UDC 911.37:301.16(438 "Warszawa") =20

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PROBLEMS OF THE ECOLOGY OF THE SUBURBAN ZONE (A CASE STUDY OF THE MODEL AREA OF BIAŁOŁĘKA DWORSKA IN WARSAW)

An ecologist, who has started research in a zone diredtly influenced by the town, is faced with numerous difficulties. They stem from the fact that notions, definitions and methods aplied in research into natural patterns are not suitable under conditions reigning in an urbanized area or a territory under urbanization pressure. This is caused by a basic dissimilarity of mechanisms which steer urban or suburban anthropocoenoses in comparison with those which reign over natural - or even field or meadow - ecosystems. Moreover, when the ecologist studies literature on urbanized areas, he is overwhelmed with amazement by his ciscovery that the range of basic principles, worked out within and adopted by the discipline he is practising, has been enlarged enormously. For example, the terms 'ecology', 'ecosystem', etc. have been "appropriated" by other sciences, while their meaning has been changed in relation to the original one.

To determine the boundaries getween what is 'urban' and what is 'not urban' is also a very difficult task. How often in the central part of a town the ecosystems function in a very similar way to the natural systems, while in the peripheries the ecological systems are unsettled to such a degree that they should be approached from a completely different angle.

The ecological investigations of towns and suburban zones are, threfore, much more intricate that those of 'rural' ecosystems, for which research methods have already been established and the systems of notions and measures worked out. That is why we know so little about conditions of life of vegetation and fauna organisms in urbanized areas and about their mutual interrelations.

Ecological research in areas under urbanization pressure has been only recently intensified, both in Poland as well as elsewhere. This research has been included in the international programme 'Man and Biosphere' (MAB), the international programme of environmental protection (UNEP), investigations carried out by the Concil for Mutual Economic Co-operation, etc. etc. The steadily developing cooperation in this respect between natural scientists, urban

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planners, architects, sociologists, etc. is a very advantageous phenomenon, and the future seems hopeful. In Poland, this cooperation has found its expression in research carried out jointly by many specialists on the site of a future housing estate, Białołęka Dworska, which is an area typical of the suburban area of Warsaw.

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To characterize in detail a suburban zone, as a separate system of ecological patterns, is not easy, because this system has not yet been identified in a sufficient degree; investigations which have been started are far from being completed. Nevertheless, results obtained os far, make it possible to discover certain specific characteristics, differentiating suburban ecosystems from those which exist in towns, as well as those found in the countryside. Forest, grass, and even field ecosystems are characterized, above all, by the fact that they are, to a higher or lesser degree, influenced by natural mechanisms developed throughout the millions of years of the evolution of the organic world. The adaptation of living organisms to one another, as well as to their environment, has created a very complicated mixture of mutual dependences and relations, which have induced the formation of ecological patterns, characterized by stability, a relative balance and structural similarity.

We are aware that individual species of plants and animals do not occur in natural conditions at will, but they form more or less intricated social patterns. As a result of the pressure of the abiotic environment, those patterns have been made out of biological material available at a given place and in a given period. Among numerous mechanisms and properties, characterizing natu ral patterns, the most essential are the following.

1) Balance of the systems, i.e. an ability to keep a relative thermodynamic balance. In the scale of a single ecosystem there is a tendency to keep the relation of enthropy to negenthropy at a more or less unchanged level. In the scale of the ecosphere, however, the unbroken evolution of living organisms has caused a decrease of enthropy, i.e. the state of the least probability.

2) Capability for homeostasis, i.e. an automatic recreation of own structure in case of its distortion by external features. This property characterizes a majority of natura and seminatural ecosystems, whereas it is in its residual form, if it occurs at all, in agroecosystems and ecological urban patterns. Specific patterns of heterotrephic organisms, closely associated with urban constructions or communal infrastructures, are an exception.

3) Capability for creating and preserving automatic mechanisms of the circulation of the matter and energy, both within the ecosystem, as well as between the ecosystem and its environment. In strongly anthropic patterns this property can hardly ever be found.

4) Capability for transforming international conditions. It is expressed by both a capability in abiotic environment to adapt itself to the needs of biocoenosis, and for an optimal adaptation (and functioning) of the structure of biocoenosis in such sonditions which have been developed by the environment. Transformation mechanisms, which model this environment, discontinue to function in either agroecosystems or ecological urban patterns.

