Distribution of some vascular plants and anthropopressure zones in Warsaw

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Abstract

The cartograms of the species distribution within Warsaw were compared to the anthropopressure zones distinguished conventionally. Floras of individual zones differ both quantitatively and qualitatively. Some species are more confined to specific zones, some have even an indicator value. The most interesting taxa are those found in sites where anthropopressure is the greatest.

Key words: town flora, flora mapping, anthropopressure, synanthropization

INTRODUCTION

It is obvious that specificity of the sites within a great city affects essentially distribution or absence of some species in this area. Mosaic system of habitats with a clear variation gradient in space (visible with a growing distance from the centre) is characteristic of the town.

Many authors have noticed some regularities in species distribution in urban areas. The species confined to the centre of a town, with undoubted indicator value, are the most interesting, such as: in West Berlin — *Ailanthus altissima* (Mill.) Swingle (Böcker and Kowarik 1982, Kowarik and Böcker 1984), *Parietaria pensylvanica* Mühlenb. ex Willd. (Sukopp and Scholz 1964), *Chenopodium botrys* L. (Sukopp 1971); in Cologne — *Ailanthus altissima* (Mill.) Swingle (Kowarik and Böcker 1984 after Kunick and Markstein 1983); in Bremerhaven — *Hordeum murinum* L. (Sukopp and Scholz 1964).

The paper aims at the attempt to find out relationships between zones with the human impact of different intensity, distinguished in the city area, and species number, as well as distribution of some of their groups.

METHODS

The floristic studies were conducted in 1977-1982 within administrative borders of Warsaw from 1970, to some extent supplemented in 1983-1985. They concerned all species occurring spontaneously in the town area (i.e. in 430 km² divided into 230 squares of app. 1.5 km side each). All habitat sites, from typically antropogenic to only slightly changed by man, were taken into account.

The investigation results (50000 floristic data) were presented in the work of Sudnik-Wójcikowska (1987a) as:

- a. species list (nomenclature and system after Rothmaler (1976), classification system of synanthropic plants after Kornaś (1982);
- b. 1096 cartogramms of species distribution (3-grade frequency scale was used).

The paper concerns the taxa which have shown some regularities in their distributions within Warsaw. These species seem to be confined, to some extent, to areas within the town, further described as anthropopressure zones.

Each zone includes specified number of squares. I have assumed that species confinement to the zone is the stronger with:

- a. the higher rate of squares with the species to the total number of squares in the zone (cf. Table 2);
- b. the more species localities in the zone in relation to the total number of its occurrence (cf. Table 3).

The anthropopressure is assumed as (after Olaczek 1972, 1974): "the complex of direct and indirect human impact, which causes changes in the vegetation cover, multistage modification system of the factors existing in nature, as well as, more rarely, introduction of the new ones".

Each square within Warsaw was characterized according to the assumed scale. To construct the scale there were used:

- a. field observations on the current land use,
- b. observations of the real vegetation stage,
- c. description of the natural conditions of the town (Sudnik-Wójcikowska 1987a),
- d. a map of the potential natural vegetation (Matuszkiewicz, mscr).

Therefore, zones composed of squares with the same scale degree were distinguished on the grounds of two following criteria:

1. Intensity of the indirect and direct human impact. Following characters were assumed as the main signs of anthropopressure in Warsaw:

- soil deterioration;
- arising of the new geomorphological forms;
- disturbance in water conditions, dessication of the area connected with the spatial development of the town (removal of water courses and surface bodies, lowering of the ground water level);

- climate transformation which resulted in the: higher temperatures, higher cloud cover, decrease in the relative air humidity;
- contamination of water, air and soil;
- direct reduction of the area available for plants.

2. Dominant type of the vegetation cover (natural, seminatural, synanthropic, cultivated).

It ought to be stressed that more or less similar basic criteria have been used also by other authors (e.g. Kornaś and Medwecka-Kornaś 1974, Kunick 1974, Michalik 1976, Sukopp 1973, Faliński 1975).

