

## FOREWORD

The Suwałki Landscape Park (SLP) was created by a resolution of January 12th 1976 from the Provincial Council in Suwałki. It was the second protected area of this kind in the country (after Wigry Landscape Park) and was the culmination of nearly 20 years of effort. SLP covers 6284 ha, or about 14 901 ha if the buffer zone is included. Almost half of this area is agricultural, with forests covering about 23%, urban areas about 6% and about 10% aquatic areas. The ultimate reason for the creation of SLP was the need to protect a fragment of young glacial landscape of the hilly type in the sub-boreal zone. This has a particularly unique relief as well as diverse habitats and ecosystems, such as lakes, wetlands, the springs of rivers and streams, natural grasslands of various types, and fragments of forests.

The aforementioned resolution described the countryside of the Suwałki area as "one of the three most valuable pearls of our nation's landscape". It went on to specify its valuable features, and explained the need for protection thus: "its valuable features are irregularly distributed frontal and basal moraines, eskers and drumlins, deep troughs and valleys with rivers and lakes, several tens of lakes – large and small, fragmented forests, a huge number of glacial erratics and features unique on the world scale like lake Hańcza and Szurpiły with the Jaćwież (Sudovian) Fort, hanging peatbogs by lake Jaczno which are the sources of rivers, and the whole group of Kamendul lakes. It is considered necessary to bring this particularly beautiful, unique and invaluable landscape under protection, in order to serve the needs of teaching, science and sightseeing".

At the same time, the resolution specifies a whole range of bans on, for example: the pollution of water and air; the alteration of water relations (i.e. also drainage); the extraction of minerals and stone; the carrying out of economic activities, or the siting of factories and developments which can change relief and pollute the environment. There are also orders, which may be exemplified by those concerning: agricultural management in accordance with the recommendations of the Park authorities; the protection of existing stands of trees; and management of forests using native species, and employing methods which maximize safeguards for the soil, forests and waters. The resolution also limits the location of recreational centres and all developments to the buffer zone or beyond. In this way conflicts with the landscape are avoided. The resolution also introduces a number of other precisely-defined limitations.

There are three nature reserves within the Park. Of these, two were created before the Park was established. The geological-landscape reserve "Głazowisko Bachanowo nad Czarną Hańczą" includes a concentration of nearly 10 000 erratics – relics of post-glacial times which are scattered over an area of 0.98 ha. This reserve was created in 1972. The aquatic-landscape lake Hańcza reserve, covering 304.08 ha, was the first of the reserves – having been created in 1963. The protected object is the lake, which is the deepest in the country (to 108.5 m). It is also one of the cleanest lowland lakes, with a shore escarpment with huge numbers of boulders and stony beaches. The newest reserve in the Park is Głazowisko Łopuchowskie in the vicinity of lake Hańcza. It was created by the resolution of July 1st 1988 from the Minister of Environmental Protection. The aim was to protect accumulations of boulders in an area of forest, meadow and pasture covering 15.88 ha. As well as nature reserves, there are also many Monuments of Nature in the Park. These include magnificent boulders and trees which are several hundred years old – including ashes, maples, spruces and others.

In the opinion of the editors, the above information on the valuable features of the landscape, the principles for its protection and the objects protected by reserves is worth recalling. Management principles for SLP will be made in the conclusions of the studies presented in this volume (and particularly in the last chapter, which is a synthesis of the studies, and which postulates various protective intentions).

With a diverse landscape in a relatively small area, SLP is a particularly interesting habitat pattern for ecological research, especially that on modern landscape ecology. In this branch of ecology, landscape is interpreted as a spatial configuration of various systems linked to one another via the

exchange of matter and biological information (of organisms, species). SLP is also an attractive area for limnological-hydrobiological research. Within, and immediately around SLP, there are numerous lakes, include the aforementioned lake Hańcza, which is unique, as well as some other deep lakes. This collection of lakes is young – having come into being about 10 000 years ago. It represents a water resource that is relatively clean in comparison to that of the Masurian lakes. This is a consequence of human impact (from pollution and eutrophication) which is as yet moderate in comparison to that experienced in other regions of the country. Being located in the sub-boreal zone, these lakes are the site of occurrence of relict or rare animal species (particularly invertebrates), as well as of the plants appropriate to the southern part of this zone.

The area has long attracted the attention of hydrobiologists. The Hydrobiological Station at lake Wigry was created in 1920, and between then and 1939 many of the lakes that are now in SLP were subject to floristic, faunistic and physico-chemical studies. These studies make it possible to evaluate the rate of change in the lake ecosystems over a period of half a century.

