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### Mapping of the forest pathological processes in landscape complexes (on the example of the Rybnyk Maidanskyi river basin in Skole Beskids)

**O. Burianyk** (*Ivan Franko National University of Lviv*), **\*M. Karabiniuk** (*Uzhhorod National University*), **Z. Gostiuk** (*"Hutsulshchyna" National Nature Park*), **Ya. Terletska** (*Ivan Franko National University of Lviv*)

#### SUMMARY

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The forest pathological situation in the landscape complexes of the Rybnyk Maidansky river basin is highlighted. The main factors of drying of European spruce are described. The dependence of the distribution of drying lesions on the landscape structure of the territory, species and age composition of the plantation was clarified. Examples of detailed mapping of forest pathological processes in the Rybnyk Maidansky river basin are given.

*Keywords:* forest pathological processes, landscape complex, geoinformation analysis, forest pathological situation, Skole Beskids

## Introduction

One of the biggest environmental problems in the Skole Beskids and the Carpathians is the drying of European spruce (*Picea abies*) or spruce. Trends in drying of spruce plantations are also observed in the forests of Poland, Germany, the Czech Republic, Romania and other countries (Slobodyan, 2003). This ecological problem has acquired a mass character in recent years in the Skole Beskids, and spruce derivatives (*Picea abies*), which are characterized by particularly low resistance to diseases and pests, are experiencing mass drying. In general, in the Skole Beskids, about 82 % of the stands are covered by group, curtain and continuous drying (Slobodyan, 2003). It is characterized by a variety of signs and the nature of pathological changes that occur in the forest, and at the same time, have certain common features. The current situation in spruce derivatives requires the development of landscape-based measures aimed at the reproduction of stable indigenous stands and the stability of forest landscape complexes in general. The forest pathological situation in the landscape complexes of the Rybnyk Maidanskyi river basin is highlighted and examples of their detailed landscape mapping are given.

## Methods of investigation

The study of the distribution of forest pathological processes was carried out according to the method developed by O.M. Fedirko (1988) with its own additions, in particular, we proposed a continuation of the form № 4 “Study of the structure and dynamics of subsoil” (Miller, 1974), which lacks indicators (Table 1).

*Table 1 Form of research of forest pathological processes*

<b>Drying of stands:</b>	<b>Landscape complexes №</b>	<b>Characteristics of the relief</b>	
<b>Characteristics of planting</b>		Slope exposure	...
<b>The formula of the stand</b>	...	Slope steepness	...
<b>Species</b>	...	The reason for the weakening	
<b>Years</b>	...	...	
<b>Completeness</b>	...	Degree of damage	
<b>Type of forest vegetation conditions</b>	...	...	

Studies of forest pathological processes were conducted in a key area, which was the basin of the Rybnyk Maidanskyi River. This basin was chosen as a key area for the study of forest pathological processes due to the fact that: represented in the landscape complexes basin, are representative of the Skole Beskids; the basin is characterized by anthropogenic changes in landscape complexes typical of the Skole Beskids; more than half of the landscape complexes of the basin has been operating in a protected mode since 1999. Data from the forest pathology department of the Skole Beskids National Nature Park on phytopathological, entomogenic, windbreaking and other disorders of afforestation (Research programs to improve) were used for the analysis. Information on the species and age composition of the plantation, the degree and stages of damage were superimposed on the landscape map, after which an analysis of the spread of forest pathological phenomena in landscape complexes was performed. For the analysis of the species and age structure of the plantations, the plans of afforestation of Maidan and the Plan of afforestation of Zavadkivskyi forestries of the Skole Beskids National Park were used. All collected materials were processed in ArcGIS 10.5. First of all, the afforestation plans were linked to a topographic map at a scale of 1:25 000, the geographical coordinates of the areas of drying of stands were indicated. Created spatial layers with attributive tables, which contain information about the species and age composition of the plantation, the cause of drying, etc. The created Shapefiles were superimposed on the landscape map, steepness and exposure maps, to elucidate the landscape patterns of the distribution of forest pathological processes, and the area of the affected stands was calculated.

Examples

In the process of gradual processing of the collected materials, we created a series of component maps of the Rybnyk Maidanskyi river basin and a general map of the distribution of forest pathological processes in the study area.

