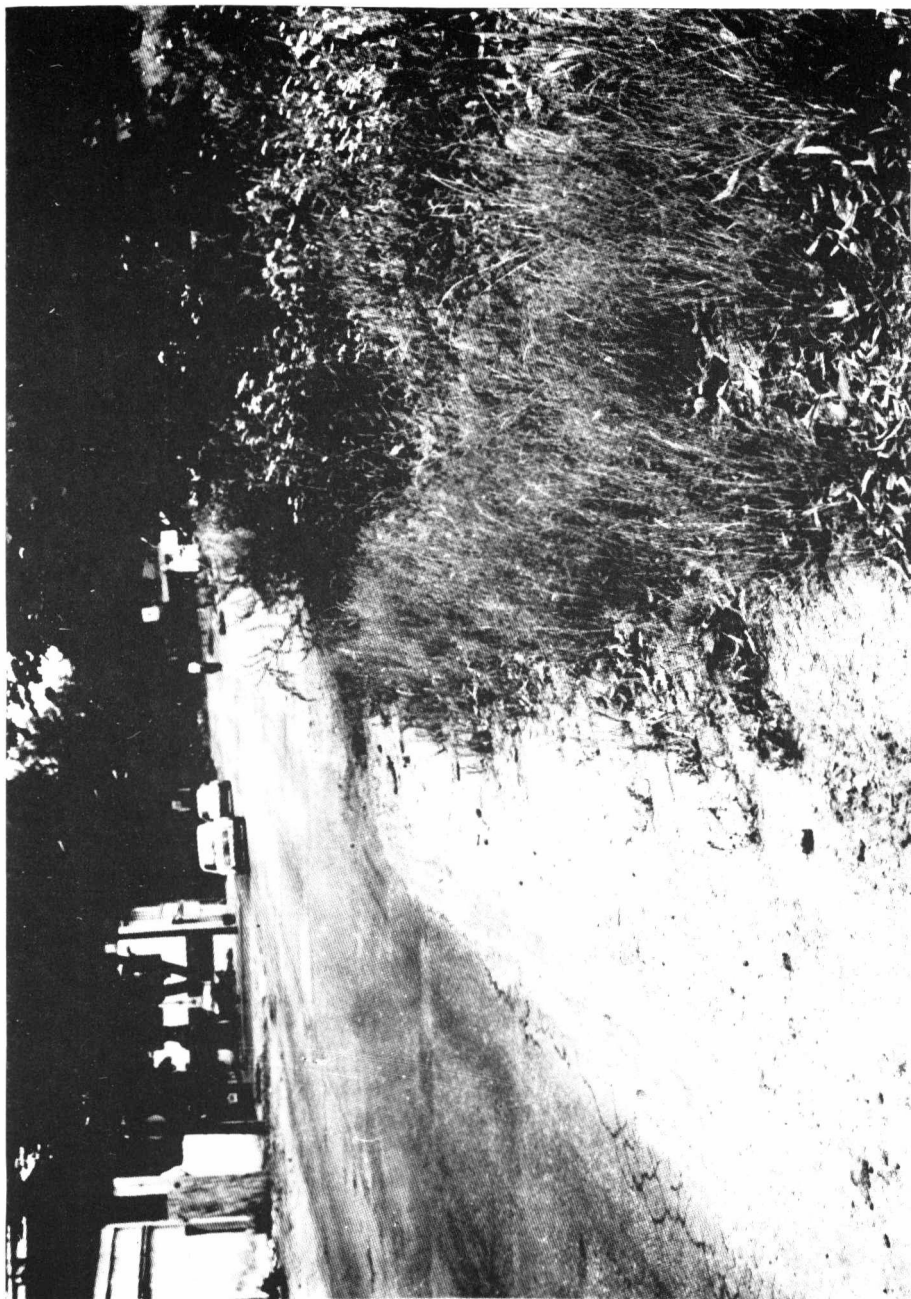


Fig. 4

Florian Świąć



Fig. 5

Florian Świąś

Tables 1–6. The most important role is played by few, generally common plants characteristic of the communities mainly from the classes of *Molinio-Arrhenatheretea* and *Polygono-Poëtea annuae*, and less frequently from the classes of *Artemisietea vulgaris* and *Secalietea*.

