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THE TIEMS MISSION TO UKRAINE

THE SECOND ROUND TABLE:

"ECOLOGICAL IMPACT OF FIRE. DEFORESTATION AND FOREST DEGRADATION. RECLAMATION OF DEVASTATED LANDSCAPES"

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THE SECOND ROUND TABLE PROGRAM:

Kuzyk A.D. (Vice-rector for research and science, Lviv State University of Life Safety, Doctor of Agricultural Science, Professor) – Forest Fires Science Research;

Chalyy D.O. (Vice-rector of education, Lviv State University of Life Safety, PhD (in Engineering), docent), **Kobylkin D.S**. (Associate professor of the department of fire-fighting tactics and emergency and rescue operations, Lviv State University of Life Safety, PhD (in Engineering)) – Improvement the operational actions of fire and rescue departments during putting out wildfire;

Gulida E. M. (Head of Department of Fire-Fighting Tactics and Emergency and Rescue Operations, Lviv State University of Life Safety, Doctor Honoris Causa, Doctor of Sciences, professor) – Localization of forest fires;

Karabchuk D.Yu.(consultant on sustainable development, PhD (in Agriculture)) - The role of the public in development of the forestry policy of Ukraine. Experience of "Lisova Varta" during 2017-2018;

Lazarenko O.V. (Associate professor of the department of fire-fighting tactics and emergency and rescue operations, Lviv State University of Life Safety, PhD (in Engineering), Assistant Professor) – Logistical and technical aspects of ensuring the fires suppression in ecosystem;

Tovarianskyi V. I. (Lecturer of the department of operation of vehicles and fire and rescue equipment, Lviv State University of Life Safety, PhD (in Engineering)) – Modeling of pine stands fire at young ages;

Chernyavsky M.B. (Associate professor of the Department of ecology UNFU, PhD (in Agriculture), Assistant Professor) – Forest biodiversity and its conservation;

Shukel I. V. (Associate Professor of the Department of Landscape Architecture, Landscaping and Urban Ecology, UNFU, PhD (in Agriculture), Assistant Professor) – Reafforestation Processes After Fires;

Popovych V.V. (Chief of Environmental Safety Department, Lviv StateUniversity of Life Safety, Doctor of Technical Science, Assistant Professor) – Impact of landscapes fires on the physical and chemical characteristics of soil.

3. Statystychnyi shchorichnyk Ukrainy. Elektronnyi Resurs – Rezhym Dostupu Do Zhurn. [In Ukrainian].: www.bookstore.net.ua/searchdirect.php?ID=51023.

MODELING OF PINE STANDS FIRE AT YOUNG AGES

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The forest environment is a collection of plant origin materials, most of which are combustible depending on their physicochemical properties. Due to the scale of forest areas assessment, according to the degree of forest fires threat [1], coniferous stands, particularly, pine stands at a young age — up to 40 years old, are the most fire hazardous. In such plantations, brush fires almost always turn into crown fires, causing significant damage, and the elimination of such fires is difficult.

The fire hazard of forest stands depends on several indicators, one of which is the linear velocity of fire propagation [2]. Experimental studies on its determination with the use of annealing pose a risk of uncontrolled spread of fire; therefore, there is a need of bringing in firefighting equipment. In case of a real fire, first of all the main task is to eliminate it. It is not always possible to obtain sufficient information about the processes of fire spreading, but it is necessary to carry out a fire hazard assessment before it occurs. So that the computer simulation is an actual method for studying forest fires. Simulating the spread of a fire in the forest is complex, since many factors affect the combustion processes that must be considered in the model parameters. Currently, a significant number of forest fires diverse patterns are developed. Actual are the physical models, which are based on the equations of mathematical physics of heat and mass transfer processes in a fire. These models include the *Wildland-Urban Fire Dynamics Simulator(WFDS)* software [3], which is used in the research of forest fires.

