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**The city as an ecological system and its impact  
on environmental quality**

**Abstract.** World urbanisation processes run so fast, that the structure of the city covers ever greater areas. The number of inhabitants reaches many millions. Towns are the nodes through which flow the main streams of energy and matter. Because of the extreme concentration of people, industrial plant, communal devices and traffic, cities are fundamental sources of environmental threat. In Poland 137 towns drain 82% of the country's treated waste production into rivers and 86% of the untreated wastes. 82.3% of the country's dust pollution and 74.9% of gaseous pollution comes from cities.

INTRODUCTION

World urbanisation processes run so fast, that cities cover ever greater areas. The number of inhabitants reach many millions. There are over 60 towns with several million and about 30 with several thousand million people at this time. Over 50% of world population and over 60% of Poles now live in cities.

Towns are also nodes through which flow the main streams of energy and matter. They are the centres of production of materials and cultural goods and also huge amounts of gas, liquid and solid wastes. These processes transform the environment inside urban systems and downgrades it both in their immediate vicinity and at a distance.

Thus cities are not only centres of habitation, but also centres of threat to the natural environment. These problems carry ever more weight. More and more time has to be given to the structure and suitability of the town as well as to its politics, economy and administration. Many scientific disciplines are interested in cities, e.g. technical, natural, medical and humanistic sciences.

This paper presents the complexity of the phenomena taking place inside the "city as an organism" and the influence of cities in posing environmental threats.

## THE CITY AS A SYSTEM

The town should be considered as an entire system, which comprises not only buildings and streets but also infrastructure greenery, energy webs and a complete administration. Such a system, similar to any other, should function on basic processes of energy flow and circulation of matter. A model of the existing structures of such a system are given in Fig. 1.

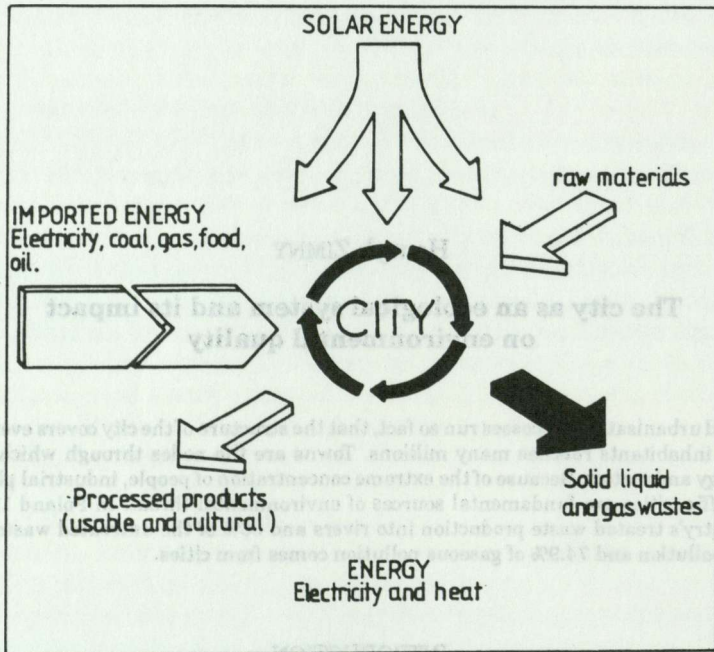


Fig. 1. Functional city scheme

In this model we see in the upper section the income of energy and materials to cities and in the lower part the export of products (industrial, cultural), and also heat, solid wastes, liquid wastes, and gases. Cities stabilise the system in which are concentrated strong flows of energy and matter. All parts of this system require precision in cooperation. In practice processes running in urbanised systems, particularly in great agglomerations, modify (degrade) the system and the vicinity. Cities change not only the character of the landscape but also create specific ecological conditions (ANDERS 1990, ZIMNY 1976, SUKOPP, HENKE 1984, HARASHINA et al. 1990). Climatic conditions change. A combination of the influence of different surfaces, buildings and great heat emission shapes the city's own climate (BEDNAREK 1990). Urbanisation process modify soil conditions too. Soils in cities have been created not only by mechanical processes but also under the influence of chemicals and they are of extremely anthropogenic character (CZERWIŃSKI, PRACZ 1990). They contain high

amounts of chloric ions and are enriched with nitrogen. They also contain high levels of heavy metals especially zinc, lead, copper, chromium, nickel and cadmium. The greatest concentration of these metals is found in the surface layer of soil, particularly when located in the central districts of the city. Contamination of the city environment comes from different sources. Analysis of atmospheric dust shows not only the presence of sulphates and chlorides, but also copper, cadmium, zinc and calcium (DUBANOWICZ 1990). Concentration of these compounds is positively correlated with the degree of industrialisation.

High concentrations of chemical compounds in the soil have negative effects on biological processes (ŻUKOWSKA-WIESZCZEK 1983).

Cities create well-recognised conditions which affect biocenoses. Buildings restrict to a minimum the existence of natural ecosystems. Moreover created biocenoses are small in area and poor in species – they have in fact few components. There are no connections between them. Processes of energy flow and circulation of matter are difficult. The lack of flora makes the fauna rich. In Warsaw 207 species of birds have been noted, of these 144 nest or probably nest and 78 regularly winter in the city (LUNIAK 1990). Some bird species achieve exceptionally large populations (Feral Pigeon, House Sparrow, Rook). However, the most varied avifauna is observed in areas having forest parks.

