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FOREST ISLANDS IN THE LANDSCAPE OF THE MASURIAN LAKELAND; ORIGIN, LOCATION IN SPACE, RESEARCH PROBLEMS

INTRODUCTION

Papers presented in this volume relate to the important and strongly developing problems of landscape structure and functioning. The scope of the problems resulted from the specyfic character of the research area. It is an area typical of a young

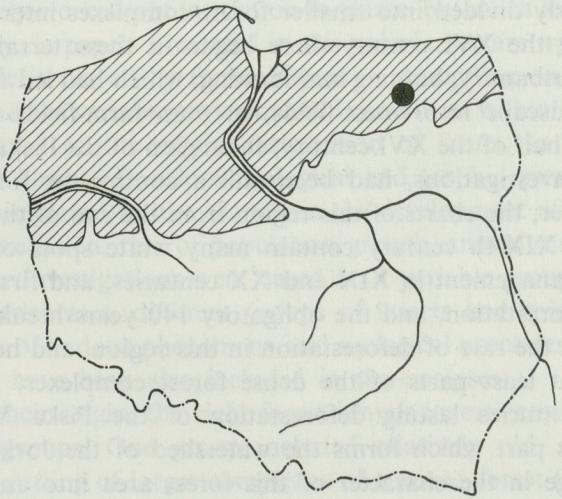

Fig. 1. A map showing the range of young-glacial lakeland landscapes in Poland (the hatched area) (after Kondracki 1972, 1976)
The solid circle denotes the study area

glacial lake landscape, situated in the region of Masurian Lakes (Mrągowskie Lakeland) in the north-eastern Poland (Fig. 1).

The major elements of the landscape structure are the following:

1. Variable structure of the terrain formed by a glacier. It contains many elevations; at their bases there often occur swamps, peatbogs or water reservoirs which together form many land-water ecotones.

2. A net of forest islands of variable origin, size and shape, located among crop fields, meadows and pastures; they are the result of the processes of deforestation, or the natural overgrowing of waste lands.

3. Numerous water reservoirs of different kinds (lakes); water courses (rivers and streams); small, permanent, and ephemeral reservoirs.

4. A system of crop fields, meadows and pastures with moderately intensive agrotechnics, which is related to the recreational purposes of the area and the environmental protection of water.

The research area is the watershed of the Jorka river, where intensive ecological studies were conducted during the previous years. This allowed us to use many data on the environmental characteristics of the area: the plant and animal communities etc. It is the region of the former Piska Forest which in the old times formed a part of a very extensive complex of virgin forests, lakes and swamps called the Great Forest (Wielka Knieja) stretching in a continuous belt from the Pregoła river (D z i e j e ... 1965). In XIII century these were still exclusively forest lands, but already at the turn of the century, the first human settlements had developed at the edges of the forest. Since the XIV century there had begun the period of an extensive farming also in the interior of the Great Virgin Forest complex. Two centuries later, it had been already divided into smaller forest complexes interweaven with many crop fields. Since the XVI century there began in these terrains a period of an intensive forest husbandry, hunting and farming, which had led to a change of parts of the forest landscape into forest-fields, or even farm-fields landscapes.

In the second half of the XVI century, the region of the Piska Forest in the area of our present investigations, had been still a continuous forest complex. Two hundred years later, the charts of this region from the end of the XVIII-th and the beginings of the XIX-th century contain many white spots of deforested areas. Planned forest management in XIX and XX centuries, and first of all, the widely used artificial reforestation, and the obligatory 140 years breaks in clearing, have limited somewhat the rate of deforestation in this region, and have allowed for the preservation of at least parts of the dense forest complexes.

The many centuries lasting deforestation of the Piska Virgin Forest, and particularly of its part which forms the watershed of the Jorka river, has led to a complete change in the character of this forest area into an agricultural-forest terrain, as it is shown by the present structure of the landscape. Over the ca. 35 km^2 of the Jorka river watershed, the lakes and water-ways take 10% of the surface area; roads and settlements take 6%; meadows and pastures — 23%; crop fields — 43%; and forests, woodlots and brushwood — 18%. The latter of the group take about one third of the surface area of crop fields and meadows (P o l a k o w s k i et al.

1985). Forest environments occur there as numerous fragments of old forests or else they occur as woodlots which naturally develop over waste lands and form, among the crop fields, forest islands of various sizes, shapes and ages. They are important elements of the spatial structure, and thus the present investigations have concentrated on their role in the structure and functioning of the landscape.