Successive anthropopressure zones may be characterized as follows:

- Zone I. No direct or indirect human impact: no buildings, untransformed soils, unchanged water conditions. Natural communities prevail (zone I does not exist in Warsaw and is only a reference point).
- Zone II. Direct human impact strongly limited (e.g. in the reserve areas), but indirect (such as small changes in water conditions, air and soil contamination) has to be taken into account. Almost natural communities dominate. Small area is covered with seminatural and synanthropic communities. More than 95% of the area is available to plants.
- Zone III. Vegetation cover only on habitats partly transformed and degraded. The area totally unavailable to plants does not exceed 5%. Seminatural vegetation dominates (e.g. meadows, replacement forest communities) with small fragments of the natural vegetation. Synanthropic, especially segetal communities accompany. Ruderal communities only in small areas.
- Zone IV. Vegetation cover on transformed, often degenerated habitats, formed and maintained due to man. The area unavailable to plants amounts from 5 to 30% (urban and suburban loose settlement, pavement etc.). Synanthropic communities prevail, such as segetal (in fields, gardens) and ruderal (mainly unspecialized, near settlements, roads, in waste dumps and wasteland). They are accompanied with small-surface seminatural communities.
- Zone V. The area unavailable to plants (like compact settlement, asphalt, concrete or paved road surface, paving flags in streets and squares, asphalt playgrounds, aprons, centre of the big railway stations), exceeds 30%. Soils are ruined, contaminated, sometimes saline to large extent. The area is often dried, water courses canalized. Climate is typical of town. Spontaneous vegetation covers only small surface. Cultivated vegetation like lawns, flowerbeds dominates. In wasteland, railway areas, by roads, between paving flags, in paths, in gaps of walls and stairs and so on, enclaves more or less specialized ruderal vegetation occur. All anthropopressure zones were presented in a cartogram (Fig. 1). Due to the method of collection of floristic data I could list almost

all the species in each of the distinguished squares within the city. Therefore, spatial differentiation in Warsaw could be presented on the grounds of species number in each square (Fig. 2). At the same time, as the square number in each zone has been known, I described each of them with the mean species number per square specific to each zone (Table 1).

RESULTS

A. It may be seen from cartogramm of the anthropopressure zones (Fig. 1) and data in Table 1 that the area with the vegetation transformed to the highest extent i.e. zones IV and V covers almost 70% of the town

Fig. 1. Warsaw, anthropopressure zones

area. They appear mainly in the central and western parts. The areas where natural-like vegetation grows are mostly located in the far suburbs. They comprise about 8% of the town surface.

Successive zones are rather well characterized with the mean species number per square (Table 1). It is the smallest, as expected, in the zone V where habitats have been unified for long. Then, it gradually increases

in zones IV and III and is the highest in zone II (the difference between this and zone V is about 130 species). It is totally understandable as in the zone II habitats are most diversified. Whereas, the whole diversity of anthropogenic habitats occur, which cover small surface only, the new, only partly man-changed habitats appear with the reach flora specific to them.

Similar conclusions may be drawn from the analysis of the cartogramm of spatial differentiation of Warsaw on the grounds of species number in successive squares (Fig. 2). Central and western town parts (zone V)

Fig. 2. Warsaw spatial differentiation on the grounds of species number in successive squares: a — more than 300 species in a square, b — 200-300 species in a square, c — less than 200 species in a square, d — no or incomplete data for a square

are floristically the poorest, there the number of species in a square does not amount to 200. Whereas, towards the suburbs it sometimes exceeds 300 or even 400 (local differences between squares of zone V and II may attain 300 species). Thus, the correlation between the species number and anthropopressure zone is marked.

B. On the grounds of 1096 cartogrames of taxa distribution within Warsaw, groups of species with similar distribution may be distinguished. Some of them are connected with anthropopressure zones.

Table 1

Quantitative description of successive anthropopressure zones

Zone	Number of squares in a zone	Participation of zone area in town area, %	Mean species number per a square in successive zones
II	18	7.9	305
III	56	24.7	301
IV	90	39.6	213
V	62	27.4	178

