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SELECTED DEVELOPMENTAL PROBLEMS IN THE SUBUBAN ZONE OF WARSAW

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Terrains of a suburban character are dynamically increasing their areas, both in Poland and in other countries. Those are specific terrains, concentrating on their area the multi-directional activity of man and fulfilling a diversity of functions. The most important of them include: housing functions, service and industrial functions, recreational functions and agricultural functions. On the terrains of the suburban zone there are areas, whose functioning undergoes natural cycles of seasons changes /e.g. agriculture recreation/, as well as such areas, which are basically independent of those cycles /e.g. industry/. The spatial overlapping of regions with different functions and dissimilar dynamics and separate requirements and conditions leads to a situation where the suburban zone is a conflict area, with distinctly defined discrepancies of aims.

During recent years the suburban zones of large cities became subjects of intense studies by representatives of numerous scientific disciplines, including social and economic geography, as well as physical geography and landscape ecology. Frequently those studies are conducted with the utilization of diametrically varied theoretical and conceptual means, which on the other hand causes difficulties in interdisciplinary studies, and on the other hand it may be a cause of numerous misunderstandings.

From the point of view of social and economic geography the concept of a suburban zone is connected to the theory of town planning based on the concept of urban and rural dychotomy, or the concept of a continuum with the diffusive spreading of a complex of urban attributes /Rykiel, 1977/. However, it seems that within that

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continuum relative discontinuities may be determined concerning various aspects of town planning, i.e. the physiognomic, demographic, economic and social.

On the basis we may determine in a conventional way, four types of coexistence of man with nature: namely, urban type, suburban type, rural type with elements of town planning and the original rural type /Kostrowicki 1988/.

Until today there is still a shortage of univocal and precise criterions for the determination of ranges of the suburban zone. Most frequently these borders are arbitrarily defined on the basis of an analysis of spatial changeability of one or several indicators concerning population /e.g. population density, migration distribution, employment structure/, agriculture /e.g. percentage of small holdings, level of horticulture and fruit growing, cultivation structure/ and town planning /e.g. density and types of built-up areas, development of a technical infrastructure/.

Additionally, it is worth bringing to attention the dissimilarity of the development and structure of suburban zones /as well as of the whole process of town planning/, depending on the local history and culture, which leads to the suggestion of studying this phenomenon at a local and regional rather than global scales. /Rykiel 1977/.

In numerous works /e.g. Zawadski 1979/ it is assumed that the range of the suburban zone of Warsaw is identical to a 45-minute isochrone of commuting to work in Warsaw. The range determined this way basically complies with the borders of the Warsaw Municipality Voivodship borders existing since 1975, which have been determined in accordance with the range of "suburban" values of demographic indices, intensity of commuting to work and close functional connections between Warsaw and the surrounding areas. We have initially assumed such spatial borders of the suburban zone for this elaboration.

Certain authors /e.g. Deja 1975, Zawadzki 1979/ suggest that the development and spatial structure of the suburban zone does not depend on the initial conditions of the natural environment which only constitutes a background reacting passively to transformations caused by progress in town planning. It is difficult to agree with such a concept. This is due to the fact that we consider the natural environment to be one of the significant factors influencing the character and rate of development of the suburban zone.

From the point of view of the ecology of landscape, the suburban zone is a specific /separate from the urban and rural/ ecological system characterized by an individual set of phenomena and processes and high degree of spatial mosaicality /Roo Zielińska, Solon 1988, in press/.

All components of the natural environment are changing with the development at the town planning level, although not at an identical rate. The most plast component

which is also susceptible to changes in the vegetation cover. Simultaneously, due to its high suprainformativeness, it is an excellent indicator of the conduction and transformation of the whole natural environment, as well as the present and past anthropogenic processes, connected with the development of the suburban zone. For this reason we assumed this vegetation elaboration as being the main object of our attention.

The aim of this work is to characterize in as much detail as possible, the differentiation of the potential vegetation of the Warsaw Municipality Voivodship, as well as the main directions of the transformation in the actual vegetation as a result of defined forms of anthropogenic activities.

Such a characterization is not an aim in itself, but may constitute a basis for an analysis of several problems, including:

— degree of correlation between the character of habitats and differentiation of the suburban zone,

— evaluation of synanthropisation of vegetation as a consequence of urbanization processes,

— succession in time and spatial differentiation of relations between selected types of anthropogenic activities and directions of vegetation transformations,

— degree and character of vegetation transformations as a criterion for the determination and characterization of the suburban zone.

In this work we do not aim to analyze all the above problems in an exhausting way, but only to define certain possible approaches and analyze the selected examples.

In analyses, besides other materials, topographical maps were used /Chart of the Quartermaster Department of the Polish Army of 1830 at a scale of 1:126,000 and map of Head Office of Land Surveying and Cartography dated 1976 — 1978 at a scale of 1:50,000/, as well as maps of potential and actual vegetation of the voivodship /at a scale of 1:100,000/, and detailed descriptions of vegetation in model areas: Łomianki, Konstancin-Jeziorina, Karczew, Nieporęt and Komorów.