The role of forest islands is, first of all, in the formation, in the "sea" of cultivated fields, of a net of natural environments which support fauna. Agricultural landscape undergoes many changes both in time (phenology of cultures, seasonal changes in environmental conditions), and space (the changing calendar of cultures), and the agrotechnical works applied are additional strong factors which exert pressures. The existence of refuge environments is therefore, necessary for the maintenance of stability of fauna in such a landscape. They periodically give shelter to fauna which migrates from fields during adverse conditions. This role can be taken on by various types of forest islands, which provide environments capable of sustaining variable natural communities, which can enrich the poor plant and animal communities.

The problem of forest islands in the landscape has an extensive literature of its own. The subject has been analysed in microscale, mainly in the aspect of the effect of this type of environment on the cropfield in its immediate vicinity, its microclimate, the size of crops, fauna etc. There are also speculations in the literature, on the ecological role of forest islands in the structure and functioning of the entire landscape, and thus on their influence on the climate, wind erosion, water circulation, migration of the fauna in the area etc. Still, however, the question remains open, on the role of particular forest islands in the functioning of the landscape, depending on such characteristics as their origin, size, shape and location in space. The problem has been more extensively worked out in relation to plants, but much less so in relation to animals. This is why, in papers presented in this volume, we are trying to answer the questions, what role is played by forest islands — depending on their size, origin, location in space and the variable environmental conditions within them (i.e. presence of water reservoir) — in the spatial distribution of fauna, in the formation of aggregations within them, of various ecological and trophic groups of organisms. Further, what role is played by the islands, in the development of certain ecological processes such as predation, rate of population growth, animal migration and plant synanthropism. Our investigations were based on a variable group of forest islands (Fig. 2), while invertebrates, different groups of insects and spiders were used as indicator organisms of various phenomena and ecological processes. Reactions of the plant communities have been also included in the analyses.

Depending on their origin, the eight forest islands investigated by us, have been divided into two groups. One group included relatively old, nearly 100 years, remnants after the cutting of larger complexes of a mixed forest (Pino-Quercetum). The second one contained much younger, birch-aspen forest islands which develop dynamically on waste lands, and which constitute, for the reason of habitat conditions, a succesive stage of the mixed forest. This gave us the opportunity of comparing the effects of forest islands on the fauna of two environments representing two different succession stages of forest vegetation.