GROUP A

These are species which occur all over town and are not connected with any of the anthropopressure zones. Mainly apophytes belong there, especially those synanthropic native species which express high tendency for apophytism. They occur commonly and for long in anthropogenic communities both in centre and in suburbs. At the same time, they occur still in seminatural or only slightly man-changed communities frequent in suburban squares. Especially grassland apophytes are numerous. The group of species considered as apophytes, but whose origins from natural communities are unknown or unclear is also relatively big. To the commonest apophytes within Warsaw there belong: *Achillea millefolium* L., *Agropyron repens* (L.) P.B., *Agrostis tenuis* Sibth., *Arctium lappa* L., *A. tomentosum* Mill., *Arrhenatherum elatius* (L.) J. et C. Presl., *Artemisia vulgaris* L., *Atriplex patula* L., *Berteroa incana* (L.) DC., *Bromus hordeaceus* L. ssp. *hordeaceus*, *B. inermis* Leyser, *Carex hirta* L., *Cardaminopsis arenosa* (L.) Hayek, *Cerastium holosteoides* Fries em. Hyl., *Chenopodium album* L., *Cirsium arvense* (L.) Scop., *C. vulgare* (Savi) Ten., *Convolvulus arvensis* L., *Dactylis glomerata* L., *Daucus carota* L., *Glechoma hederacea* L., *Leontodon autumnalis* L., *Linaria vulgaris* Mill., *Lolium perenne* L., *Medicago falcata* L., *M. lupulina* L., *Plantago lanceolata* L., *P. major* L., *Poa annua* L., *P. pratensis* L., *Polygonum arenastrum* Bor., *P. amphibium* L., *Potentilla anserina* L., *P. argentea* L., *Ranunculus repens* L., *Rumex crispus* L., *Sambucus nigra* L., *Silene alba* (Mill.) E. H. L. Krause, *Sonchus arvensis* L., *Stellaria media* (L.) Cyr., *Tanacetum vulgare* L., *Taraxacum officinale* Wiggers, *Trifolium repens* L., *T. pratense* L., *Tussilago farfara* L., *Urtica dioica* L.

Group A includes also many alien species, like introduced the earliest — archaeophytes. Presently, in Warsaw archaeophytes are in general decline (Sudnik-Wójcikowska 1987a, b). However, there are some and not yet a few that are still quite common. These are some ruderal archaeophytes or species of both ruderal and segetal habitats, like: *Armoracia rusticana*

Fig. 3. Distribution within Warsaw of group A selected species; a—zone V. b—zone V borders, c—species occasional in a square, d—species fairly frequent in a square, e—species common in a square

G. N. Sch., *Atriplex nitens* Schkuhr, *Ballota nigra* L., *Capsella bursa-pastoris* (L.) Med., *Cichorium intybus* L., *Descurainia sophia* (L.) Webb. ex Prantl, *Echinochloa crus-galli* (L.) P. B., *Fallopia convolvulus* (L.) A. Löve, *Geranium pusillum* Burm. fil., *Lactuca serriola* L., *Matricaria maritima* L. ssp. *inodora* (L.) Dostal, *Raphanus raphanistrum* L., *Senecio vulgaris* L., *Setaria pumila* (Poir.) R. et Sch., *S. viridis* (L.) P.B., *Sisymbrium officinale* (L.) Scop., *Solanum nigrum* L. em. Mill., *Sonchus oleraceus* L., *Urtica urens* L.

There are also kenophytes—aliens introduced relatively late (mostly in XVIII-XIX century) but common now in anthropogenic (often, at the same time in segetal and ruderal habitats) such as epoecophytes: *Amaranthus retroflexus* L., *Chamomilla suaveolens* (Pursh) Rydb., *Conyza canadensis* (L.) Cronquist, *Galinsoga ciliata* (Rafin.) Blake, *G. parviflora* Cav., *Helianthus tuberosus* L., *Oxalis stricta* auct. non L., *Sisymbrium altissimum* L., *S. loeselli*

L. Some now common kenophytes enter from anthropogenic habitats into natural and seminatural communities e.g. agriophytes: *Acer negundo* L., *Erigeron annuus* (L.) Pers., *Impatiens parviflora* DC., *Robinia pseudoacacia* L., *Solidago gigantea* Ait. Four exemplary distributions of group A species are shown in Fig. 3.

GROUP B

These species seem to be confined mainly to the centre of the town, where they are more common and numerous. They were recorded in most squares for zone V (Table 2). Almost 80% of their sites are located in zones IV and V (Table 3). It is worth stressing that dominants in this group are aliens, especially ruderal archaeophytes: *Euphorbia peplus* L.,

Table 2

Frequency of selected species of B, C, D groups in successive anthropopressure zones