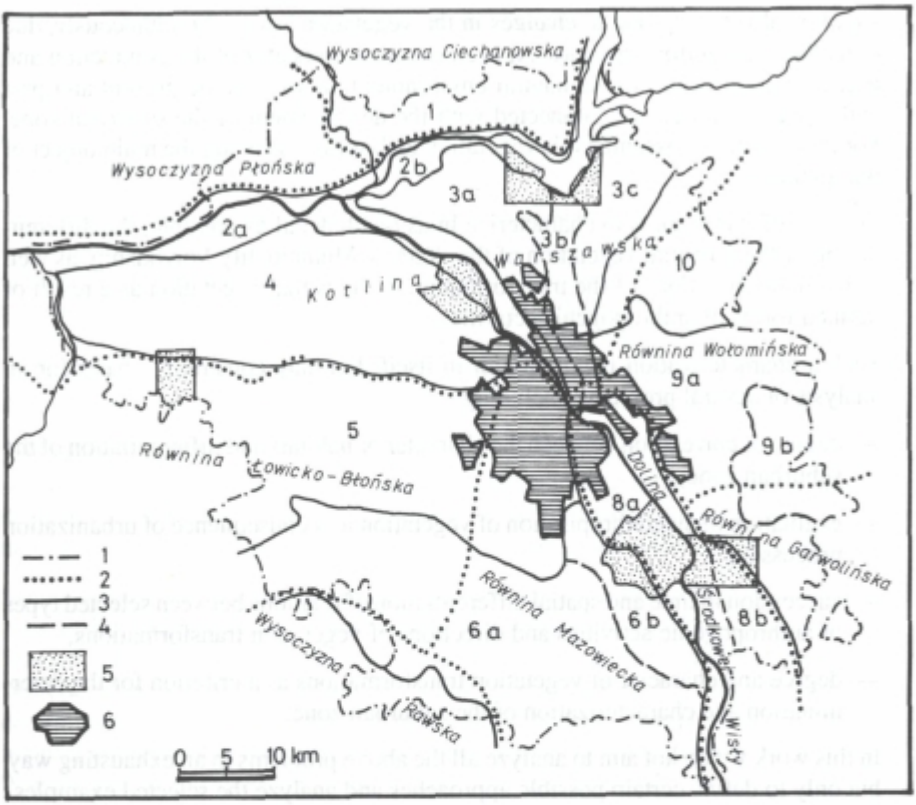

Fig 1. Geobotanical regionalization of Warsaw voivodship:
1 - Borders of the voivodship;
2 - borders of physical-geographic regions according to Kondracki (1977);
3 - first rank borders of geobotanical regions according to Plit (mscr.);
4 - second rank borders of geobotanical regions according to Plit (mscr.);
5 - model areas investigated in detail;
6 - high urbanized area of Warsaw.

Slika 1. Geobotanična regionalizacija Varšavskega vojvodstva:
1 - meje vojvodstva;
2 - meje naravnogeografskih enot po Kondrackem (1977);
3 - meje geobotaničnih regij prve stopnje po Plitovi;
4 - meje geobotaničnih regij druge stopnje po Plitovi;
5 - meje podrobno proučenega območja
6 - močno urbanizirano območje Varšave.

Spatial differentiation of habitats in the Warsaw Municipality Voivodship

On the basis of the map of the potential natural vegetation of the Warsaw Municipality Voivodship a new and more detailed regional division has been conducted on the basis of structural criterions and distribution of habitat types. Due to a relatively small area embraced by the analysis, only two ranks of a low order were determined, and the division has not been related to the general hierarchy of geobotanical regionalization units. The spatial distribution of potential vegetation on the map indicates a favorable spatial arrangement and allows for the determination of 10 regional units /Fig. 1/, differing with the contents of plant communities and their structure. Those units are slightly different from physical and geographical units of J. Kondracki /1977/.

Considerable differences and characteristic of the series of uplands /Płońsk Upland and Ciechanów Upland/, stretching to the north from the valley of the lower Narew river and the middle Vistula river /unit 1/. The upland rows are constituted by moraine kame monadnocks. The steep erosive edge of the upland and hills built of clay and clay gravels are occupied by habitants of Swichisla dobrova the Potentillo albae-Quercetum termophilous oak forest. In depressions, dominating are poor oak hornbeam forests. In the valley axes, and particularly in the Wkra river valley, there are sandy formations occupied by habitats of mixed coniferous forests.

Within the genetic unit of the Warsaw basin we may determine the following:

1/ contemporary valleys of the Vistula and Narew rivers /region 2/, which constitute a wide system of depression. Rivers are here unregulated, but embanked. Habitants of Salici-Populetum, Ficario-Ulmetum typicum and Circaeo-Alnetum, as well as Carici-Alnetum create a complicated design which enables reconstruction of the old course of river beds. After the linking of the Narew and Vistula Rivers the valleys broadens. The river distinctly accumulates the dragged materials. Created are backwaters and parallel rows of depressions occupied by habitats of Ficario-Ulmetum typicum, Tilio-Caprinetum, sometimes Querco-Pinetum. The valley of the Narew and Vistula rivers below Modlin is asymmetrical, with the rivers washing away the high northern bank;

2/ the duned fragment of a higher terrace in the fork of the Vistula, Narew and Bug rivers /regions 3a and 3c/, characterized by the northern and northwestern direction arrangement in the landscape structures. Sediments of clay and clay gravels have been covered with a tick layer of sand, often duned. Dominating are landscapes of mixed coniferous forests and coniferous forests /Peucedano-Pinetum — in the 3c unit also Leucobryo-

Pinetum/. The rows of depression are more fertile, and are occupied by habitats of poor oak hornbeam forests and Ciraceo-Alnetum reparian forests. From the side of the contemporary valley of the Vistula river there is a more fertile bedding for habitats of Potentillo albae-Quercetum oak groves and for oak hornbeam forests /fertile and poor/;

3/ the valley primeval Vistula river /region 3b/, running from Warsaw directly to north /more or less from Miedzeszyn to Zegrze /Różycki 1969, 1972/. The wide valley, which is not utilized today by the Vistula river, can be well seen on the map of potential natural vegetation. Its bed creates a system of spindle-shaped depressions and patches of old backwaters. The patches are potentially overgrown with a scanty oak hornbeam forest /Tilio-Carpinetum/, old sandbanks by mixed coniferous forest /Querico-Pinetum/, in the depressions are habitats of Circaeo-Alnetum. In the axis of the valley was dug the Zerań Canal;

4/ duned higher was the terrace of the Vistula river /region 4/. This is a large area with a characteristic belt landscape structure. The axis arrangement is in east-west direction. Observed are about 4 km wide two alternatingly placed belts of habitats of coniferous and mixed coniferous forests and Circaeo-Alnetum reparian forests, Carici, elongatae-Alnetum alder swamp forests and oak hornbeam forests /particularly in the eastern part/, as well as a remnant belt — smaller, but maintaining the same direction, with habitats of mixed coniferous forests, and in depressions habitats of oak hornbeam and reparian forests. A major part of this area is included into the Kampinos National Park and is protected. Inter-dune depressions have been drained to a large extent, with the water being disposed of in to the Bzure river. This causes the talking over of alder swamp forest habitats into reparian forest habitats, as well as the lowering of ground water in the area of the whole Kampinos terrace.

