

THE ROLE OF FIRE-TECHNICAL EXPERTISE IN THE PREVENTION OF FOREST FIRES**Yuldashev Javlonbek Radjapovich**

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Abstract: This article presents substantiated information on forest structure regulations, the development of systems for preventing potential forest fires, the application of international experience in forest fire prevention, the impacts of forest fires on humans, wildlife, and the natural environment, as well as proposals and recommendations for improving forest fire prevention measures. In addition, the article outlines the capabilities of fire-technical and criminal examinations in forest fire cases, the rules for appointing fire-technical and criminal examinations, the timeframes for conducting examinations, and the procedures for collecting physical evidence. At the same time, the article identifies key aspects of fires caused by deliberate arson, emphasizes the urgent issues of environmental protection and ecosystem restoration in forest fire prevention, and describes modern approaches to examining forest fire scenes, including the scientific analysis of collected physical evidence based on technical and academic sources, as well as the use of new types of field-based laboratory equipment that differ from traditional fire scene inspection methods. Scientifically substantiated data are presented in this regard.

Keywords: forest, forest fires, forest structure, forest fire prevention, aspects of deliberate arson, fire-technical and criminal examination, expert, research, physical properties of trees

РОЛЬ ПОЖАРНО-ТЕХНИЧЕСКОЙ ЭКСПЕРТИЗЫ В ПРЕДОТВРАЩЕНИИ ЛЕСНЫХ ПОЖАРОВ

Аннотация. В данной статье представлена обоснованная информация о правилах лесоустройства, создании системы предотвращения возможных лесных пожаров, использовании мирового опыта в предотвращении лесных пожаров, влиянии лесных пожаров на человеческий, животный и природный мир, а также предложениях и рекомендациях по предотвращению лесных пожаров. Также приводятся возможности пожарно-технической и криминалистической экспертизы при лесных пожарах, правила назначения пожарно-технической и криминалистической экспертизы, сроки проведения экспертизы, порядок получения вещественных доказательств. При этом перечислены аспекты пожаров, вызванных умышленным поджогом, сохранение и восстановление экологии окружающей среды при предотвращении лесных пожаров, перечислены чрезвычайно актуальные проблемы, осмотр мест пожаров в лесах, исследование полученных вещественных доказательств на основе научной и технической литературы, в отличие от старых процессов осмотра мест пожаров, представлены процессы исследования с использованием нового типа лабораторного оборудования в полевых условиях. Приведены научно обоснованные данные по этому поводу.

Ключевые слова: Лес, лесные пожары, лесоустройство, предотвращение лесных пожаров, аспекты умышленного поджога, пожарно-техническая и криминалистическая экспертиза, экспертная, исследовательская, физические свойства деревьев.

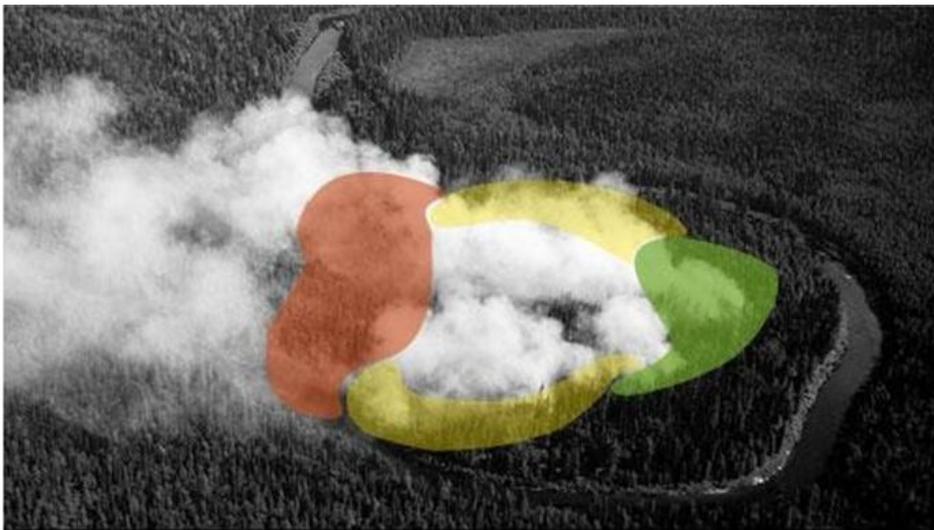
Introduction: The Development Strategy of the Republic of Uzbekistan until 2030 defines the strategic goals for the protection, conservation, and development of forest zones, as well as the priority directions of state policy in this field. [4]

Nevertheless, various emergency situations, including fires, continue to occur in forestry areas. Preventing such adverse incidents, ensuring their effective mitigation, and implementing

conceptual measures in this regard constitute not only the responsibility of relevant system sectors but also the duty of every citizen of the Republic.