Species group	Species	Contribution of squares with a species to the total number of squares in a given zone, %			
		zone V	zone IV	zone III	zone II
B	<i>Euphorbia peplus</i> L.	45.9	25.6	10.7	21.1
	<i>Hordeum murinum</i> L.	77.4	36.7	23.2	15.8
	<i>Onopordum acanthium</i> L.	58.1	32.2	26.9	21.1
	<i>Bunias orientalis</i> L.	32.3	13.3	10.7	21.1
	<i>Diplotaxis muralis</i> (L.) DC	72.6	21.1	12.5	10.5
	<i>Eragrostis minor</i> Host	21.0	5.6	3.6	5.3
	<i>Iva xanthiifolia</i> Nutt.	61.3	48.9	32.1	5.3
	<i>Potentilla intermedia</i> L.	33.9	5.6	8.9	0.0
	<i>Reseda lutea</i> L.	33.9	24.4	21.4	0.0
	<i>Astragalus cicer</i> L.	17.7	1.1	1.8	5.3
	<i>Potentilla supina</i> L.	41.9	15.6	8.9	10.5
C	<i>Arabidopsis thaliana</i> (L.) Heynh.	9.7	28.9	21.4	26.3
	<i>Deschampsia caespitosa</i> (L.) P.B.	9.7	38.9	46.4	73.6
	<i>Erophila verna</i> (L.) Chevall.	4.8	33.3	53.6	57.9
	<i>Luzula campestris</i> (L.) DC.	1.6	31.1	51.8	47.4
	<i>Scleranthus perennis</i> L.	6.5	20.0	37.5	52.6
	<i>Agrostemma githago</i> L.	6.5	25.6	25.0	15.8
	<i>Viola arvensis</i> Murray	21.0	60.0	60.7	68.4
	<i>Asperugo procumbens</i> L.	6.5	20.0	16.1	15.8
D	<i>Genista tinctoria</i> L.	0.0	7.8	23.2	63.2
	<i>Melica nutans</i> L.	0.0	2.2	21.4	68.4
	<i>Polygonatum odoratum</i> (Mill.) Druce	0.0	6.7	30.4	68.4
	<i>Veronica officinalis</i> L.	0.0	11.1	30.4	63.2

Hordeum murinum L., *Onopordum acanthium* L., also some epoecophytes like: *Bunias orientalis* L., *Diploaxis muralis* (L.) DC., *Eragrostis minor* Host., *Iva xanthiifolia* Nutt., *Potentilla intermedia* L., *Reseda lutea* L.,

Table 3

Contribution of sites of selected species of B, C, D groups to successive anthropopressure zones

Species group	Species	Total species site number	Total species site number represented in successive zones, %			
			zone V	zone IV	zone III	zone II
B	<i>Euphorbia peplus</i> L.	61	45.9	37.7	9.8	6.6
	<i>Hordeum murinum</i> L.	97	49.5	34.0	13.4	3.1
	<i>Onopordum acanthium</i> L.	84	42.8	34.5	17.9	4.8
	<i>Bunias orientalis</i> L.	42	47.6	28.6	14.3	9.5
	<i>Diploaxis muralis</i> (L.) DC.	73	61.6	26.0	9.6	2.7
	<i>Eragrostis minor</i> Host	21	61.9	23.8	9.5	4.8
	<i>Iva xanthiifolia</i> Nutt.	101	37.6	43.6	17.8	1.0
	<i>Potentilla intermedia</i> L.	31	67.7	16.1	16.1	0.0
	<i>Reseda lutea</i> L.	55	38.2	40.0	21.8	0.0
	<i>Astragalus cicer</i> L.	14	78.6	7.1	7.1	7.1
	<i>Potentilla supina</i> L.	47	55.3	29.8	10.6	4.3
C	<i>Arabidopsis thaliana</i> (L.) Heynh.	49	12.2	53.1	24.5	10.2
	<i>Deschampsia caespitosa</i> (L.) P.B.	81	7.4	43.2	32.1	17.3
	<i>Erophila verna</i> (L.) Chevall	74	4.1	40.5	40.5	14.9
	<i>Luzula campestris</i> (L.) DC.	67	1.5	41.8	43.3	13.4
	<i>Scleranthus perennis</i> L.	53	7.5	34.0	39.6	18.9
	<i>Agrostemma githago</i> L.	44	9.1	52.3	31.8	6.8
	<i>Viola arvensis</i> Murray	114	11.4	47.4	29.8	11.4
	<i>Asperugo procumbens</i> L.	34	11.8	52.9	26.5	8.8
D	<i>Genista tinctoria</i> L.	32	0.0	21.9	40.6	37.5
	<i>Melica nutans</i> L.	27	0.0	7.4	44.4	48.2
	<i>Polygonatum odoratum</i> (Mill.) Druce	36	0.0	16.7	47.2	36.1
	<i>Veronica officinalis</i> L.	39	0.0	25.6	43.6	30.8

and more rarely apophytes: *Astragalus cicer* L., *Potentilla supina* L. Group B is especially interesting. Therefore, cartogramms of distribution of all its species have been presented (Figs. 4, 5, 6). Some of these species may have indicator value.