The southern border of the discused area stands out very sharply from the Łowicko-Błońska Plain and the Mazowiecka Plain /unit 5/. This is also an area lying distinctly evenly with the parallel latitude of the structure. It embraces the whole area of the Łowicko-Błońska Plain / up to approximately the railway line Brwinów-Grodzisk Mazowiecki/ and the northern part of the Mazowiecka Plain, up to the area of the Jeziorka valley. This is a flat denudational area with dust soils, black soils and brown earths — habitats of the fertile oak hornbeam forests and the Ficario-Ulnetum chrysosplenictosum reparian forests. The southern parts of the Łowicko-Błońska Upland and the Mazowiecka Upland /unit 6a/ has a more diversified land relief, it is characterized by a mosaic structure of plant landscapes. It is constituted by poor

oak hornbeam forests and mixed coniferous forests. On the duned "hill" tops there are small areas of the Leucobryo-Pinetum coniferous forests. Attention is drawn to a well developed, dense network of valleys radially disposing water to the west, north and east. Valley beds are occupied by habitats of the Circaeo-Alnetun raparian forests.

To the south the area becomes elevated — this is the edge the Rawa Upland. The bedding gravels commence to dominate, and the share of habitats of termophilous oak forest increases /unit 7/.

A significant individual character is indicated by the escarpment of the Vistula river and the area near the escarpment. From the preceding unit it is divided by a dry valley running from Góra Kalwaria, Konstancin, and farther to Wilanów and Raszyn. The height of the escarpment ranges from 20 to 30 meters. Dominating this area are more fertile habitats: oak hornbeam forests, richer oak hornbeam forests and termophilous oak forest /region 6b/.

The valley of the Vistula river, in the area south of Warsaw /region 8a/, with a width about 6 km, is mainly occupied by the Salici-Ulmetum, Ficario-Ulmetum habitats.

To the south from the Swider estuary there is a large flat area of the second Vistula river terrace /region 8b/. This is a wide depression, presently filled with peat and occupied by the Circaeo-Alnetum and Carici-Alnetum habitats, grown on the area of the old valley of the Vistula, which has functioning in the lower Drias period.

The remaining part of the Warsaw Municipality Voivodship has been included by J. Kondracki into the Wołmin Plain and the Garwolin Plain. An analysis of the distribution of potential plant communities enables for the determination of three regional units. Almost in the whole of the studied area is a sandy dunned slope of the denudational plain /region 9a/. It runs in an arch with a width of about 8 km from Wilga along the Vistula river to the north, and then on the level of Rembertów it is directed to the east up the Czarna river. Dominating there are poor habitats, most frequently dry, overgrown by pine forests Leucobryo-Pinetum, a mixed coniferous forests; in depressions with no outflows there are habitats of alder swamp forests, swampy coniferous forests, with bogs being very seldom raised.

The eastern border of this area has a washed out character; gradually the surface share of coniferous forests habitats decreases, and the share of poor oak hornbeam forests /region 9b/.

To the east of the Warsaw Basin is a fertile plain /region 10a/, densely populated. It is defined by the towns of Radzymin. Wołmin, Zielonka, Marki. In the Bedding there are varved clays in which brown earths were created — habitats of oak hornbeam forests. Varved clays are not permeable, consequently there are numerous

depressions with no outflows with alder swamp forest habitats. Observed are considerable anthropogenic disturbances of the landscape structure; depressions most frequently are of an anthropogenic origin — mainly deserted clay-pits. The region is characterized by a well developed network of small rivers, the valley of which is occupied by the Circaeo-Alnetum habitats.

The determined regions may be connected into two groups differing by the directions of arranged structures. In the western and south-western parts of the voivodship, and also in the valley of the Bug and Narew rivers, below the Zegrze Artificial Lake and the Vistule river From Modlin, dominating is an even arrangement of the habitats with a parallel latitude. On the other hand, in the left-bank part of the voivodship a southerly direction prevails to be more precise NNW-SSE/. Susc a direction is also characteristic for the Vistula river valley from Modlin and a fragment of the Narew river valley.

Attention is drawn to the favorable situation of Warsaw in relation to the regional distribution of habitats. The capital has a central situation on the bordering place of 10 units, and the largest part of the town from the area viewpoint lies in a fertile plain with oak hornbeam forests, elevated a few meters above the valley bed.

Selected examples of anthropogenic vegetation transformations

The present state of real vegetation is an effect of mutual influences lasting several hundreds of years between the developing society and the natural environment. In general the causes of changes, both the natural and anthropogenic, may be defined with the help of the following general scheme:

Vegetation changes due to the following causes:

I Natural
- I.1. Natural evolution of habitats
- I.2. Natural succession of plants

II Anthropogenic
- II.1 Transformation of habitats, including:
  - II.1.A. changes of water relations
  - II.1.B. changes in ground surface
  - II.1.C.built-up areas
- II.2. transformations of vegetation due to:
  - II.2.a. economic activity
  - II.2.b activity other than economic.

Naturally the above scheme is very simplified and is related to an idealized situation, in which each vegetation change is a consequence of one cause. In reality in the suburban zone there is always a complex of interrelated antropogenic activities and natural mechanisms, whish as a total result in environmental transformations.