Essentially, all the distinguished syntaxons with *Puccinellia distans* are characterized by two most significant floristic and phytosociological properties. First of all, these communities are poor in species and at the same time they are floristically very heterogeneous. Next, these communities have been distinguished on the basis of the plants which dominate individually or in mixtures. This refers mainly to *Puccinellia distans*, *Plantago major*, *Polygonum aviculare*, less frequently to *Lolium perenne*, *Achillea millefolium*, *Lepidium ruderae* and *Sisymbrium loeselii*. As for the other plants, the most common in the distinguished communities include only *Taraxacum officinale*, *Matricaria discoidea* and *Artemisia vulgaris*.

According to the latest and most spread system of carpet communities (12–14, 23, 24), the distinguished communities with *Puccinellia distans* have been qualified within the two following classes: *Molinio-Arrhenatheretea* and *Polygono-Poëtea annuae*.

It turns out that the floristic and phytosociological borders between the separated communities with *Puccinellia distans* are very different. For example, it is especially difficult to classify in the definite communities, a small proportion of phytosociological records of temporary character among communities from the class of *Molinio-Arrhenatheretea* and from the class of *Polygono-Poëtea annuae*.

It is obvious that a number of phytosociological records presents different successive stages of communities. For example, a separated very rarely found form of the communities with *Sisymbrium loeselii* in the association of *Polygono-Matricarietum discoideae* can be simultaneously considered as a sub-association of *Polygono-Matricarietum puccinellietosum* or *Lolio-Plantaginetum puccinellietosum*.

No cases of especially clear general correlation between the distinguished 20 phytocenoses with *Puccinellia distans* and the physical and chemical properties of the soils on which they occurs have been observed (Table 7). These communities are formed equally often on uniform loess bedding with 40–90 cm deep overlay of differently mixed silty, clayey, sandy and gravelly formations with coal clinker, pieces of stone, brick and concrete.

Generally, these are the habitats of artificial and initial antropogeneous soils types. These soils, because of their granulometric composition are easily

Table 6. 3.1. — *Polygono-Matricarietum discoideae puccinellietosum* in the forms: 3.1.2. — with *Plantago pauciflora*, 3.1.3. — with *Sisymbrium loeselii*, 3.1.4. — with *Lepidium ruderale*

No of community	3.1.			3.1.
	2.	3.	4.	
No of record	92	94	96	99
Date	91-07-27	91-09-01	91-08-05	91-08-05
Area of plot in m ²	9	10	8	9
Cover the layer in %	100	100	100	100
Number of species in record	10	23	14	12
				Frequency
I. Ch: Puccinellion maritimae				
Puccinella distans		1 3 3 3 4 4 5 4		8
II. Ch: a - Molinio-Arrhenatheretea, Arrhenatheretalia, b - Trifolium fragiferi-Agrostietalia, c - Plantaginietalia majoris, Lolio-Plantaginietum				
a Achillea millefolium		+	+	+
a Taraxacum officinale		+	+	+
a Trifolium repens		+	+	+
a Trifolium pratense		+	+	+
a Lotus corniculatus		+	+	+
a Tragopogon pratensis		+	+	+
b Agrostis stolonifera		+	+	+
c Plantago major		+	+	+
c Lolium perenne		+	+	+
III. Ch: Polygono-Poëtea annuae, Polygono-Poëtalía annuae, Matricario-Polygonion avicularis				
Capsella bursa-pastoris		1 1		2
Polygonum aviculare		2 3 2 1	+	6
Bryum argenteum		+	4 1	5
Matricaria discoidea		1	+	3
Lepidium ruderale		1 1 3 5 3 2 3		7
IV. Ch: a - Bidentetea tripartiti, b - Agropyretea intermedi-repentis, c - Artemisietea vulgaris				
a Bidens tripartita		+	+	1
b Poa compressa		+	+	1
b Agropyron repens		+	+	1
c Artemisia vulgaris		1	+	3
c Tanacetum vulgare		+	+	2
c Cannabis ruderalis		+	+	1
c Carduus acanthoides		+	+	1
c Iva xanthifolia		+	+	1
c Cirsium lanceolatum		+	+	1
V. Ch: a - Secalietea, b - Chenopodietea				
a Matricaria chamomilla		+	+	4
a Tripleurospermum inodorum		+	+	1
b Atriplex patulum		+	+	2
b Chenopodium album		+	+	3
b Sisymbrium loeselii		5 2	+	4
b Lactuca serriola		+	+	6
b Bromus tectorum		+	+	5
b Sonchus oleraceus		+	+	2
b Sonchus asper		+	+	3
b Sisymbrium strictissimum		+	+	3
b Galinsoga parviflora		+	+	2
b Atriplex hortense		+	+	1
b Stellaria media		+	+	1
b Erysimum cheiranthoides		+	+	1
b Xanthium riparium		+	+	1
VI. Other: a - synanthropic, b - Ch: Sedo-Scleranthetea				
a Plantago pauciflora		5 1		2
a Medicago lupulina		+	+	2
a Amaranthus retroflexus		+	+	3
a Senecio vulgaris		+	+	1
a Acer negundo b		+	+	1
b Calamagrostis epigeios		+	+	1
b Festuca heterophylla		+	+	1

