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Information about studies on Hungarian forest ecosystems. Selected research-papers and future investigations of Síkfõkút long-term project (1973–1998)

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Abstract – The 'Síkfõkút Project' was initiated in 1972 by the Institute of Botany of the Kossuth Lajos University (KLTE) in Debrecen (second largest city in Hungary). The project followed the Paris meeting of UNESCO in 1971 ('Research on the temperate zone forest'). Since 1979, the Institute of Ecology (first to be established in the history of the country), has continued the project. An appeal to ecology specialists (botanists, meteorologists, soil scientists, geographers, zoologists, etc.) was made to solve goal tasks and collaborate in research. Therefore, 72 researchers from 23 disciplines volunteered and began their investigations according to the coordinated work plan. During the first period of research the Project was related to the globally advertized IBP (International Biological Program). At the time of inauguration of the 'Man and Biosphere Program Project' (UNESCO Program) in the 1970s, Síkfõkút become one of the most important research areas with the most characteristic hardly disturbed forest of Pannonia and surrounding cultivated areas. More recently, several national and international institutes and universities dealing with environmental protection or scientific research have been carrying out measurements on the area, thus aiming to contribute to the study of the accrue Hungarian forest decline. (© Inra/Elsevier, Paris)

Résumé – Le programme à long terme Síkfõkút. Hongrie (1973-1998). Initié en 1972 par l'Institut de Botanique de l'Université Kossuth Lajos (KLTE) à Debrecen (deuxième ville de Hongrie), le programme *Síkfõkút Project* faisait suite à la réunion de l'Unesco « Research on the temperate zone forest » à Paris en 1971. Depuis 1979 le programme est dirigé par l'institut d'écologie de KLTE. Afin de réaliser les objectifs de recherche, 72 chercheurs regroupant 23 disciplines se sont portés volontaires et ont participé au programme de recherche, partie intégrante du IBP *(international biological program).* Ainsi, au moment de l'inauguration du programme

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de l'Unesco « Man and Biosphere », le programme Síkfõkút était-il un des plus importants en recherche forestière d'Europe centrale.
Plus récemment, plusieurs universités et instituts étrangers, engagés dans la protection de l'environnement ou menant des recherches scientifiques se sont joints aux programmes contractuels de coopération. Ils contribuent ainsi aux recherches visant à étudier les causes du dépérissement croissant de la forêt hongroise.

1. INTRODUCTION

With an area of 93 000 km^2, Hungary represents about 1 % of Europe. Its natural landscape is very diverse because of different relief type regions (plains, hills, mountains). Deviating climatic effects (central-European, sub-Atlantic, sub-Mediterranean, sub-continental, etc.) reach the country in the basin-feature of the Carpathian ring.

In 1896, before industrialization and large-scale human intervention, 31.5 % of the country was covered by forest. In 1978, most parts of the hill and lower central mountain regions (19 % of the country) were covered by oak forests (*Quercetum petraea-cerris*) which could be regarded as the most typical of Hungarian mountain region species. These have been reduced to around 2.2 % nowadays as the total Hungarian forest surface has been reduced to 16.7 % of the territory, of which 9 % is the proportion of man-made forest. This is leading to changes in the tree species, giving rise to non-indigenous ones.

At the time of selecting the forest to be studied, the following considerations were taken into account:

- the forest of the sample area should be at least 60 years old;
- it should be homogeneous, in agreement with the average climazonal Hungarian turkey–oak forest;
- it should have been as little disturbed as possible (forest close to the natural state);
- the site external environmental conditions should be homogeneous;
- the mesoclimate should be the same over the whole area. The soil horizon should be equally deep.

To ensure long-term undisturbed investigations, the 'Síkfõkút Project' forest was declared an 'environmental area research purpose' by the resolution 9/1976 of the National Environmental Protection Office. The 65 hectares of protected forest are today part of the National Park of Bükk Mountain region. The 'Síkfõkút Project' lies along a latitude of 47"90', longitude 20"46' and altitude of 320–340 m above sea-level. The research area (6.3 ha) is located 6 km from the next city (*figure 1*).

2. FACILITIES AT SIKFÕKUT

A basic square of 100 by 100 m forming the central part of the area was divided into several plots of different sizes by means of nylon cords. These plots facilitate the separate investigations of various biological or ecological parameters. In this way, all quantitative results obtained can easily be calculated on the basis of area units.

Meteorological instruments are mounted partly on a 35 m high tower erected in the forest, partly located near the soil surface at different heights or buried in the soil at different depths. Control measurements of radiation, temperature, air humidity, precipitation and wind are carried out also in the open, 300 m from the sample area. Beside the sample