Most frequently it is difficult do describe the chronological succession of the main causes resulting in changes of the vegetation. However, it seems that until the end of the first half of the last century directional transformations of the vegetation prevailed with a relatively small transformation of habitats/, due to economic activity. In the later period, with a rapid development of the suburban zone, a larger role was played by changes caused by deep transformations of the habitats. This phenomenon developed particularly during the last 4 decades. This is accompanied by a gradual change in the spatial structure of the vegetation, which is a side effect of changes in non-economic attitudes and social preferences, connected among others with the model of life, family, recreation and a perception of the natural environment.

The role of various motifs and thief influence on vegetation transformations is distinctly connected to the spatial differentiation of habitats and the type of previously existing ties with Warsaw.

And so, for example, in the Łonianki rural commune, situated to the north-west of Warsaw, between the years 1830 — 1990, changes of distribution and character of habitats were influenced, above all, by changes in water relations caused mainly by the natural condition — shifting of the Vistula river bed. During the last 160 years there were numerous such oscillations, and the largest of them had a range of up 500 meters. All this caused a wider than at present range of reparian forest and alder swamp forest habitats.

The gradual building of dams and the draining of canals influenced the general drying up of the Vistula river valley.

Thus during the last 160 years changes in the habitats were minimal, and the only observable trend was the decreasing of the range of alder swamp forest habitats and some reparian forest habitats /mainly Ficario-Ulmetum/, with a simultaneous increase of the area of Circaeo-Alnetum and Tilio-Carpinetum habitats.

In comparison to a rather small transformation of habitats, real vegetation has undergone rather rapid and far going transformations /Solon 1990/. Generally speaking, during the last 200 years the area of forest communities decreased by about 3 times, from about 53 % in 1800 to 17.3 % in 1975. Almost totally destroyed were forests on habitats of Ficario-Ulmetum, /almost 10 times/ considerably de-

creased was the area of Tilio-Carpinetum. Smaller losses occurred in the case of the Querco-Pinetum habitat.

Basically the whole area of the rural commune was subjected to the process of deforestation, although it affected coastal forests to a smaller extent /Salici-Popoletum/ and the southern part, were practically natural forest communities have been maintained, mainly on poor and very humid or very dry habitats /Carici-Alnetum, Peucedano-Pinetum, Cladonio-Pinetum, Vaccinio uliginosi-Pinetum/.

Grassy communities /containing sandy grasses, meadows, pastures, lowmoors and rushes/ never constituted a large part of the area. They share ranges from about 15 % in 1830 through to about 10 % in 189 — 1913, increasing to about 18 % in the interwar period, to decreases to about 8 % at present. During all that time the majority of grassy communities concentrated in the valley of the Vistula river, but their character was changing.

Considerable transformations also took place in the bog area of "Luże", which 20 years ago still represented an almost natural complex of rushes and moors, which was little changed for almost 100 years. At present this is a dried up area, partly degraded and overgrowing with shrubs. it is additionally decreased by the establishment of fields, meadows and plots along the edge of the eastern side.

Interesting is the increase in the area share and the change of character of ruderal communities, connected with the built-up areas. The area of built-up areas initially increased rather insignificantly, from 4.2 % in 1830 to 6.7 % in 1913, and later to 13.8 % in 1933, and after a period of rapid development following the war it amounted to 27.6 % in 1975.

The presently occurring ruderal communities may be divided into two groups. The first one is connected with the traditional built-up areas and occurs in courtyards, grounds adjoining cottages and fences.

The second group of ruderal communities is characterized by a changeable structure, creating complexes with a considerable differentiation in space and a rapid rate of transformation of one community into another. It is connected to built-up areas of an urban character, building sites and glasshouses. Those are historically younger communities, which appeared in the area of the Łomianki rural commune during the last 50 — 80 years.

The above presented picture of the transformations of vegetation is basically typical for the majority of areas in the northern, north-eastern and eastern parts of the voivodship. On the other hand, in similar habitat areas, but with a less closer functional connection with Warsaw /as it takes place for example in the area of Komorów — to the west of Warsaw/, the course of the transforming of vegetation

was slightly different. The basic formation of the spatial structure was completed over 100 years ago, and since that time only slight modifications took place. Even larger drainage investment inputs /e.g. Olszowiecki Canal finished about 60 years ago/ had an influence on a small fragment of the analyzed area.

Only in the last years could we observe symptoms of a quickening rate of changes, connected with the development of recreational building and increasing orchard areas. The described situation is typical for areas of the Błonie Plain, terrain situated west of Warsaw, which was deforested for a long time and with a traditional structure of agricultural landscape.

A different complex of phenomena occurs in areas on which there were relatively large transformations during the last 40 Years. This is particularly true in the wide valley of the Vistula river to the south of Warsaw.

As a result of the natural changes of the Vistula river bad in the flood terrace on the place of several rushes communities /associations of Phragmition and Magnocaricion/ Salicetum triandro viminalis ans Salici-Populetum are developing, and there is a lack of change in the direction and intensity of the utilization of those areas. On the other hand, replacing a part of he stands of the communities of the Chenopodietea and Secalietea class apear meadows of the Arrhenatherion association, sandy grasses representing Festuco-Sedetalia and Salicetum triandro-viminalis, as well as younger forms of Salici-Populetum.

The next factor causing considerable transformation of plant landscape is the draining of swampy terrains. They are based on a varied lowering of the ground water surface and a forcing of their horizontal movement. This is accompanied by an intensification of the breeding direction in agriculture. As a result of such influences meadows of the Molinion association, so popular 40 years ago, have vanished completely. Among others they are replaced by meadows of the Calthion association, and hay-growing sown maedows with the domination of Alopecurus pratensis. The remaining meadows of the molinion association were changed into pastures of Lolio-Cynosuretum, meadows from the Arrhenatherion association as well as hay- growing sown meadows with the domination of Dactylis glomerata. Meadows with the domination of Alopecurus pratensis also appeared in the place of wide areas occupied by a complex of communities of the Magnocaricion association. In the vicinity also transformed were certain forest areas. In the place of the Ribo nigri-Alnetum alder swamp forest appeared reparian forest communities of Circaeo-Alnetum.