It is these circumstances that were a prerequisite for several years of in-depth, multidisciplinary research carried out in the 1980's. The final aims of this research may be presented briefly as follows: to recognize the current ecological state of the lakes and their drainage basins: to determine the links with certain landscape processes in order to determine the source of threats and the changes anticipated (in particular the rate of eutrophication); and to indicate protective measures, and those which may serve to counteract the degradation of the waters, environments and landscapes of these lakes.

The results of the in-depth research which was carried out are presented in the series of papers making up this collection. The studies relate to the following issues: (1) description of the hydrographic network, against the background of the physiography of the area under study, the hydrological connections of individual lakes, and the rate at which their waters are exchanged; (2) identification of the character of the drainage basins of individual lakes, and of their structure in relation to geology, soil cover and land use; the carrying out of an evaluation of the drainage basins in relation to threats and the resistance of the lakes to them; (3) description of the geochemical and trophic character of the waters of the lakes and of their dependence on the surface supply of water; evaluation of the loads of compounds responsible for eutrophication, along with long-term analysis of changes in the trophic state of lakes; evaluation of the interrelations of trophic indices in order to gain information about the expected rate of further eutrophication; (4) research on the higher vegetation fringing the shores and banks of lakes and watercourses, of the littoral zone of lakes and of the natural pools of small size (usually  $\leq 1$  ha) which are a very frequent component of the landscape, involving studies of the distribution and nature of the vegetation, as well as of its buffering capacity (i.e. its ability to act as a spatial barrier counteracting water pollution); (5) identification of the structure, abundance and distribution of certain communities of organisms (zooplankton and molluscs) among other things in relation to their distinctness from those of other regions of the country, and their role as bio-indicators of the rate and character of eutrophication.

Research was also carried out on some of the landscape processes which affect the waters of SLP either indirectly or directly. It was the long-term trends and the current state of air pollution in the Suwałki region as well as the rate of supply to waters and soils of various compounds (including those of sulphur and nitrogen). The watershed of the upper Szeszupa river was the fragment selected for research on the intensity of various forms of soil erosion by water and wind. Assessments were made of the mass of sediment transported. The variability of the topoclimate within SLP was identified, as was the role played by lakes in shaping this topoclimate, as well as the microclimate of zones near water. Using several selected lake watersheds as examples, an attempt was made to describe the structure of the landscape, i.e. the size, distribution, dispersion and density of various "patches" of landscape, and their border (ecotone) zones. Habitats or ecosystems were grouped in three functional classes in relation to their different capacities to act as buffers (protective barriers) for the waters of lakes. Aerial photography and methods of photo-interpretation were employed to make this description. This effort is particularly significant for the methodology of landscape ecology as it allows for objective comparisons of the structure of various drainage basins from the point of view of the protection of waters.

Presented in the final paper are the most important results relating to the ecological state of the lakes, their watersheds and groups, as well as to the links between them and the landscape. Also included are proposals for the protection of particular lakes and for the organization of the landscape in their drainage basins and in zones near the water's edge.

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## PHYSIOGEOGRAPHICAL AND HYDROGRAPHICAL CHARACTERISTICS OF SUWAŁKI LANDSCAPE PARK (NORTH-EASTERN POLAND)

**ABSTRACT.** A brief description of main relief forms, climatic conditions and river network of Suwałki Landscape Park. The development of river-lake systems (Szczupia, Szchwentka, Czarna Hańcza) is characterized, morphometric characters of lakes in each system are given.

**KEY WORDS:** relief, river-lake network, lakes, Suwałki Lakeland.

### 1. PHYSICO-GEOGRAPHICAL ENVIRONMENT OF THE AREA

Suwałki Landscape Park (SLP) in north-eastern Poland is in the Lithuanian Lakeland, a mesoregion of East-Suwałki Lakeland (Kondracki 1988). A considerable part of the Park is in the Jelaniowo Upland micromegion, and only its northwestern part belongs to the Wizajny micromegion (Richling 1985). The morphology of SLP and of the whole Lithuanian Lakeland is genetically connected with accumulative and erosive effect of the glacier of the last glaciation and has been formed by the Hańcza glacial. However, many elements of contemporary relief, especially vast depressions and valleys of main rivers are already shaped in the outline of surface of glaciation deposits (Ber 1973, 1981). The thickness of quaternary glacial deposits on the area depends on the relief and formation of the top of pre-quaternary glacial deposits, and is 200–300 m. Because terminal moraines of two main glaciation periods and the subordinate modifications in glacier oscillation stages overlap, the relief of the area under discussion is characterized by considerable