Fig. 4. Distribution within Warsaw of group B species. Signs explanations as in Fig. 3

Fig. 5. Distribution within Warsaw of group B species. Signs explanations as in Fig. 3

Fig. 6. Distribution within Warsaw of group B species. Signs explanations as in Fig. 3

GROUP C

It comprises synanthropic species, avoiding town centre (zone V), more often found in zones under lower anthropopressure (zones IV and III). These are numerous apophytes (more strongly connected with segetal communities and exploited meadows, that seems obvious) such as: *Anthoxanthum odoratum* L., *Arabidopsis thaliana* (L.) Heynh., *Campanula patula* L., *Cardamine pratensis* L., *Carex leporina* L., *C. nigra* (L.) Reichard, *C. praecox* Schreber, *Cerastium semidecandrum* L., *Deschampsia caespitosa* (L.) P.B., *Dianthus deltoides* L., *Erophila verna* (L.) Chevall., *Euphorbia cyparissias* L., *Galium boreale* L., *G. palustre* L., *G. verum* L., *Geranium robertianum* L., *Gypsophila muralis* L., *Hieracium umbellatum* L., *Jasione montana* L., *Luzula campestris* (L.) DC., *Lychnis flos-cuculi* L., *Lysimachia vulgaris* L., *Lythrum salicaria* L., *Mentha arvensis* L., *Myosotis palustris* (L.) L., *Oenanthe aquatica*

Fig. 7. Distribution within Warsaw of group C selected species. Signs explanations as in Fig. 3

Fig. 8. Distribution within Warsaw of group C selected species. Signs explanations as in Fig. 3

(L.) Poiret, *Peucedanum oreoselinum* (L.) Moench, *P. palustre* (L.) Moench, *Potentilla erecta* (L.) Räuschel, *Scleranthus perennis* L., *Sedum maximum* (L.) Hoffm., *Senecio jacobaea* L., *Sium latifolium* L., *Solidago virgaurea* L., *Veronica serpyllifolia* L., *V. verna* L., *Vicia sepium* L. The group includes also some archaeophytes: sepal such as *Anagallis arvensis* L., *Agrostemma githago* L., *Veronica triphyllos* L., *Viola arvensis* Murray and more rarely ruderal like *Asperugo procumbens* L.

Group C is as interesting as group B. Exemplary distributions of species of this group are presented in Figs. 7 and 8. From Table 2 it may be inferred that these species have been recorded from the smallest number of squares in zone V. Also only 10% of their localities occur in this zone, whereas zones III and IV comprise 80% of sites together (Table 3).

GROUP D

These are native species with no tendency for apophytism (e.g. some water and mostly forest plants). They "retreat" towards suburbs with the

Fig. 9. Distribution within Warsaw of group D selected species. Signs explanations as in Fig. 3

diminution of habitats and communities suitable for them. Their distributions agree with zones where anthropopressure is the smallest i.e. zone II, rarely III. The group includes such species as: *Calluna vulgaris* (L.) Hull., *Chamaecytisus ratisbonensis* (Schaeffer) Rothm., *Comarum palustre* L., *Genista tinctoria* L., *Luzula pilosa* (L.) Willd., *Melampyrum pratense* L., *Melica nutans* L., *Vaccinium myrtillus* L., *Veronica officinalis* L., *Polygonatum odoratum* (Mill.) Druce.

Exemplary distributions of 4 species have been presented in cartogramms (Fig. 9). They do not occur in zone V, while 75-90% of their sites are located in zones III and II (Table 3). In zone II they occur in 60-70% of squares (Table 2).

DISCUSSION

Great-city-created conditions of plant growth affect essentially qualitative and quantitative composition of flora. Unification of the habitat type in the centre, especially zone V, if compared to suburbs, causes in the species poorness in this part of the town. Ways of the land use by man, century-lasting although alternating in time, have eliminated and still eliminate very many plant species. At the same time, specific town centre conditions of habitats favour growth of some, though few species.