As a consequence of changes in the main direction of agricultural land use from a small producers' economy and grain economy into breeding or fruit-growing, which is connected to a change in economic and social relations based on including the

area which is the feeding baes of the capital, the area of arable fields occupied by communities from the Chenopodietea and Seralietea classes decreased. In a part of the field complexes dense areas of meadows from the Arrhenatherion association and complexes of orchards appeared.

During the past 40 years considerable increase took place in the area occupied by ruderal communities from the Onopordetalia and Eragrostietalia orders. This increase took place at the cost of weeds from field cultivations, and to a smaller extent also meadow forest communities. Two types of spatial distributon of new uderal communities may be observed. The first one, in the form of large irregular patches on the peripheral parts of old built-up areas; and the second one, of a linear character. An increase in the area occupied by ruderal communities is connected to a significant increase in the urbanization level, and on the other hand it is based on a centrifugal growth of an earlier existing settlement, and on the other — on the creation of new ones along transport routes /Plit, Solon 1990a, 1990b/.

An important, although in the scale of the voivodship only a single example, of the transformation of habitats and vegetation are the surroundings of Nieporęt near the Narwia river /north from Warsaw/. During the sixties a retention tank was built on the Narew river, as a result of which over 25 sq.km of fields and pastures were flooded. Apart of the flooded terrain, the range of habitat transformation in the direct vicinity of the reservoir is surprisingly small. Changes in habitats are connected with the creation of a new hydrographical network, which in effect led to the flooding of several depressions. The depressions communities of the Phragmitetea class then developed. A habitat change of a considerably wider character, although in a way secondary to the construction of the reservoir was the change and development of the previously existing drainage system in the north-eastern part of the Warsaw Basin. This led to the vanishing of sedge communities and low moors, which were numerous 40 years ago; and the development of humid meadows instead. On the other hand, in more elevated areas grasses of the Sedo-Scleranthetea class even appeared.

With the construction of the reservoir is connected a considerable development of sojourn recreation, and what is more — a significant increase of built-up areas and a generally progressing ruderalisation of vegetation, particularly in the coastal part.

The above described transformations represent a certain more general trend of the synanthropisation of the vegetation cover. According to Falinski /1972/ the process of synanthropisation includes above all:

— eurythopisation, i.e. replacing of stenothopic elements by eurythopic ones,

— cosmopolitisation, i.e. replacing of indigenous and individual elements by cosmopolitic ones,

— allochtonisation, i.e. replacing of autochthonous components by allochtonic ones,

— differentiation and complication, i.e. the replacing of simpler patterns by more complicated ones, but not homogeneous from the point of view of genetic, dynamic, as well as historical and geographical reasons.

Those phenomena may be observed on various levels of organization of the vegetational cover.

In relation to the level of plant communities and plant landscape of suburban zones, an effect of eurythopisation is the decreasing of the number of types and area share of xero- and hygrophilous communities and the replacement of them by mesophylic systems. Additionally there is a loosening of ties between the actual and potential vegetation, which is particularly distinct in the case of ruderal communities, which occur on numerous different habitats.

An effect of cosmopolitisation and allochtonisation of vegetation is the diminution and vanishing of ranges of autogenic communities and the increase in area and number of anthropogenic communities. Sowa and Olaczek /1978/ indicate that in towns the number of synanthropic community types ranges from 11 to 30, and maximum values occur only in larger towns. As is generally known in rural areas the number of community types from this group is similar /Faliński 1971/ and for example in the vicinity of the Wigry lake it amounts to 16, which constitutes about 30 % of all types of communities occurring in that area /Solon 1988/. On the other hand, in the suburban zone the number of types of anthropogenic communities is most frequently higher, and their share in the general number of types frequently amounts to 40 % /Roo Zielińska, Solon 1988/.

The role of synanthropic communities is even more distinct when the area occupied by them is taken into consideration. They occupy about 70 % of the terrain, which is more or less evenly divided between ruderal and segetal communities. This is a characteristic phenomenon for the suburban zone, as both in the urban landscape and in the rural landscape the synanthropic vegetation may occupy an area which is similar or even larger. But in the first case decidedly dominating are ruderal communities, and in the second onesegetal communities.

An effect of the differentiation and complication of the vegetation landscape are several mutually connected phenomena, namely:

— the occurrence of communities representing the same syntaxonomical unit, but in various stages of degeneration and differing from the viewpoint of vertical structure, richness and species variety. This causes the existence of stands with various values of the informative richness index /Kostrowicki 1982/. For example in the area of Białołęka Dworska, within communities of the Festuco-Sedetalia order there are both stands for which this index reaches the value of 106, and stands with a value of 1830, and in the case of larger stands those values remain in the range of 300 — 700.

— considerable fragmentation of the terrain: per unit of area in the suburban zone there is on average 5 — 10 times more of various communities than in the agricultural landscape, and about 4 — 24 times more in comparison with the town center,

— significant increase in the number of local phytocenoses and enrichment of dynamic circles of substitute communities by about 20 — 50 % /at least on habitats of Tilio-Carpinetum, Querco-Pinetum and Peucedano-Pinetum/ in relation to the agricultural and urban landscape,

— decreasing of the average area of a single stand,

— changing of the hitherto dominating belt-island spatial pattern of communities into a mosaic arrangement,

— the creation of secondary repeatable spatial complexes of vegetation, including communities of different ecological character, differing synorigin and in various phases of transformations of ecological mechanisms,

— an increase in the contrasting of actual vegetation with a simultaneous decreased contrasting of potential vegetation.