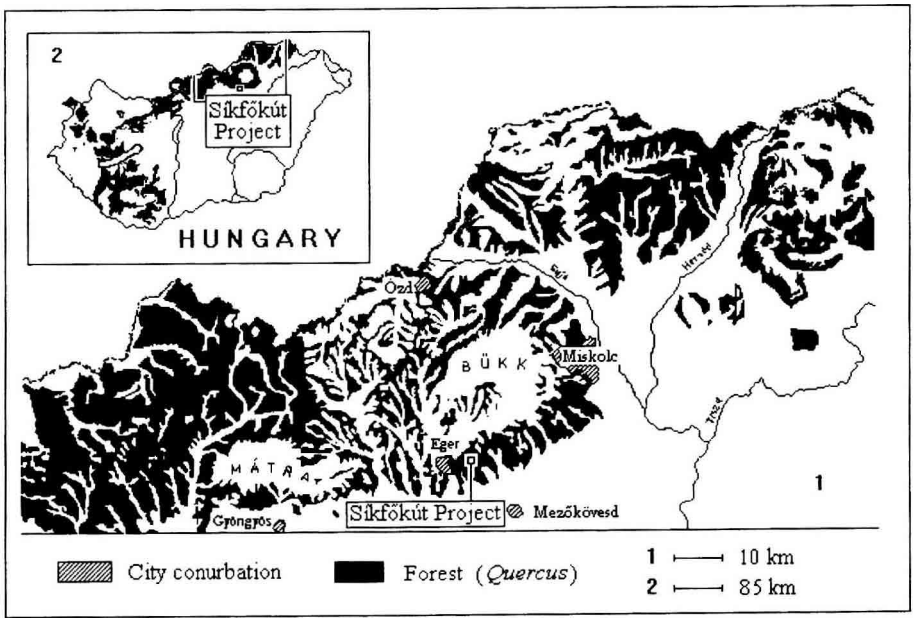

Figure 1. Potential turkey and sessile oak forest regions in Hungary (after Jakucs, 1969)

area, two wooden houses, of 30 m^2, have been constructed to protect the instruments.

Smaller plots (10 by 10 cm) are reserved for the study of certain groups of living organisms (e.g. meso- and microfauna, soil fungi and bacteria), for different kinds of soil analyses, essays relating to carbon cycle, migration of labeled compounds, etc.

3. AIMS OF RESEARCHES

Practically, the research goals of 'Síkfőkút Project' can be grouped around the main problems of synecology. The researches with interdisciplinary studies hoped to solve the following:

- the quantitative and qualitative processes of autotrophic and heterotrophic biomass, production food chains and degradations;
- the chronological change within and between the trophic levels of element cycles under different abiotic effects;
- the input–output element balance of ecosystems;
- the efficiency of organic matter binding, and energy flow through food chains in space and time;
- tolerance limits to external pollution of partially or wholly anthropogenically regulated community;
- modelling the processes and interactions of the structural and functional levels of an ecosystem by systems analysis;
- establishment of scientific regularities which may be generalized incrementing planning on the investigated landscape.

4. INTERDISCIPLINARY FIELDS OF RESEARCHES

For the realization of the listed goals, intensive researches have been going on in the selected forest and its environs since 1972, within the following themes:

A) Autotrophic organisms, phytostructure, phytomass

- Number of tree species and individuals, crown cover and projection map, height, stem diameter, leaf number.
- Tree phytomass and its fractions

B) Primary production (phytoproduction)

- Annual production of trees.
- Annual dynamics of tree leaf area and leaf weight.
- Growth analysis of the assimilating shoots of dominant plants.

C) Mass of organic and inorganic matter. Element and water cycles

- Seasonal changes of bioelement content in trees and their fractions.
- Study of photosyntethis and respiration of tree leaves.
- Seasonal dynamics of inorganic substances in precipitation reaching or having crossed canopy.
- Seasonal dynamics of inorganic substances in stemflow-water.
- Changes of bioelement content in the course of litter decomposition.

D) Energy content and energy flow

- Measurement of solar radiation and energy balance of the forest.
- Energy content of trees and shrubs and of their fractions.

E) Decomposition of organic matter. Complex investigation of soil

- Estimation of litter production; litter fractions.
- Study of soil bacteria and their fractions.
- Study of the qualitative changes of soil humus.

F) Other investigations

- Continuous recording of precipitations, humidity of air, fog, wind, etc.
- Heat balance of the forest and its soil
- Study of pollutants in the forest air (particulate and gaseous components).
- Production studies in the neighboring agroecosystems.
- Decomposition of pesticides in the forest and in nearby agroecosystems.

5. FUTURE INVESTIGATIONS

First results obtained in Hungary from ecological investigations of the endangered sessile oak and its environment support the views presented by Ulrich et al. [6] and Jakucs [4]. From the late 1970s the dying-off of sessile oak stands has caused the heaviest shock [3]. All the potential factors that may be involved in the forest decay have not been investigated. If the ones already indicated (e.g. acid depositions, biotic factors, virus pest, mesoclimatic changes, etc.) are unequivocal, they do not explain all the phenomena and can not be ascribed as the only reasons for the huge forest damages [7].

Ozone has been studied abroad for many years, and remains (in many places) one of the main incriminated aggravating factor of forest decay [1, 2]. Until recently, the technological equipment, scientific knowledge and budget availability prevented investigations on ozone in the region.

Thus, currently, atmospheric pollution remains one of the factors to be investigated in the frame of a global ecosystem study. Field measurements must be carried out at a large scale. In addition to in situ analyses, complementary conclusions on in vitro experiments on the effect of photo-oxidants on native Hungarian tree species must be established. Protocols (involving phytotronic chambers) are currently under development at the Ecologi-

cal Department of the University Kossuth Lajos in Debrecen [5].

In addition to specific researches, a global ecosystem analysis should be performed in order to attempt to find remedy solutions to the occurrence of pollution or to allow species and phenotype selection in the purpose of reforestation. The only possible means of alleviating this widespread problem is by concerted international cooperations that aim at both the transfer of knowledge and technologies as well as an exchange of experiences. Thus, attuned protocols can allow results for comparison into future investigations.

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