Mammals also make up a rich component of Warsaw's biocenoses with 41 species recorded. Most of them, however, appear only sporadically. Only 5-6 species can be considered permanent inhabitants. Among these are Squirrel, Domestic Mouse, Striped Field Mouse, Brown Rat, Beech Marten, and Pipistrelle (LUNIAK 1990a). These animals occupy defined ecological niches and take direct part in the flow of energy and circulation of matter. The fauna of urban ecosystems also includes rich insect populations (KROPczyńska-LINKIEWICZ et al. 1990). The richest populations have been found on oak trees *Quercus robur* no matter whether these are in streets or in parks. In parks large populations occur on Norway Maple Trees *Acer platanoides*. Parasites and predators occurred independent from tree species and biocenosis type. Studies of basic ecological processes showed comparatively high productivity of biomass, particularly in park and synanthropic associations (WYSOCKI, JANECKI 1990) and where organic wastes are being mineralised (ZIMNY, ŻUKOWSKA-WIESZCZEK 1990). Thus the city is a defined ecological system where structure and function shape its differences from the surrounding areas. We can consider the city as a distinct ecological system – a so called ecosystem.

#### ANTHROPOPRESSURE PROCESSES

Because of massive concentrations of people and industrial plants, cities are fundamental sources of environmental threat to the atmosphere, hydrosphere and lithosphere. The influence of the cities on the countryside is great. 137 towns drain 82% of Poland's treated waste and 86% of the untreated wastes into rivers. From cities comes 82.3% of country's emission of dust pollution and 74.9% of gaseous pollution (data from Central Statistic Office 1989).

Considering the high levels of pollution emitted from areas of concentrated urbanisation, i.e. medium and big towns we must hold the view that cities endanger their own internal environment as well as that of surrounding areas. Cities put pressure on open areas not only by absorbing them continually into new development but also through dust, gaseous and liquid pollutants. Anthropopressure on the environment depends on the concentration and strength of emission sources. Environmental protection is thus possible only by preventing pollution at its source.

The city as an ecological system functions on the basic processes concerning energy flow and circulation of matter. Changes in this system and systems in its vicinity we can describe in several ways: plant biomass production (WYSOCKI, JANECKI 1990); transformation of the level of consumers; (KROPCZYŃSKA-LINKIEWICZ et al. 1990, LUNIAK 1990); activity of destruents (ZIMNY, ŻUKOWSKA-WIESZCZEK 1983, 1990, ŻUKOWSKA-WIESZCZEK 1978). These processes are fundamental not only to natural ecosystems but also to anthropogenic ones. The processes of anthropization can be applied to entire biocenoses, particular populations or even individuals. Living structures should be examined through living organisms and on the basis of their reaction the scale of influence of the pressures on the environment should be assessed. Bioindication methods are particularly valuable in estimating the anthropopressure influence on the environment in the city itself and the near and more distant environments around it.

#### CONCLUSIONS

- The city is a specific structurally-functional system, a so called ecosystem.
- Cities are main nodes in the flow of energy and circulation of matter and a source also of threats for the natural environment (dust, gaseous and liquid wastes).
- Cities are the areas requiring not only planning solutions but also technological ones, particularly to limit pollution.
- Cities are systems with a comparatively high degree of ecological distinctiveness as well as sources of anthropopressure.
- Solutions to the endangerment of natural environments nationally as well as globally can be found by disentangling these problems in the structure of the city.

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### Taruja PARJUNEN

#### Urban ecology in Finland: different phases and actors

**Abstract.** Environmental research was strongly emphasized in Finland from the early 60s, as well in social as in natural sciences. A specific Research Institute for Environment Protection was founded within the Academy of Finland in 1983. The urban ecology research in Finland has been largely dominated by a socioeconomic paradigm. At the same time a new research front was breaking through in the form of history, environmental medicine, environmental anthropology. There were also several international Research Programmes for Sustainable Development at the beginning of 90s. On a more practical level an experimental project with 14 municipalities was also launched under the nationally developed umbrella. Several research institutes have specialized in researching ecological urban housing and urban environments. At the beginning of the 90s environmental issues on international as a professional field of the underlying philosophy of science on our land and the development of environmental policy as a strong academic branch on the other. Multidisciplinary doctoral programs have produced new researchers into the field.

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#### PHASE I: THE ECOLOGICAL AWAKENING OF THE 60S AND EARLY 70S

The early interest in environmental matters had already produced in-depth studies from various starting points. In the field of sociology, Tyne JÄRVINEN started to study conflicts between energy planning and water area conservation; in the field of social policy Britta ROSKJÄRVO started to study the social aspects of urban renewal processes. Also Jussi HALMOLIN began to create an individual approach to environmental politics. All of these persons still have a central position in environmental research in the 90s.

In the specific field of urban ecology were Työ HALLAS studied about urban ecology in the sense of studying nature within cities, as well as related multidisciplinary studies of the relationship between built environments and nature carried out by natural scientists, ecologists and landscape architects. Dr HALLA and the school of landscape architects are still active members of the urban ecological scientific community.

The culmination of the early phase was the founding in 1983 of the Research Council for Environmental Sciences in the Academy of Finland. It is the youngest of the seven Research Councils in the Academy. It is remarkable that from the very