Changes in the degree of vegetation transformations in the period 1830 — 1990

The above presented processes leading as a consequence to changes in the vegetation landscape, had and still have a different intensiveness in various regions. As a result the degree of anthropogenic deviations of vegetation is also varied. In order to observe that differentiation well, with the help of the conventional 11-degree scale /Kostrowicki, Plit, Solon 1988/ the modern degree of anthropisation of vegetation on various habitat types was described, and separately in various regions and in two moments in time, i.e. for the year 1830 and for 1990.

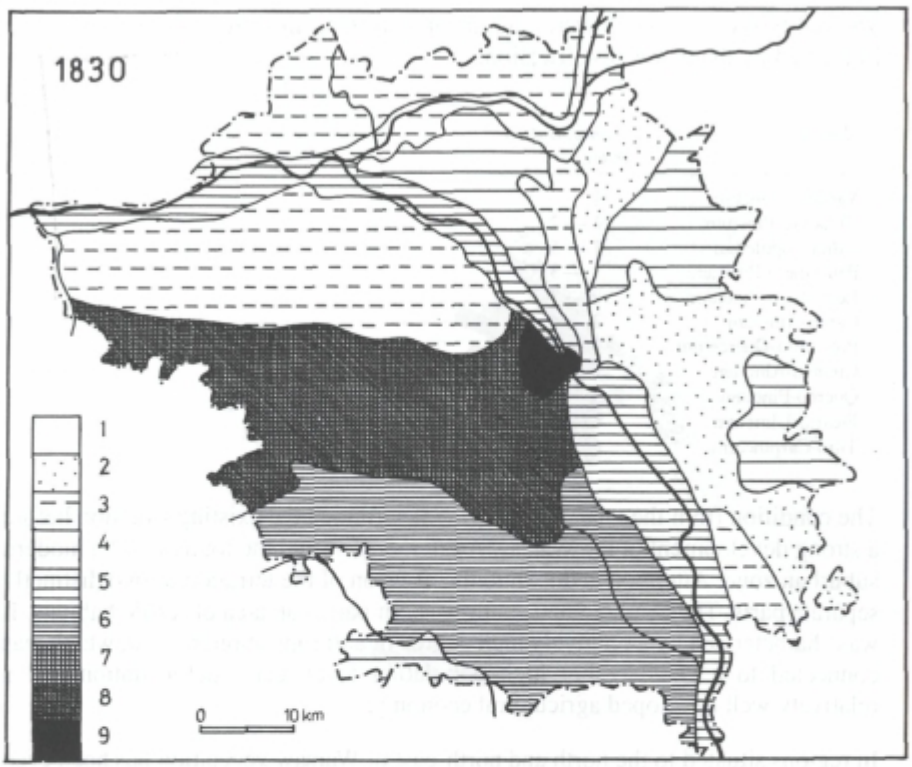

Fig. 2. Degree of vegetation anthropization in 1830 (acording to formula of Kostrowicki, Plit, Solon, 1988):

1 - almost natural vegetation;

2 - high level of synanthropization

Slika 2. Stopnje preoblikovanosti rastja v letu 1830 (po formuli Kostrowickega, Plitove in Solona, 1988):

1 - skoraj naravna vegetacija;

2 - visoka stopnja preoblikovanosti

Various types of habitats were and are transformed in different ways, which is illustrated by the below specification:

Habitat	*Anthropisation index*
Vaccinio-Pinetum	?1
Cladonio-Pinetum	1 — 2
Salici-Populetum	1 — 5
Peucedano-Pinetum	2 — 3
Leucobryo-Pinetum	2 — 3
Carici-Alnetum	2 — 4
Potentillo-Quercetum	3 — 7
Circaeo-Alnetum	4 — 7
Querco-Pinetum	5 — 8
Ficario-Ulmetum	6 — 9
Tilio-Carpinetum	6 — 10

The condition from the year 1830 /Fig. 2/ determined the existing situation before a strong development of the Warsaw Agglomeration and the founding of a modern suburban zone. Attention is drawn to the division of the terrain into two distinctly separate parts. The southern and south-western part is an area of fertile habitats. It was characterized by a relatively high degree of anthropisation /6 — 8/, which was connected to a considerably high population level, early deforestation and a relatively well developed agricultural economy.

In regions situated to the north and north-east of Warsaw vegetation has been even less intensely transformed/ anthropisation level from 2 to 4/. Prevailing here were large forests and marshes. Surprising is the very low level of deviation in the vicinity of the right-bank part of Warsaw. This may be explained, on the one hand, by a relatively low populating of this area, and on the other — by the occurrence of a transport barrier /lack of bridges and roads/.

The intermediate degree of vegetation transformation was adequate for the valley of the Vistula river, which was under constant pressure already since the Middle Ages, but continuous changes of the river bed rendered it impossible to create permanent anthropogenic structures.

The present state of vegetation anthropisation /Fig. 3/ is distinctly different. Regions situated to the east and north-east of Warsaw have undergone a considerable degradation /even by 4 units/. This is a consequence of an intense deforestation and the building of new estates, particularly along new railway lines. In areas situated to the west of Warsaw the index of anthropisation of the vegetation increased slightly over 1 unit. On the other hand, the valley of the Vistula river almost did not