At this point, briefly addressing the concept of forests, a forest is a complex of arboreal vegetation that interacts with one another depending on growth conditions and forms a geographical landscape element. In turn, forests have a significant influence on soil conditions, including the water regime, structure, accumulation of organic and mineral substances, and overall soil fertility. Due to the high moisture levels in forests, biogumus (humus) accumulates, the soil undergoes rapid dealkalization, acidity increases, and plant roots spread deeply. Forests influence the distribution and accumulation of summer and especially winter precipitation, thereby creating a microclimate for plants and animals. The forest cover of the Earth is one of the planetary accumulators of living matter, whereby forests retain a number of chemical elements and water within the biosphere, interact dynamically with the troposphere, and determine the balance of oxygen and carbon. Forests produce about 60% of the oxygen required for humanity. They also play an important role in recreation and public health improvement. [13]

The primary causes of forest fires include human factors, improper disposal of waste, smoking in undesignated areas, inappropriate use of agricultural land, lack of control in tourism activities, technical malfunctions, improper use of open flames, and deliberate arson. Figure 1 illustrates the negative consequences of forest fires. [7]



(Figure 1. A still image captured from a forest fire)

At this point, determining the cause of the fire, its point of origin, and the direction of its spread provides critical information that clearly plays an important role in preventing potential fires in the future. Of course, in this regard, the role of fire-technical and criminal examination is invaluable.

In forest fire cases, a qualified specialist possessing specialized knowledge in fire prevention and fire suppression disciplines may be involved as a fire-technical expert. [9]

In forested areas, the abundance of combustible materials, their dense arrangement, the absence of firebreaks, limited access roads for the free movement of fire engines, the lack of open water sources, and long, cone-shaped burning zones contribute to the rapid spread of fires over large areas. Forests protect soil from wind and water erosion and safeguard railways and highways, canals, agricultural croplands, and populated areas from various adverse natural phenomena. Forests prevent the formation of mudflows in mountainous areas and reduce the risks of avalanches and landslides. Afforestation primarily contributes to the creation of an ecologically active zone that exerts a positive impact on the local environment, including flora

and fauna, plant and animal life, trees, and insects. Forest fires, in turn, inevitably exert a negative impact on the ecological system of the area.

In the investigation of such forest fires, fire-technical and criminal experts, forestry specialists, impartial witnesses, and other relevant participants may be involved. [11]

Review of Relevant Literature: The study of forest fires, including the identification of their causes, points of origin, and patterns of spread, has become one of the most relevant topics in recent scientific research. This is primarily associated with the environmental, economic, and social consequences of forest fires and indicates the growing importance of fire-technical and criminal examination in this field. Studies conducted by Russian researchers have noted that, in determining the causes of fires occurring in forests and buildings, the accurate identification of the fire origin and the assessment of the development of thermal effects are of critical importance. In particular, V. N. Belyakov evaluates criminal examination as an effective means of applying specialized knowledge in criminal investigations and emphasizes the necessity of strict compliance with the rules for collecting and preserving physical evidence during the examination process. In the works conducted by A. P. Astapov, the role of criminalistic indicators, thermal damage to materials, residues of combustible substances, and signs of deliberate arson in identifying the fire origin is comprehensively addressed. Studies carried out by P. V. Korshunov and A. S. Plotnikov have scientifically substantiated that the causes of fires can be determined through the analysis of the fire origin and the directions of flame spread. These studies serve as an important source for understanding how the size of the affected area, the density of combustible materials, and natural factors influence the rate of forest fire spread. Considering international experience, J. J. Lentini and J. D. DeHaan, in their dissertation research, particularly emphasize the necessity of a scientifically grounded approach to fire investigation. The authors emphasize that fire-technical and criminal examinations should rely not on subjective conclusions, but on experimental data, laboratory analyses, and measurements obtained using specialized instruments and equipment. In particular, the use of instrumental methods in determining the fire origin has been adopted as an international standard. [10]

In addition, current GOST and O'zDSt standards define methods for assessing the combustibility of materials, thermal damage, and fire-hazardous conditions, serving as an important scientific and practical basis for fire-technical examination. These regulatory documents ensure the reliability of results when conducting laboratory studies. Overall, the analysis of existing scientific literature indicates that the integration of fire-technical and criminal examination provides high effectiveness in the investigation of forest fires. The analysis of physical evidence using modern laboratory equipment and the application of scientifically grounded methodologies play an important role in preventing future fires and reducing their negative consequences. [19]

Research Methodology: During the investigation of forest fires, the collection of physical evidence in the following manner plays an important role in determining the cause of fire occurrence. The collected physical evidence is also documented on the schematic plan of the fire scene. After the samples are selected, an inspection report of the fire scene is prepared, indicating the corresponding points on the schematic diagram. Each sample is placed in a securely sealed bag or container (such as a metal container or glass vessel), labeled with a sample identification number, and all containers are then collectively placed into a polyethylene package. Figure 2 illustrates the procedure for collecting physical evidence, while Figure 3 presents the specialized laboratory vehicle of a fire-technical expert.