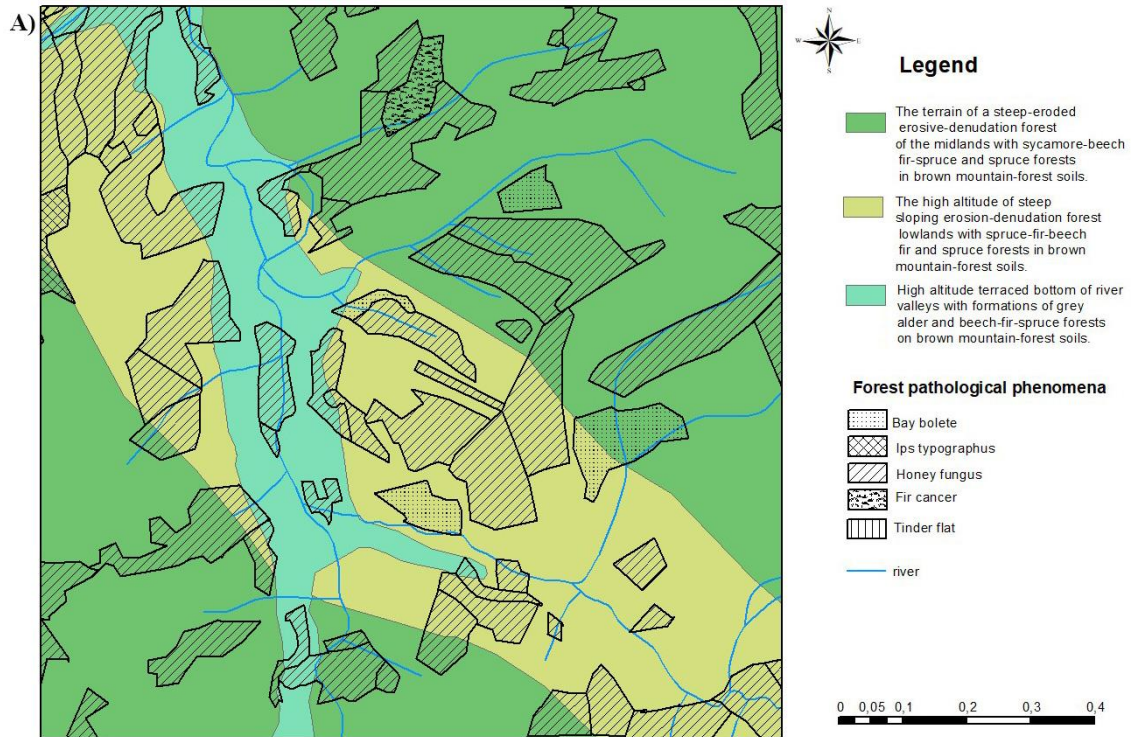


Figure 1 Examples of the analysis of the dependence of European spruce drying on the landscape structure of the territory in the Rybnyk Maidanskyi river basin

