Spore dispersal study for landscape ecological forest planning*

Gone With the Wind

Field tests of the dispersal of wood-rotting fungi. Mr. Reijo Penttilä (right) from the Research Centre of Friendship Park was part of the research team and responsible for the dispersal studies in the field.

'Phlebia centrifuga' is found in old-growth forests, where it grows on large fallen spruce trunks.

Vaisala's user-friendly MAWS201 (Mobile Automatic Weather Station) was used in a study of the dispersal of wood-rotting fungus spores. The information that the MAWS201 provided about wind and other climate conditions will be essential for developing a spore dispersal model. The results of these studies play an important role in landscape ecological forest planning.

Intensive forest management has altered the structure of both stands and landscapes in boreal forests. Fragmentation, alteration and the loss of previously continuous habitats, e.g. natural old-growth forests, are the primary threats to forest dwelling species. Since most forests are managed, the network of conservation areas cannot provide adequate protection for biological diversity in boreal ecosystems. So it is very important to maintain and restore the structural elements and processes of natural forests in managed taiga.

Maintaining natural species and ecosystems

In 1994, the Finnish Forest and Park Service (FPS) and the Finnish Environment Institute started a landscape ecological forest planning program in Finland. A landscape ecological plan comprises an ecological study of a 10,000–40,000 hectare forest mosaic that can include both managed forests and conservation areas. The aim of the plan is to manage forestry, conservation and other uses of forest resources in such a way that the natural species and ecosystems of the area are maintained in the long run. In a landscape ecological plan, isolated old growth forest patches, key habitats and protection areas such as national parks are connected to each other by ecological corridors and stepping stones, in order to improve the possibility of species dispersal.

There is limited ecological knowledge, however, of the role of corridors, buffer zones and stepping stones in boreal forests and the conservation area network. More information is required on species dispersal and population dynamics in fragmented landscapes. Practical tools for landscape ecological planning are urgently needed. This includes methods for the selection of stepping stones to complete the conservation area network in an optimal way.

The main purpose is to develop a method for landscape ecological forest planning. This method is a GIS-based (geographical information system) tool that relies on forestry inventory data, satellite images and field inventories. It can be used for the priority assessment of forest patches for the selection of networks of protection areas and stepping stones in the landscape ecological forest plan. The method is also useful for comparing alternative landscape ecological plans.

The project is financed by the Finnish Ministry of Agriculture and Forestry and coordinated by Paula Siitonen of the Finnish Environment Institute. It is linked with a larger project financed by the Ministry of the Environment, the Ministry of Agriculture and Forestry and the Academy of Finland and headed by Professor Ilkka Hanski from the University of Helsinki. The entire project is part of the Finnish Biodiversity Research Program of the Finnish Academy (FIBRE).

Data for planning conservation area networks

Populations should be large enough to maintain viability in the long run. Today, old growth

Paula Siitonen from the Finnish Environment Institute coordinated the study of the methods for the landscape ecological forest planning.

PHOTO COURTESY OF PAULA SIITONEN, FINNISH ENVIRONMENT INSTITUTE

Fragmentation, alteration and the loss of previously continuous habits such as natural old-growth forests are the primary threats to forest dwelling species.

forests are fragmented into small and isolated patches occupied by small and isolated populations of old growth specialized species. These populations can easily become extinct locally. In order to maintain populations, habitat patches should be either large enough to provide habitat for a sufficiently sizeable population or in close enough proximity to allow dispersal from one patch to another. If the patches are close enough to each other, species can re-occupy those empty habitat patches where populations have temporarily become extinct.

The main purpose of stepping stones and corridors, which are small patches or strings of habitat, is to facilitate species dispersal from one similar kind of habitat patch to another. Habitat connectivity is especially important for species with poor dispersal ability. Habitat patches may not be located further from each other than the maximum dispersal length of the target species. The problem is that very little data exists on the dispersal ability of the species found in old growth forests.

PHOTO COURTESY OF REIJO PENTTILÄ, RESEARCH CENTRE OF FRIENDSHIP PARK

Vaisala's MAWS201 weather station was used for weather conditions monitoring in the field.

Hunting flying spores in the forest and the laboratory

The dispersal of wood-rotting 'Phlebia centrifuga' fungi, which are specialized in old-growth forests and thick spruce logs, was studied to develop a prediction model for the dispersal of the species in a fragmented forest landscape. The dispersal and deposition of viable spores was studied in the field in Kuhmo in northeastern Finland and in the wind tunnel of the Technical Research Centre of Finland (VTT) and the test laboratory of the IVO Group.

In autumn 1997 and 1998, spores disseminated in the field were captured in agar plates containing haploid mycelia of Phlebia centrifuga. The agar plates were placed at eight cardinal points at varying distances (0–1,024 meters) from an isolated site – one fallen tree – supporting the species. The agar plates were kept open for one hour. The plates were then analyzed for the occurrence of diploid mycelia, which indicates that a spore/spores of the studied species had landed and germinated on the plate.

In 1998, two Vaisala MAWS201 climatic stations were used to measure wind direction and velocity, relative air humidity, air temperature, precipitation and soil temperature inside an old-growth forest and in clear-cut areas. The aim was to study the effects of climate on dispersal and spore production. Climatic data, forest structure and empirical data on spore dispersal and spore production will be used in the development of a dispersal model for Phlebia centrifuga.

The dispersal and deposition of viable spores with a wind velocity of 0.2–1 m/s was studied in VTT's wind tunnel. The fruiting body was placed in the tunnel for 15 seconds–30 minutes, and the dispersing spores were captured using agar plates. The effect of air temperature and relative humidity on the falling speed of the spores was studied in IVO Group's testing laboratory using the laser radius method. The fruiting body was placed in a still dark room for 30 minutes. Air temperature and humidity were measured at various distances from the fruiting body. At the same time, the falling spores were captured using agar plates, and the falling speed was measured using a laser radius and digital camera.

Wind information is crucial in studies of spore dispersal

According to the preliminary laboratory results obtained in 1997, the dispersal and falling speed of spores seemed to be very sensitive to air movement caused by air temperature and humidity differences. Spores are captured by the wind almost like smoke particles. The preliminary results from field experiments in 1997, however, indicate that in old growth forests, the dispersal of Phlebia centrifuga is strongly concentrated in the neighborhood of the fungal fruiting bodies. The findings from the experiments in 1998 have not yet been analyzed.

The dispersal model developed on the basis of this research project will be used in landscape ecological forest planning – for the selection of stepping stones, new conservation areas and restoration planning, for example. Data will be used for the verification of the method for landscape ecological planning. ■

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