permeable and susceptible to elution of chemical compounds. They are also periodically moistened or overdried to a different extent. On the top, they are fairly rich in the washed silty formations and humus substances. In the whole profile studied down to the depth of 60 cm, they are of alkaline or neutral reaction as well as strongly saline and rich in the compounds of N-NO₃, P, K, Ca, Mg, Na, Cl (Table 7).

It is curious for example that there is a lack of distinct differences in physical and chemical properties between the outcrops examined for instance in the central and marginal parts of the same area of a definite type community with *Puccinellia distans* (profiles a and b).

It should be emphasized, too, that together with the increase of the profile depth, the content of definite chemical compounds generally grows or decreases depending on the degree of their elution down to the profile. In the former case, it refers to such a group of compounds as N-NO₃, Ca, Mg, Na and Cl, while in the latter only P, K and the general state of salinity. Besides, when the profile depth in these soils is greater, the value of *pH* gradually passes from alkaline to neutral reaction.

Among all the examined chemical properties of soils in seven definite communities with *Puccinellia distans*, using as the example 18 outcrops, it is interesting to observe an exceptionally high content of phosphorus compounds in the outcrop in the area of association *Polygono-Matricarietum discoideae*, formed as a community with *Lepidium ruderae* (Tables 6 and 7).

Nearly all important individuals of the associations with *Puccinellia distans* characterized now in the area of Lublin have been described earlier in different regions in Poland and abroad as different types of carpet communities (8–10, 12–14, 16, 19, 20, 23, 26). The synthetic data provided by Jackowiak (14) about phytosociological differentiation of landscape ruderal communities with *Puccinellia distans*, must be thoroughly supplemented by numerous new source materials collected on this subject (29 and the quoted literature).

Among the communities with *Puccinellia distans* described from Lublin (Tables 1–6), the sub-association of *Potentilletum anserinae puccinellietosum* is described most rarely in the country (14, 26, 27, 29). On the other hand, other sub-associations such as *Lolio-Plantaginetum puccinellietosum* and *Polygono-Matricarietum discoideae puccinellietosum* were described earlier as secondary phytocenoses in the broadly viewed association of *Lolio-Plantaginetum* or as a separate association of *Puccinellietum distantis* (14, 26, 27, 29). The association of *Puccinellietum distantis* described by Fijałkowski (8, 9) earlier from two indefinite habitats from the Lublin region should be included in the 2 sub-associations

Polygono-Matricarietum discoideae puccinellietosum, in the variant with *Polygonum aviculare* and *Potentilletum anserinae puccinellietosum* in the variant with *Bidens cernuus*.

Most of small individuals distinguished in the area of Lublin in all the three above-mentioned sub-associations with *Puccinellia distans* have not been isolated so far and if so it was often against the material supplied for them in phytosociological records. It seems that the least known lower individuals of ruderal sub-associations with *Puccinellia distans* include all the formations of these communities listed in Tables 4 and 6: with *Lolium perenne*, *Medicago lupulina*, *Achillea millefolium*, *Plantago pauciflora*, *Sisymbrium loeselii* and with *Lepidium ruderales*.

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EXPLANATION TO FIGURES

Fig. 2. Lublin, Czechów district, Kompozytorów Polskich Street, tussocks of *Puccinellia distans* in the cracks at the road kerbs.

Phot. F. Świąś

Fig. 3. Lublin, Czechów district, Smorawińskiego Street, a row of tussocks with *Puccinellia distans* and *Plantago major* in a crack at the road side, on the bridge.