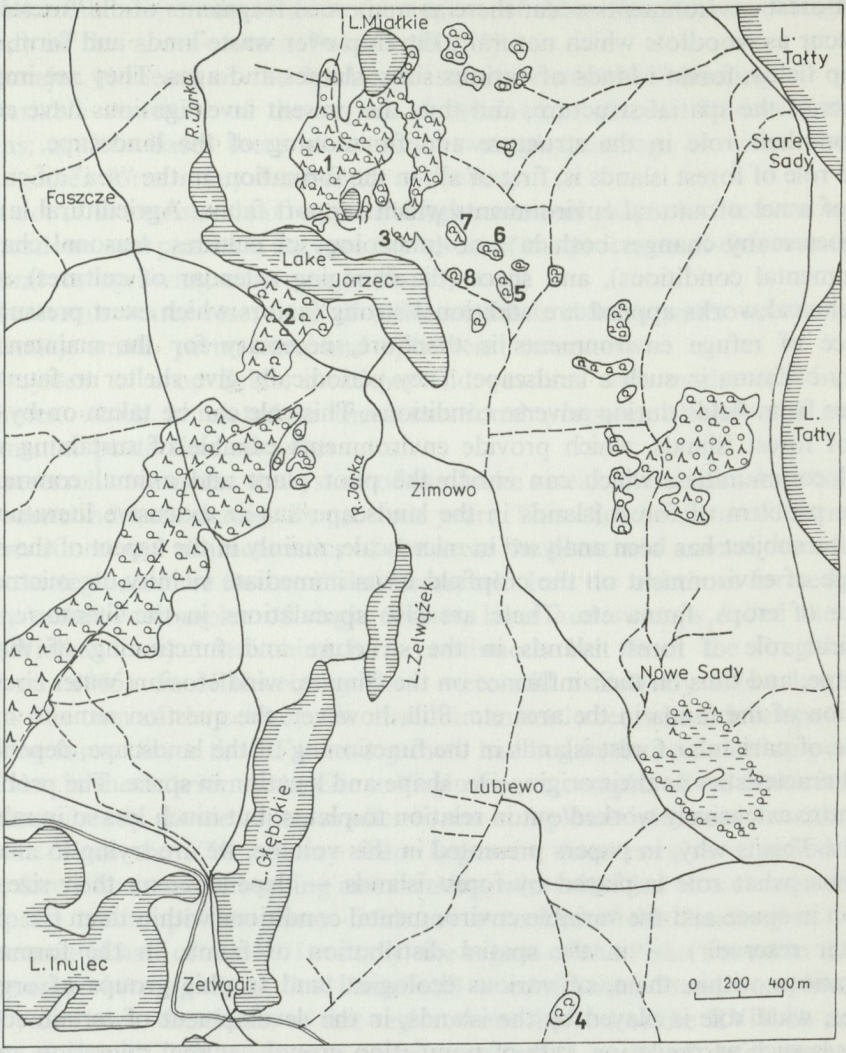

Fig. 2. Distribution of forest islands
1–4 — Pino-Quercetum woods, 5–8 — birch-aspen woods

Size and shape have distinctly differentiated the forest islands, and consequently, the contribution of the ecotone in the surface area of the forest islands, ranged between 1.5 and 24%. The zone of contact of the forest islands with the surrounding open areas was more or less an important element of its spatial structure. It was decisive about the degree of openness of the forest island to the outside influences, and to the intensity of exchange of the biological materials between the forest and cropfield environments. Attention has been called to this problem in the works presented here, however it will be the subject of more detailed analysis in the planned volume of papers on the ecology of ecotones. The importance of ecotones in our

research results from the fact, that the fine mosaic structure of the Masurian landscape and the variable relief provide a substantial environmental heterogneity of the investigated landscape. Consequently, this causes the formation of numerous and variable edge zones between different types of ecosystems. As stated by Forman and Godron (1986), such shaping of the landscape brings about considerable differences in the communities of organisms, and causes high dynamics of some ecological processes, particularly an increase in the extent of biological exchange between the ecosystems.

The variable terrain relief is one of the important elements of the spatial structure of the Masurian lake landscape. Many elevations of 300 m above sea level are dominant in the landscape. They have slopes of several tens degrees and are formed by glaciers and subsequent processes of denudation and erosion. Different nabitats are being formed on the slope of the elevation, which are related to the change of microclimatic and soil conditions, as consequence of the height and exposure.

In our research we have also included this particular element of the landscape structure. We have analysed the differentiation between the communities of soil microorganisms found on the typical slopes in the area. On an elevation of ca. 150 m, with a 5 degree slope slant facing north-east, over an area of 400 m, there exists a number of environments. In the top part there is a crop field, then a tongue of a Pino-Quercetum mixed forest; in the lower part of the slope, a meadow of the Arrhanatheretum elatioris community descends towards a lake, and the base of the elevation it transforms into the community of rushes which make the land-water ecotone. On this slope, the formation of the microcomplex of soil organisms including bacteria, fungi, protozooans and algae, has been investigated. These organisms either stimulate, or inhibit each other's development and they cooperate in the processes of mineralization of organic matter in soil. The main purpose of the investigation has been to make an estimate of the quality and intensity of the effect on these organisms, of two groups of factors acting simultaneously, namely, the type of the ecosystem, and the particular environmental conditions of the slope.

Thus, generally, the purpose of our investigation has been to determine the role of the typical structural elements of a very diversified fine-mosaic landscape, in the functioning and stability of this landscape. The area chosen for the research has been, in the previous years, the object of complex ecological investigations initiated by the Institute of Ecology of the Polish Academy of Sciences. They included the climate, soil, vegetation and biological productivity of both terrestrial and aquatic ecosystems. The results of the studies have been reported in several papers (Traczyk 1985a, 1985b, Hillbricht-Ilkowska 1983, Hillbricht-Ilkowska and Ławacz 1985). These results, especially those refering to the estimate of various parameters of the environmental quality of Masurian landscape, and to the phytosociological analyses, have been largely used in our papers. We believe, that the present volume is a valuable supplement to the problems discussed in the publications cited earlier, and that it will contribute to the better assessment of the functioning of a young-glacial, hilly, lake-landscape.

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