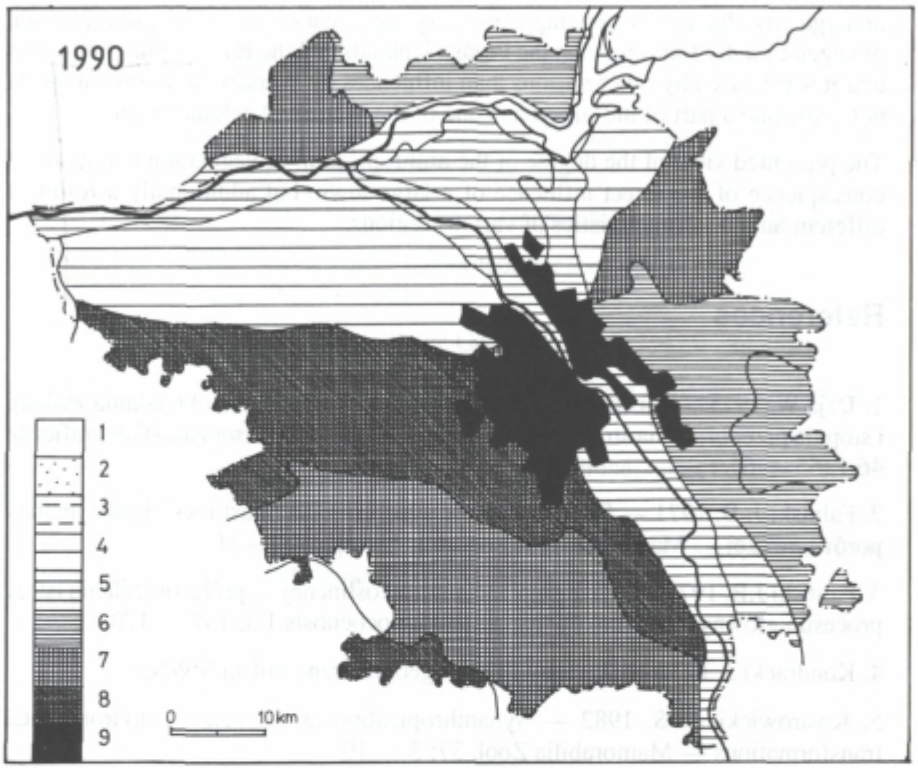

Fig. 3. Degree of vegetation anthropization in 1990 (according to formula of Kostrowicki, Plit, Solon, 1988):

1 - almost natural vegetation;

9 - high level of synanthropization.

Slika 3. Stopnja preoblikovanosti rastja v letu 1990 (po formuli Kostrowickega, Plitove in Solona):

1 - skoraj naravna vegetacija;

9 - visoka stopnja preoblikovanosti.

undergo any changes. Surprising is the very significant increase of anthropisation of vegetation /by four units/ on the Płońsk Uplands and the Rawa Upland. It seems that it was caused by other reasons than influences by Warsaw, and those areas do not constitute a part of the suburban zone of the Warsaw Agglomeration.

The presented view of the degree of the anthropisation of vegetation is not only a consequence of the direct influence of a large town, but additionally a result of different habitat characteristics of various regions.

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Warsaw suburban zone, Ribo-Alnetum forest degradated due to amelioration.
Zaradi melioracij degradiran gozd Ribo-Alnetum v obmestju Varšave
***Foto* J. Solon**

Izbor razvojnih problemov suburbanega območja Varšave

Joanna Plit, Jerzy Solon

Povzetek

Suburbana območja se dinamično povečujejo tako na Poljskem kot tudi v drugih deželah. To so posebna območja, na katerih se koncentrirajo raznovrstne človekove dejavnosti in ki imajo zelo različne funkcije. Med temi so najbolj pomembne stanovanjske, uslužnostne, industrijske, rekreacijske in kmetijske funkcije. V teh območjih so dejavnosti, katerih delovanje je odvisno od naravnih ciklusov letnih časov (n.pr. kmetijstvo in rekreacija), kakor tudi dejavnosti, ki so v osnovi neodvisne od teh ciklusov (n.pr. industrija). Prostorsko pokrivanje teh območij z različnimi funkcijami, različnimi dinamikami, različnimi zahtevami ter pogoji vodi do tega, da postane suburbano območje konfliktno, s posebno jasno določeno različnostjo svojih namenov.

S stališča pokrajinske ekologije je suburbano območje poseben ekološki sistem (različen od urbanega in ruralnega za katerega so značilne vrste individualnih pojavov in procesov ter visoka stopnja prostorske mozaičnosti).

Vse sestavine naravnega okolja se z razraščanjem mestnega obsega spreminjajo, čeprav ne vse na enak način. Najbolj vidna in občutljiva na spremembe je vegetacijska odeja. Obenem je tudi odličen indikator pogojev in sprememb vsega naravnega okolja, sedanjih in preteklih antropogenetskih procesov, ki so povezani z razvojem suburbanega območja.

Namen tega prispevka je kar najbolj podrobno označiti različnosti potencialne vegetacije v varšavskem mestnem vojvodstvu, kakor tudi glavne smeri transformacij pri današnji vegetaciji kot posledici določenih oblik antropogenih dejavnosti.

Pri analizah smo uporabljali, poleg drugih virov, topografske karte (Karta intendantskega oddelka poljske armade iz leta 1830 v merilu 1:126,000 in karto Glavnega geodetskega (katastrskega) in kartografskega urada za obdobje 1976 — 1978 v merilu 1:50,000), kakor tudi podatke o potencialni in dejanski vegetaciji v

vojvodstvu (v merilu 1:100,000) ter podrobne opise vegetacije na vzorčnih področjih: Łęmianki, Konstancin-Jeziorna, Karczew, Nieporęt in Komorów.

Prostorske različnosti rastišč v varšavskem mestnem vojvodstvu

Na osnovi karte potencialne naravne vegetacije varšavskega mestnega vojvodstva je bila izpeljana nova in bolj podrobna regionalna členitev, na podlagi strukturalnih kriterijev in distribucije raztiščnih tipov. Zaradi relativno majhnega območja, zajetega v analizo, sta bili določeni samo dve vrsti nižjega reda in delitev ni bila povezana z glavno lestvico geobotaničnih regionalizacijskih enot. Prostorska razdelitev potencialne vegetacije na karti pomeni ugodno prostorsko razdelitev in omogoča členitev na 10 regionalnih enot (sl.1), ki se razlikujejo po vsebnosti rastlinskih združb in njihovi strukturi.

