

PROJECT REPORT

“MODELS OF THE LONG-TERM EVOLUTION OF FOREST PHYTOCOENOSSES REGENERATING IN POST-AGRICULTURAL AREAS IN VARIED SOIL AND ANTHROPOGENIC ENVIRONMENTS ON THE BORDER BETWEEN THE MASURIA AND KURPIE REGIONS, NORTHEASTERN POLAND”

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During the period 2008-2012, the Institute of Geography and Spatial Organisation PAS, ran the project “Models of the long-term evolution of forest phytocoenoses regenerating in post-agricultural land in varied soil and anthropogenic environments on the border between the Masuria and Kurpie regions, northeastern Poland”. The project was headed by Jan Marek Matuszkiewicz and involved a core team consisting of Marek Degórski, Bożenna Grabińska, Anna Kowalska, Anna Kozłowska, Joanna Plit, Ewa Roo-Zielińska, Jerzy Solon, Jacek Wolski and Izabela Zawiska.

The main objective was to develop a range of models of the long-term evolution of forest communities. This was to take into account their pedological and landscape aspects, as well as the human impact, including, specifically, the large-scale change in land use that has occurred as a result of mass afforestation on former agricultural lands during the last 200 years in two regions with different histories. The area selected for the modelling exercise straddled the border between

the former East Prussia (Masuria) and the Kurpie regions. The study was conducted in six forestry administration units: Jedwabno, Szczytno, Spychowo, Wielbark, Parciaki and Myszyniec.

The study involved two detailed objectives. The first was to develop models of the change in the species composition and spatial structure of the groundcover layer of forest phytocoenoses in forests regenerating in post-agricultural habitats, including natural and anthropogenic factors. The issue of regeneration of forests in areas that experienced deforestation in the more or less distant past and were then used for agricultural purposes is an important topic in both research and practice. While spontaneous or artificial afforestation in this kind of area begins the process of forest regeneration, not even the attainment of a mature age by the trees is by itself synonymous with an effective regeneration of the forest that was there before the original deforestation. The composition of spontaneous species in the new forest is bound to be different to that existing in an area that has

never been permanently deforested. Such observations and in-depth research has resulted in the coining of a term 'ancient forest' and the topic has attracted numerous researchers who have come up with lists of species that define old forests both in Western Europe and in Poland. Another very important observation is that the availability of species propagules was a precondition for the regeneration, which for some species meant the existence of an 'ancient forest' as a refugee for forest species in relatively close proximity. At a later stage, the regeneration process may indeed be regarded as a reinstatement of a natural plant community with its specific structure and species composition, including a replacement of a 'pool of foreign species' (i.e. non-forest communities) with a 'pool of own species', or the 'ecological pool', or the 'community pool', corresponding to a characteristic combination of species in a given unit.

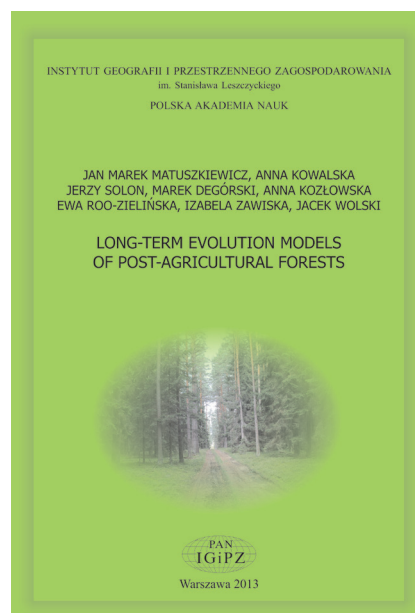
The study has produced the following major conclusions:

- The time factor, also referred to as the regeneration history, is the most important factor in the spontaneous regeneration of forests on post-agricultural land.
- The richness of the habitat has an impact on the rate of the regeneration of both the plantlife and the soils. This relationship may be expressed as a simple formula: "the less fertile the habitat the lower the rate of regeneration".
- In the least fertile of habitats the rate of regeneration may be so low that a full regeneration might take centuries to complete.
- The distance to the refuges of the 'pool of own species' is a factor in the rate of post-agricultural forest regeneration. It is highly likely that this is a strictly 'ecological' relationship that takes into account the potential and ways of transfer of diasporas of certain species and the occurrence of natural and artificial barriers and corridors.
- The rate of regeneration of the secondary forest is strongly dependent on the tree species that has colonised the area at an early stage of regeneration (typically with human assistance).
- The results obtained in the study point to a correlation between the history of secondary forest regeneration and the distance to patches of 'ancient forests', which leads to the conclusion that the regeneration of post-agricultural forests is influenced by a complex set of factors. The influences depend in general on the local

landscape structures, i.e. components (types of habitats and the forms and types of plant communities), spatial structure (e.g. the distribution and structure of patches of ancient forest) and on the historic evolution of the landscape.

- The results clearly suggest that regeneration of a *Vaccinium myrtillus* population is a very important element in the regeneration of a natural composition of plant life and the structure of forest communities in this area. This would point to a need to assist the regeneration of this species in post-agricultural areas as part of forest renaturalisation.

In 2013, details of the project research were published as a comprehensive English-language study "Long-term evolution models of post-agricultural forests"¹.



The second detailed objective was to develop landscape transformation models focusing on forests and considering habitat and socio-historical aspects as impact factors. This objective involved a number of study topics, including:

- an analysis of the location and characteristics of the geographical environment in the borderland between the Masuria and Kurpie regions;

¹ MATUSZKIEWICZ J.M., KOWALSKA A., SOLON J., DEGÓRSKI M., KOZŁOWSKA A., ROO-ZIELIŃSKA E., ZAWISKA I., WOLSKI J., 2013. *Long-term evolution models of post-agricultural forests*. Prace Geograficzne, no. 240, Warszawa: IGiPZ PAN, 320 pp.

- a characterisation of the potential natural vegetation in the study area and its physical geographic conditions;
- the change of forest coverage in the study area during the previous 200 years, as studied on topographical maps;
- the types of sequence of change in the context of deforestation and afforestation in the study area;
- an analysis of forest coverage in historical regions and habitat types;
- directions of historical landscape change;
- the history of human influences on forests in the study area;
- wildlife pressures on forest communities in the study area;
- a concept and model of sustainable forest distribution.

An attempt was also made to assign values to the historical change in the natural environment in the context of criteria of sustainable development.

The project produced an important study "Differences in plant-species composition, richness and community structure in ancient and post-agricultural pine forests in Central Poland"². And also these topics will be covered in detail in an English-language study scheduled to be published in 2014 under the title "Historical transition of landscape influenced by forest cover changes in terms of sustainable development".

² MATUSZKIEWICZ J.M., KOWALSKA A., KOZŁOWSKA A., ROO-ZIELIŃSKA E., SOLON J., 2013. *Differences in plant-species composition, richness and community structure in ancient and post-agricultural pine forests in Central Poland*. *Forest Ecology and Management*, vol. 310, pp. 567-576.