5) Capability for creating and preserving specific biocoenotic structures, recognizable in both a harmonious, hierarchical structure, as well as precisely defined qualitative and quantitative relations between separate trophic levels. This property makes it possible not only to make a maximum use of creative forces of environment and shorten the struggle for survival among individual components of biocoenosis, but also it contributes to the development of a pattern, which is structurally closed and has limited possibilities for exchange with the neighbouring ecosystems (the closing of the pattern is, in the light of the principles of the thermodynamics of open patterns, a condition limiting the growth of enthropy and therefore of balance). This property is also in its residueal state in certain ecological urban patterns, but it is most clearly recognizable in natural and seminatural ecosystems.

The properties, listed above to exemplify the problem, are common to all mature natural ecosystems, while in the patterns which have already been strongly transformed by man, their significance gradually goes down. Other mechanisms, which are associated with intensity and the character of anthropopressure, begin to grow in importance.

Contrary to the influence exerted by traditional agriculture, forestry, etc. transforming mainly biocoenoses (i.e. flora, fauna, and soils) and interfering with the remaining components of the natural environment ot a minimum degree and usually indirectly, urbnization changes and transforms the entire environmental conditions. So if 'rural' ecosystems are in a natural way related to the environment, 'urban' patterns mainly depend on man. It may be assumed therefore that natural and strongly anthropic ecosystems contribute to the formation of the two different types of nature, which are governed by different lews and subordinated to other conditions. However, this does not mean that a new quality of nature has been created in such a way - a technospherical or sociospherical one. A changed and transformed biocoenosis remains a product of nature, though it is steered by mechanisms differing from those which has modelled its original shape.

A majority of biocoenoses, which are within the range of influence of the town, have become not-authentical, labile and with fluctuating quantitative and qualitative relations. Specific conditions, reigning in a town, and a easy penetration of organisms from the outside, lead to a levellling up of the degrees of variability, both of fauna and flora, as well as of entire ecological patterns. Thus, the ecological unification of towns is taking place, of course, within individual climatic and vegetation zones. In the species composition of plants and animals, occurring in towns, a domination of strange species, migrants, often from other

continents, begins to manifest its presence more and more distinctly. Native species are gradually eliminated, with the exception of a specific group of organisms resistant to urban pollution, which are able to withstand the competition of strange species. Thanks to those immigrants and species artificially introduced by man, the flora in towns in rather rich, though, species spontaneously developing are rare.

How on the basis of the properties discussed above can the ecological character of the suburban zone be defined? Is it only a transitory area between the town and the countryside, or is it an ecologically distinct quality? The current state of knowledge points clearly to the distinct character of the suburban zone because:

1) spatial differences in ecological systems, at various levels of internal organization, from natural, or almost natural, to entirely derivative, are quite outstanding. Those systems are, as a rule, structurally open, they may be found in close vicinity one from another, and they exert an influence one upon another. As they usually spread over small areas, forming a kind of patchwork composed of various patterns, among which the largest portions are under the ecosystems of arable land. A fact that illustrates those spatial differences is that in the 400-ha area of Białołęka Dworska 500 almost homogeneous ecological spatial complexes have been differentiated, while in an analogical area in the countryside the maximum number of such comlexes is 50-70, and in touns (the central part of the right-bank Warsaw) from 20 to 150.

2) The flora is there much richer and more heterogeneous than in the countryside, or in urban areas. For example, over 600 species of higher plants (mosses, lichen, and introduced plants excluded) i.e. almost three times the numbers which grow in the analogical areas outside the suburban zone, are growing spontaneously at Białołęka Dworska.

3) The ecological and geographical structures of the flora are much more strongly differentiated. When in towns the structure is extremely simplified, and in the rural area it is characterized by a marked structure of dominants, differing in the types of ecosystems, plants, often of different origin and with different needs, meet and co-exist at Białołęka Dworska.

4) The stability of biocoenoses, and phytocoenoses in particular, is rather high in contradiction to ecological urban patterns, though they do not achieve dimensions typical of natural ecosystems.

5) The phytosociological structure is specific, as characteristic combinations of species, differing from both 'rural' and 'urban' phytocoenoses, occur in the area of the suburban zone.