Figure 2. Procedure for Collecting Physical Evidence



Figure 3. Specialized laboratory vehicle

A fire-technical and criminal expert, depending on the circumstances, may conduct the expert examination either at the fire scene or in a specialized laboratory facility. Below are the devices that fire-technical and criminal experts can use in forest fire investigations. [20]

The thermal imaging device is used to measure the heat zones at the fire scene, which plays an important role in identifying the fire origin. (Figure 4)



(Figure 4)

TOP 01 EP device is used to detect the overheating condition of electrical wires in forest areas, which enables rapid and effective identification of the fire origin at the incident site. (Figure 5)



(Figure 5)

Using the MVP-2M-EP device, the extent of damage to metal (sheet) fragments at the fire scene caused by the fire is determined. (Figure 6)



(Figure 6)

Using the AKO1-01-EP device, the extent of damage (maximum impact) to wooden ash residues in forest areas resulting from the fire is determined. (Figure 6)



(Figure 6)

Using the ANT-3M2 device, the concentration or odors of flammable substances in wood ash within forest areas are detected. (Figure 7)

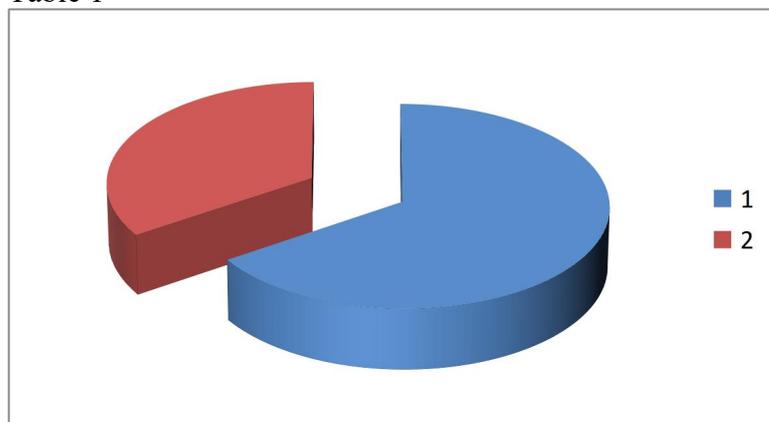


(Figure 7)

The devices listed above are used by a fire-technical and criminal expert during on-site fire investigations to determine the fire origin.

Analysis and Results: Using the example of forest fires, I would like to present an expert examination conducted by a fire-technical expert using the AKO1-01-EP device. In the course of the investigation, the physical evidence (ash) presented in packages 1 and 2 is separated and labeled with the letters A (1st package) and B (2nd package). Using this device, the thermally damaged areas or zones most affected by high temperatures within the ash are determined through laboratory testing of the ash samples collected as physical evidence. According to the research methodology, the higher the results obtained during the examination, the higher the temperature that was present at that location. The investigation was conducted in the direction of the area where characteristic traces corresponding to higher numerical values in the ash were identified. The results of the study are shown in the graph. The ash, presented as physical evidence, was initially crushed, and after crushing, various foreign materials (i.e., non-ash substances) were removed. The ash was then placed into the hole in the central part of the device and pressed. The highest indicator on the device's sensor corresponds to the area where the fire has burned the most. Below, I will present the schematic diagram of the combustion zone.

Table 1



A (1st package) – shown in red, the indicator of ash residues collected from the eastern side of the fire scene (laboratory device reading: 1.1).

B (2nd package) – indicated in blue, representing ash residues collected from the western side of the fire scene (laboratory device reading: 2.1).

From this table, it can be observed that the wood shavings presented in package 2 have a larger combustion zone compared to the ash residues presented in package 1. This plays a key role in cases of deliberate forest fires and helps determine the fire origin and its spread. [15]

As a proposal: The conducted studies have shown that the integrated application of fire-technical and criminal examination in the investigation of forest fires yields high effectiveness. Based on the conducted studies, it is considered appropriate to propose the following measures in order to prevent forest fires, effectively investigate occurred fires, and reduce their negative consequences: to organize fire-technical and criminal examination activities in forestry enterprises within a unified methodological system, to strengthen, through regulatory documents, the procedures for identifying fire origins, collecting, packaging, and submitting physical evidence to laboratories, to expand the provision of mobile forensic laboratory vehicles in areas with a high probability of large-scale forest fires and equip them with modern diagnostic instruments (thermal imagers, gas analyzers, and devices for detecting thermal damage), to give priority to instrumental and laboratory methods in forest fire investigations, to abandon conclusions based on subjective indicators and focus on scientifically grounded conclusions based on instrument readings and to integrate remote monitoring tools (drones, satellite surveillance) and geographic information systems into fire-technical analysis for the purpose of forecasting forest fire risks. [17]

Conclusion: In this article, the significance of fire-technical and criminal examination in the study of forest fires was scientifically analyzed. The research results showed that correctly selecting physical evidence and conducting laboratory analyses play a crucial role in identifying the causes, origin, and spread directions of forest fires, as well as signs of deliberate arson. The use of mobile forensic laboratories and modern instrumental tools enhances the reliability of expert conclusions. In addition, conducting activities in accordance with national regulatory documents and international standards contributes to the prevention of fires and the reduction of their negative consequences. According to the research results, the concepts presented in this article are recommended for application in practical activities and scientific research.

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