Phot. F. Świąś

Fig. 4. Lublin, Wrotków district, a dense patch of *Puccinellia distans* on the trampled rim of Krochmalna Street.

Phot. F. Świąś

Fig. 5. Lublin, Ponikwoda district, the corner of Zawilcowa Street and Wrzosowa Street. A dense patch of *Puccinellia distans* on a big lowering between old waste-heaps of clay, debris and industrial waste.

Phot. F. Świąś

STRESZCZENIE

Opracowano rozmieszczenie *Puccinellia distans* oraz stosunki fitosocjologiczne i ekologiczne zbiorowisk z udziałem tego gatunku na terenie miasta Lublina. Jest to gatunek rodzimy na kontynentalnych i nadmorskich solniskach. Jako roślina zawleczona pojawia się na miejscach wtórnie przypadkowo zasolonych. W tej ostatniej sytuacji są to najczęściej tereny zurbanizowane i przemysłowe oraz obrzeża głównych szlaków komunikacji. Na terenie Lublina i najbliższych okolic brak naturalnych siedlisk dla tej rośliny typu źródłisk słonych czy też słono-siarczanowych. Stąd też *Puccinellia distans* na terenie Lublina i okolic rośnie jako gatunek zawleczony. Po raz pierwszy stwierdzono ją w tym rejonie w latach 1960–1963 na odległych, dość licznych 2 stanowiskach, zlokalizowanych na torowiskach stacji kolejowych w Lublinie i w Zemborzycach. Aktualnie jest to jedna z najpospolitszych roślin na terenie miasta Lublina (ryc. 1). Rośnie pojedynczo lub gromadnie, tworząc charakterystyczne zbiorowiska ruderalne.

Nasilona ekspansja zawleczonej *Puccinellia distans* na terenie miasta Lublina przypada dopiero na lata 1980–1990. Bezpośrednio wiąże się to z postępującym i odpowiednio dużym zasoleniem podłoża miejskiego na skutek usuwania śniegu i gołodzi za pomocą różnych związków soli, głównie: NaCl, MgCl₂ i CaCl₂. Obecnie *Puccinellia distans* występuje w Lublinie na najsilniej zasolonych obrzeżach jezdni, rond i pasów zieleni (ryc. 2 i 3). Często jest również na niektórych placach przedankowych i na starych terenach gruzowiskowych (ryc. 4). Sporadycznie pojawia się na torowiskach kolejowych. Na innych siedliskach występuje nader rzadko (ryc. 1).

Na terenie Lublina *Puccinellia distans* jest częstym składnikiem tylko 3 zbiorowisk ruderalnych: *Potentilletum anserinae puccinellietosum*, *Lolio-Plantaginetum puccinellietosum* i *Polygono-Matricarietum discoideae puccinellietosum*. Wymienione podzespoły są w różnym stopniu zróżnicowane na mniejsze jednostki fitosocjologiczne, wydzielone w randze 5 wariantów, 6 facji i bliżej nie określonych fitosocjologicznie 6 postaci zbiorowisk. Strukturę fitosocjologiczną tych zbiorowisk roślinnych podano w tab. 1–6.

Niektóre właściwości granulometryczne i chemiczne gleb w ważniejszych zbiorowiskach z *Puccinellia distans* zestawiono w tab. 7.

W skali krajowej do najbardziej interesujących zbiorowisk z *Puccinellia distans* należą: *Potentilletum anserinae puccinellietosum* oraz 6 postaci zbiorowiska zestawionych w tab. 6: z *Lolium perenne*, z *Medicago lupulina*, z *Achillea millefolium*, z *Plantago pauciflora*, z *Sisymbrium loeseli* i z *Lepidium ruderale*.

Szczegółowe badania nad tym konkretnym gatunkiem pokazują ogólne prawidłowości, a mianowicie:

a) ekspansja gatunku uzależniona jest od stworzenia przez gospodarkę człowieka odpowiednich dla niego warunków siedliskowych;

b) roślina reaguje na siedlisko z pewnym opóźnieniem, niezbędnym do nagromadzenia odpowiednio dużej ilości nasion, umożliwiających jej trwałe osiedlenie i ekspansję.

W kraju podobne badania nad ekspansją *Puccinellia distans* na wtórnie zasolone tereny zurbanizowane przeprowadzono jedynie w rejonie Krakowa i w obrębie miasta Poznania.