The above mentioned properties: the spatial differentiation of phytocoenoses, rich flora, phytogeographical and phytoecological heterogeneity, a relative stability and a specific character of phytosociological patterns, occurring in the urban zone, indicate that this zone develops its own distinct system of ecological structures, which can be compared with the ecotones (i.e. specific bordering structures which develop at the border lines of differing phytocoenoses). It seems that the protective importance of the suburban ecotone refers mainly to rural areas, which develop it as a kind of defense against the influences of a town.

Table 1 presents differences between ecological systems of the suburban zone and 'rural' and 'urban'ecosystems:

Table 1

Property	systems			
	natural	field	suburban	urban
Thermodynamic balance of biological systems	big	small	medium	none
Capability for homeostasis of systems	big	medium	small	small/none
Capability for self-regulation of circulation processes of matter and energy	big	small	small	none
Capability to modify the external environment	big	small	medium	none
Stability of systems	big	big	medium	small
Number of dominating species	small	medium	big	mediun
Number of specimens in dominating species	big	medium	big	small
Number of accompanying species	big	small	small/medium	medium
Number of specimens in accompanying species	small	small	small	medium
Quantity of spontaneous flora	small/medium	small	big	small
Shere of species of strange origin	none/small	big	medium	big

It should be emphasized that the above table presents the discussed relations in a very general way, and is based on a small number of data. It may, however, be assumed that a detailed research will yield sufficient material and a more detailed and more profoundly interpreted table will be made.

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To conclude my contribution I would like to say a few words on researches which have been started at Białołęka Dworska.

They were initiated in order to prepare an ecological study for the area of a future experimental housing estate for about 25 thousand people. Plans and designs have been made under the direction of Professor Halina Skibniwska, who also has been responsible for research work connected with their preparation.

The basic assumtion, underlying all this enterprise, is to obtain a maximum ecological efficiency for the future inhabitants. The idea was that every inhabitant and every dwelling should be in as cirect as possible contact with nature, and at the same time that all natural values offered by the site should be not only preserved but also enriched. Therefore, the spatial pattern should be planned in such a way as to provide for the future inhabitants all comfort obtainable in a town and a direct access to nature, as little changed as possible. Those assumptions, and a number of other factors (e.g. an easy access to the housing estate for people who are not in good physical condition, a chance to make use of the values offered by nature for people at various age and with various needs, etc.). have made it nacessary to start the whole undertaking with a number of research studies of climatic, soil, hydrographic, geomorphological, phytoecological, zoocoenotic, and even accoustic, sociological and medical subjects.

Ecological research, carried out in that area, is meant not only as a foundation for an exper's report advising how to develop future green areas for the estate, but also as an investigation of ecological processes and phenomena occurring at the foreland of a town. The area of Białołęka Dworska is at the same time an excellent ground for testing methods which could be applied in planning other housing estates ; those methods should be concerned with such problems as how to form ecological systems, the internal structure of which would guarantee a possible maximal stability, and in consequence produce also economic effects.

At present, work proceeds in the following three directions:

1) an inventory is being made of the current situation, and the adequateness of bioindicative methods for a complex evaluation of the character of existing ecological systems is being determined;

2) processes occuring in biocoenoses, which are expressed by the character of the circulation of matter and energy through ecosystems are being identified;

3) the optimal structure of plant cover, its phytotherapeutical properties and resistance to use , are being investigated.

The Polish Academy of Sciences' Institute of Zoology and the Research Institute for the Environmental Development are carrying out intensive zoocoenotic studies, which will provide the picture of the transformation of fauna during and after construction of the housing estate.

I believe that such comprehensive, complex research work which has been started at Białołęka Dworska will have a very significant effect on the knowledge of phenomena of the anthropization of nature, a subject so little known as yet. There is also a practical side: this work will greatly assist to develop more favourable living conditions in towns, not only in the housing estate at Białołęka Dworska, but also in other similar housing estates in our country.