Celotno območje glede na oblike urejanja struktur razdelimo v dve skupini. V zahodnih in jugozahodnih delih vojvodstva, prav tako v dolini rek Bug in Narew, pod umetnim jezerom Zagrze in reko Visla od Modlina naprej, prevladuje enakomerna razporeditev rastiščnih pogojev vzporedniški smeri. Po drugi strani pa prevladujejo na levem bregu vojvodstva smeri S — J (bolj natančno SV — JV). Ta usmeritev je tudi značilna za dolino reke Visle do Modlina in za del doline reke Narew.

Poudariti je treba ugoden položaj Varšave glede na regionalno razporeditev rastišč. Glavno mesto leži v centru stičišč desetih enot in največji del mesta leži na plodni ravnini z gozdovi hrasta in belega gabra, nekaj metrov nad dnom doline.

Izbrani primeri antropogenih sprememb vegetacije

Sedanje stanje vegetacije je posledica nekajstoletnih obojestranskih vplivov razvijajoče se družbe in naravnega okolja. Na splošno lahko vzroke za naravne kot antropogene spremembe določimo s pomočjo naslednje sheme:

Vegetacija se spreminja zaradi naslednjih vzrokov:

I Naravni vzroki
   1. Naravna evolucija rastišč
   2. Naravni razvoj rastlin

II Antropogenetski vzroki:
   1. Transformacije rastišč, ki vključujejo:
      a. spremembe vodnih razmer,
      b. spremembe površja,
      c. pozidana območja.

2. Transformacije vegetacije zaradi:
   a. ekonomskih dejavnosti,
   b. dejavnosti, ki niso ekonomske.

Seveda je zgornja shema zelo poenostavljena in vezana na idealizirano situacijo, kjer je vsaka sprememba vegetacije posledica enega samega vzroka. V resnici je v suburbanih območjih vedno veliko med seboj povezanih antropogenih aktivnosti in naravnih mehanizmov, ki vzajemno povzročajo spremembe okolja.

Največkrat je težko opisati, kako so si kronološko sledili glavni vzroki za spreminjanje vegetacije. Vendar se zdi, da so do konca prve polovice prejšnjega stoletja prevladovale smerne transformacije vegetacije (z relativno majhno spremembo rastišč) zaradi ekonomske dejavnosti. Pozneje so ob naglem razvoju suburbanega območja igrale večjo vlogo spremembe, ki so jih povzročile globoke transformacije rastišč. To se je dogajalo posebno v zadnjih štirih desetletjih. Ta pojav je spremljala postopna sprememba prostorske strukture vegetacije, kar je stranski učinek sprememb v neekonomskih odnosih in socialnih vrednotah, ki so med drugim povezane z načinom življenja, vrednot naravnega okolja in rekreacije.

Vloga različnih motivov in njihovega vpliva na spremembe vegetacije je razločno povezana s prostorsko diferenciacijo rastišč in tipom zvez, ki so že pred tem obstajale z Varšavo.

Glede na stopnjo ohranjenih rastlinskih združb in pokrajine v predmestju lahko rečemo, da je posledica eutrofikacije padajoče število vrst in površinskih obsegov ksero- in hidrofilnih združb, ki jih nadomeščajo mezofilni sistemi. Dodatno k temu se rahljajo vezi med resnično in potencialno vegetacijo, kar je posebno očitno pri ruralnih združbah, ki se pojavljajo na številnih rastiščih različnih vrst.

Posledica kozmopolitizacije in alohtonizacije vegetacije je zmanjševanje in izginjanje mnogih avtogenih združb in naraščanje števila in obsega antropogenih združb. Sowa in Claczek (1978) trdita, da je v mestih število vrst sinantropičnih združb od 11 do 30, najvišje število pa se pojavlja samo v velikih mestih.

Vloga sinantropičnih združb je še večja, če upoštevamo tudi njihovo razširjenost. Pokrivajo namreč 70 % površine, bolj ali manj enakomerno porazdeljene med ruderalne in segetalne skupnosti. To je značilen fenomen suburbanih območij, kajti tudi v mestnem in kmečkem okolju lahko sinantropična vegetacija zavzame podobno ali celo večjo površino, vendar v prvem primeru odločno prevladujejo ruderalne, v drugem pa segetalne združbe.

Spremembe v intenzivnosti vegetacijskih transformacij v obdobju 1830 — 1990

Predstavljeni procesi, ki povzročajo spremembe v vegetacijskem pokrovu, so bili in so še vedno različno intenzivni v različnih območjih. To povzroča tudi različno intenzivnost antropogenih deviacij vegetacije. Da bi lahko bolje opazovali te razlike, smo s pomočjo običajne 11-stopenjske lestvice (Kostrowicki, Plit, Solon 1988) opisali sodobno stopnjo antropizacije vegetacije na različnih vrstah rastišč, posebej v različnih območjih in v dveh časovnih profilih, za leto 1830 in za leto 1990.

Stanje iz leta 1830 (sl.2) prikazuje situacijo pred močnim razvojem varšavske aglomeracije in nastankom sodobnega suburbanega območja.

Sedanje stanje antropizacije vegetacije (sl.3) je precej drugačno. Predeli na vzhodu in severo-vzhodu Varšave so doživeli precejšnjo degradacijo (celo do 4. stopnje). To je posledica intenzivnega izsekavanja gozdov in gradnje novih posestev, posebno ob železniških progah. Na področjih zahodno od Varšave je indeks antropizacije vegetacije narasel za malo več kot 1. stopnjo. Po drugi strani pa dolina reke Visle skoraj ni doživela sprememb. Presenečа pa pomemben porast antropizacije vegetacije (za 4 stopnje) na vzpetih območjih Płońska in Rawe. Zdi se, da je ta posledica drugih vzrokov in ne vplivov iz Varšave. Ti predeli tudi ne predstavljajo suburbanega območja varšavske aglomeracije.

Predstavljeni vidik stopnje antropizacije vegetacije ni samo posledica direktnega vpliva velikega mesta, temveč dodatno še posledica različnih značilnosti rastišč v različnih območjih.