The aim of the work is to assess the dependence of the fire danger of pine young stands from age according to the results of forest fire computer simulation. The fire was simulated for tree stands between 5 and 40 years old with a frequency of 5 years. In the process of growth, along with an increase in height, there is a decrease in the number of trees as a result of self-constriction, to simulate which was used a random number generator. Since the crowns between the rows are completed at the age of 10 years, causing almost complete disappearance of the grass cover, for sites at the age of 5 years, the ground combustible material was chosen for the grass cover, and starting from 10 years — a coniferous litter. The shape of the crowns of trees 5–15 years old was considered conical, and from the age of 20 a truncated cone. The trunk was considered a cone with a height equal to the height of the tree and a diameter at the ground level. Arson was carried out in three places. To determine the temperature of flame in simulating a fire in a *WFDS* environment, thermocouples were used, placing them in rows midway between the trees at a height of 0; 0.25; 0.5; 0.75 and 1 m from the soil surface. The maximum simulation time was set at 300 s. Other properties of combustible materials used for modeling were chosen in accordance with [3].

Wind speed is important for the spread of fire. In the process of modeling pine forest fires at wind speeds of up to 1 m/s, it was found out that the spread of

flame by litter is very slow, therefore, the main studies were carried out for wind speeds of 2 m/s. During the simulation of the young pine stands fire, the moment of transition and the propagation speed of the brush and crown fire were determined. The propagation velocity was determined from the temperature values of the corresponding thermocouples.

The simulation process was observed in the program *Smokeview*. For example, Figure 1 shows the occurrence and spread of fire for young pine stands at the age of 10 years.

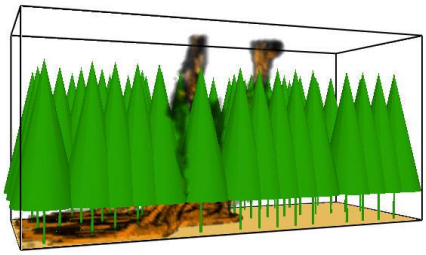

Figure 1 — Visualization of the process of modeling pine forest fires in age of 10 years on the experimental plot

According to the simulation results, obtained values of the average speed of fire propagation (Fig. 2).

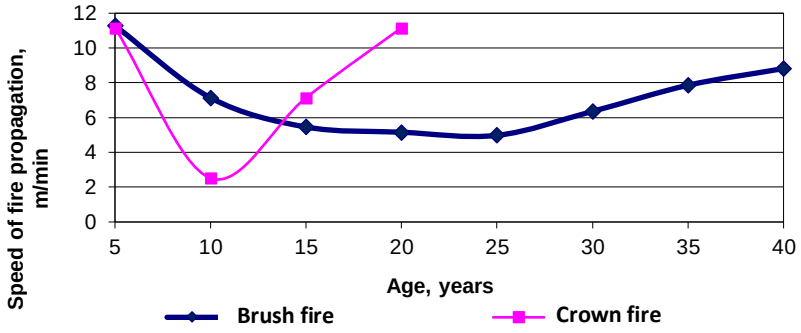

Figure 2 — The rate of spread of forest fire in the experimental plot

The general speed of fire propagation in pine young growths is shown in Fig. 2. In plantations at the age of 5 years, there was a continuous (brush and crown) fire. In particular, at the age of 10–15 years, a fire develops at a slower rate, which is explained by the absence of dry lower branches, which contribute to the spread of crown fire. For the presence of both forms of fire (total fire), the high rate of propagation of which is due to a significant stock of grass in a dry state and is more than 11 m/min. During the growing season, the moisture content of the grass was more than 100% and the spread of burning did not occur. At the age of 10–20 years, in the absence of grass, a brush fire and a crown fire occurred simultaneously, and the brush fire speed decreased with increasing age, and the overhead fire increased. At the age of 20-40 years, a crown-level fire does not occur, and the speed of

propagation of a brush-wood fire increases with the planting age, which is explained by an increase in the stock of litter.

Conclusion. The most fire-dangerous are young pine trees under the age of 20 years, especially at the age of 15 and 20 years, in which the brush fire passes into the crown. In plantations older than 20 years, the risk is less, because there is only a brush fire.

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