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EKOLOŠKI PROBLEMI OBMESTJA (NA PRIMERU MODELNEGA OBMOČJA BIAŁOŁĘKA DWORSKA V VARŠAVI)

Šele v zadnjem času je prišlo do ekoloških raziskav območij, ki so podvržena urbanizaciji. Pomembno je da pri tovrstnih raziskavah prihaja do vse močnejšega sodelovanja med strokovnjaki različnih znanstvenih disciplin (strokovnjakov s področja naravnih znanosti, urbanistov, arhitektov, sociologov itd.). Do takega sodelovanja je prišlo na Poljskem v primeru raziskave Białołęk Dworske, tipičnega obmestnega območja Varšave.

Stopnja sprememb življenskih pogojev vegetacije predstavlja enega od kazalcev intenzivnosti človekove dejavnosti. Med številnimi mehanizmi in lastnostmi vegetacije so najpomembnejši naslednji:

1. Ravnotežje sistemov, to je sposobnost vzdrževanja relativnega termo-dinamičnega ravnotežja.

2. Zmožnost homeostazije, to je avtomatske obnove lastne strukture, če pride do poškodbe zaradi zunanjih dejavnikov.

3. Zmožnost oblikovanja in ohranjanja avtomatskega mehanizma kroženja snovi in energije, tako znotraj ekosistema kot tudi med ekosistemom in njegovim okoljem.

4. Zmožnost preobrazbe pogojev v okviru ekosistema.

5. Zmožnost oblikovanja in ohranjanja svojevrstne biocenotske strukture, vsklajene v hierarhični strukturi, kot tudi v točno opredeljenih kakovostnih in količinskih odnosih med posameznimi trofičnimi nivoji.

Navedene lastnosti so skupne vsem zrelim naravnim ekosistemom, medtem ko njihove značilnosti postopno slabijo na območjih, ki jih je človek močneje preoblikoval. Nasprotno pa se povečuje pomen drugih mehanizmov, ki so povezani z intenzivnostjo in značajem človekovega delovanja. V nasprotju z učinkovanjem tradicionalnega kmetijstva in gozdarstva, pri katerih pride do preobrazbe v glavnem biocenoz (flore, favne in prsti) pa urbanizacija spreminja in preoblikuje celotne življenske pogoje. Če je pri "kmetijskih" ekosistemih razvita predvsem naravna povezava z okoljem pa pri "urbanih" tipih prevladuje vpliv človeka. Zato lahko povzamemo, da za naravni in močno antropični (od človeka preoblikovani) ekosistemi oblikujejo dve različni vrsti narave, za katere veljajo različni zakoni in so podvržene drugačnim pogojem.

Večina biocenoz, ki so na območju urbanizacije, je postala drugačna od prvotne, labilna z nihajočimi količinskimi in kakovostnimi odnosi. V sestavi rastlinskih in živalskih vrst, ki se pojavljajo v mestih, se vse bolj odraža prevlada tujih vrst, pogosto celo z drugih celin. Domače vrste postopno izginjajo; ostajajo le tiste, ki so odporne na onesnaženje v mestih in ki so sposobne vzdržati tekmo s tujimi vrstami.

Na osnovi sedanjega poznavanja ekoloških razmer in sprememb v obmestju je možno podčrtati naslednje poteze:

1. prostorsko diferenciacijo ekoloških sistemov na različnih stopnjah notranje organizacije;

2. flora je bogatejša in pestrejša kot v podeželski pokrajini ali v mestih;

3. ekološke in geografske strukture flore so mnogo močneje diferencirane;

4. stabilnost biocenoz, posebno še fitocenoz, je precej večja v nasprotju z mestnimi ekološkimi tipi, čeprav ne dosegajo obsega tipičnih naravnih ekosistemov;

5. fitosociološka struktura je specifična in sicer v razponu od "kmetijskih" do "urbanih" fitocenoz.

Pri načrtovanju novih naselij se vse bolj upoštevajo tudi ekološki vidiki. Tako je bilo tudi v primeru Białołęka Dworske, kjer naj bi bilo zgrajeno eksperimentalno stanovanjsko naselje za 25 000 prebivalcev. Načrtovalce je vodil osnovni cilj doseči največjo možno ekološko učinkovitost za bodoče prebivalce. V ta namen je bila izvedena temeljita ekološka raziskava, v kateri so sodelovali različni strokovnjaki. Raziskava je bila v svojem izhodišču zastavljena tako, da je bila velika pozornost posvečena metodologiji tovrstnih raziskav in teoretskim spoznanjem.