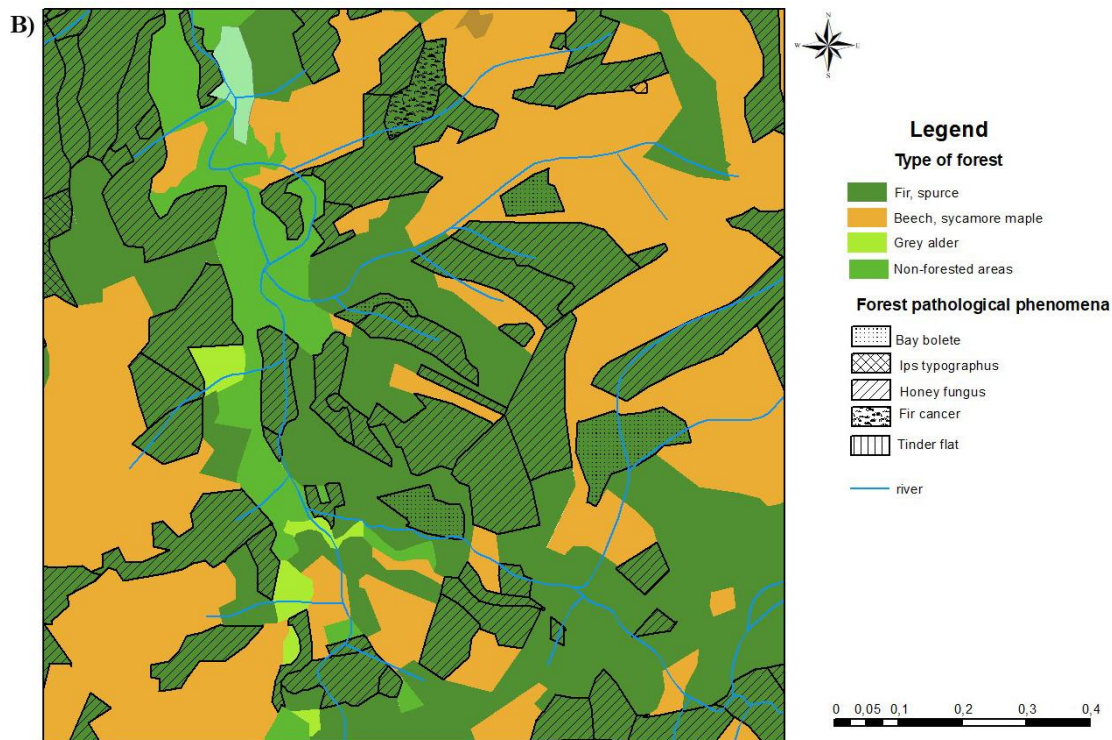
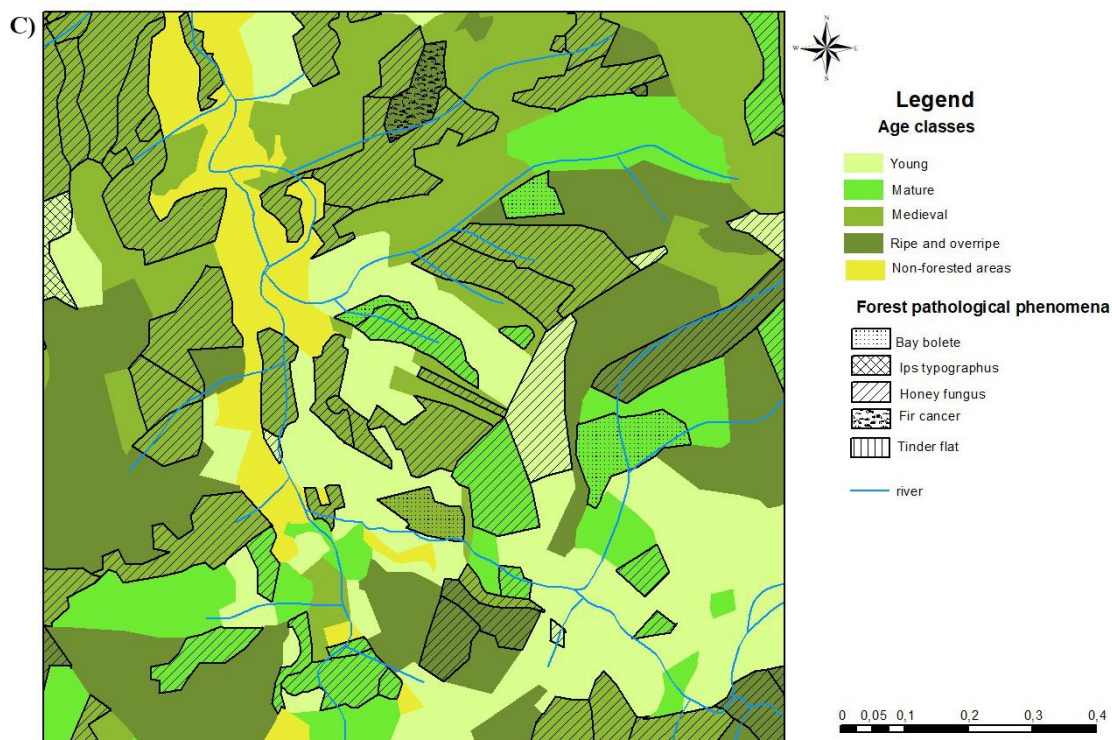


Figure 2 Examples of the analysis of the dependence of European spruce drying of the species composition of the plantation in the Rybnyk Maidanskyi river basin



**Figure 3** Examples of the analysis of the dependence of European spruce drying on the age of the plantations in the Rybnyk Maidanskyi river basin

### Recommendations and conclusions

Analysis of forest pathological survey data in the Rybnyk Maidanskyi river basin shows that spruce drying areas cover tracts of slopes of different exposures. The share of drying of spruce plantations in the tracts of the south-eastern and south-western exposures is slightly higher and is 27,5 % each, in the tracts of the north-western exposition – 20 % and in the north-eastern – 25 %. In the tracts of the slopes of the northern exposure, the nature of the distribution of damaged trees is mainly single and group. Drying here is not significant and mainly due to the defeat of honeysuckle autumn and root sponge. In the tracts of the slopes of the southern exposure, the nature of damage and drying of trees is curtain and continuous (Gerenchuk, 1972). Analysis of the dependence of drying of stands on the age of plantations shows that the largest share of affected stands falls on tracts occupied by mature species aged 81–100 years (47 %), and the least affected young animals under 40 years (3,1 %). Also, there is a direct dependence of the degree of damage to spruce plantations on the completeness of the plantation. The smaller the completeness of the planting in the tract, the higher the degree of drying. Tracts with less planting density receive more heat and moisture, which intensifies the development of pests and diseases. Most tracts, namely 74.6 % of the total area have a low degree of drying (percentage of the affected area of the tract up to 20 %), medium – 24.8% (percentage of the affected area of the tract up to 40 %) and only 0,6 % of tracts are strong degree of drying (the percentage of the affected area of the tract is more than 40 %). Based on the above data, we have created a map of the distribution of forest pathological processes in the basin of the Rybnyk Maidanskyi River in the scale of 1:25 000, which can be the basis for developing measures to reduce the intensity of drying of European spruce, both in only a fragment of the map is presented).

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