The species that may play the role of indicators of anthropopressure zones ought to fulfil following conditions:

- a. They cannot be occasional or rarely occurring taxa.
- b. As a rule, they should not be confined to some particular habitat type (though sometimes, stenotopic species may indicate the smallest-anthropopressure zone, if habitats specific to them are not rare within a town).
- c. They rather should not include species which are commonly grown and grow wild easily.

Group B is the most interesting among 4 distinguished groups of species. It many posses indication value. Alien species dominate täire, as it is understandable. Its components are the taxa that find favourable habitats under conditions of intensive anthropopressure. Possibly, elimination of competitors that occurs then is of some importance.

Biological properties of these species are also significant. First of all, they are resistant to contamination. It is worth stressing that most taxa come from areas with slightly warmer and usually drier climate (e.g. *Eragrostis minor* Host and *Buniás orientalis* L. — from south-eastern Europe, *Euphorbia peplus* L. — from Mediterranean region, *Iva xanthiifolia* Nutt. — from prairie in North America, *Diplotaxis muralis* (L.) DC. — from southern and western Europe, *Hordeum murinum* L. and *Onopordum acanthium* L. are of Mediterranean-Iranian-Turanian origin). Thus, there is nothing strange

in fact that they find favourable conditions in the most dry and warm town parts (cf. Sudnik-Wójcikowska 1987a). Also properties of their germination and dissemination play a significant role, probably. It has been already proved for: *Bunias orientalis* L. (Jehlik and Slavik 1968) and *Iva xanthiifolia* Nutt. (Hejný 1958, Krippelová 1969 and others).

The introduction time seems to be of secondary importance. It is clear in the case of *Iva xanthiifolia* Nutt. It was introduced to Warsaw only after the Second World War and shows how very expansive newcomers may in short time occupy habitats, free of competitors and favourable for them.

The group of species confined to the town centre is markedly dominated by alien species, especially kenophytes and some archaeophytes. Whereas, composition of groups that avoid this part of the town alternates. In group D mainly nonsynanthropic species dominate. Group C is dominated by native species, many apophytes of segetal communities and extensively exploited meadows among them. Among aliens segetal archaeophytes prevail. It partly results from the presence in zones II and III (to some extent also in zone IV) of field and meadow communities, which are absent from zone V.

It is worth noting that for some taxa from group B similar type of distribution has been recorded from other towns, e.g. for *Hordeum murinum* L. in Bremerhaven (Sukopp and Scholz 1964).

The rank of anthropopressure indicators of at least some species mentioned above will be determined better when richer comparative data from other European towns are collected. Further studies on biology and ecology of synanthropic species seem to be essential as well.

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Rozmieszczenie niektórych roślin naczyniowych a strefy antropopresji w Warszawie

Streszczenie

Biorąc pod uwagę nasilenie pośredniej i bezpośredniej ingerencji człowieka w warunki przyrodnicze oraz dominujący na danym terenie typ pokrywy roślinnej, wydzielono w granicach Warszawy 4 strefy (obszary) antropopresji. W poszczególnych strefach antropopresji zaznaczają się wyraźnie ilościowe i jakościowe różnice składu florystycznego. Centralna część miasta (V strefa) jest uboższa w gatunki, peryferie, z racji większej różnorodności siedlisk — bogatsze (lokalne różnice sięgają 300 gatunków).

Analiza 1096 kartogramów rozmieszczenia gatunków na terenie Warszawy pozwoliła na wyróżnienie na terenie miasta co najmniej 4 grup gatunków wykazujących pewne prawidłowości rozmieszczenia, w określony sposób reagujących na antropopresję:

- grupa A: gatunki powszechnie spotykane na terenie całego miasta, nie związane wyraźnie z żadną ze stref antropopresji,
- grupa B: gatunki związane z centralną częścią miasta (V strefa),
- grupa C: gatunki niejako unikające centrum,
- grupa D: gatunki związane ze strefami o najmniejszej antropopresji.

Taksony, należące do poszczególnych grup, różnią się przede wszystkim pochodzeniem (obecnie dominują zwłaszcza w grupie B), typami siedlisk, w których występują, biologią, odpornością na zanieczyszczenie środowiska. Natomiast czas zawleczenia w przypadku niektórych gatunków obcych nie odgrywa zasadniczej roli.