

# Assessment of the Condition of Forest Objects in the Territories of Armed Conflict

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**Abstract:** The article proposes approaches to assessing the condition of forests in the territories of armed conflict, which include both forests of territories where combat operations were directly conducted, and forests of territories that were under occupation, in terms of determining their position (status) in the system of forest division of Ukraine, the impact on the natural resource of the factors of an armed encounter, as well as possibilities and ways of restoring the natural resource. The assessment of the state of the forest in the territories of armed conflict from the position of its status in the system of dividing forests according to the main functions determined by their natural resource involves the formation of its profile according to criteria and indicators regarding the scope of application, the form of presentation, the process of its acquisition, type, importance, etc. Since individual forest areas (objects), which are integrated into the forest of the territories of armed conflict, have been affected in various ways, the assessment of the state of their natural potential involves the grouping of such objects by categories. We should refer to a set of objects with a certain nature of influence on their economic and socio-ecological potential to the category of objects of the forest of the territories of the armed conflict. The categories of objects are determined by the following signs of impact: engineering and fortification works, rocket fire and aerial bombardment, artillery fire, and mining. A detailed analysis of object categories based on signs of impact allows us to get closer to the solution to the problem of determining the level and type of hazard of the object and, most importantly, determine the possible mode of activity of business entities and methods of restoring the resource potential of a specific category of forest objects in the territories of armed confrontation, which determines the relevance of the chosen research direction. These are the approaches to assessing the state of the forest in the territories of armed conflict within the chain “position – influence – hazard – mode of activity” that allow us to consistently get a result regarding the loss of the natural potential of the forest (forest objects) in the territories of armed conflict and the possibilities of its restoration, which is important for the activation of state response to the problems of such a forest in the area of relevant legislative acts and special State programs.

**Keywords:** Forest, forest condition, forest status, forest objects, forest categories, areas of armed conflict, special management mode, forest reproduction.

## I. INTRODUCTION

According to the scale of human casualties, destruction, and negative impact on the state of natural ecosystems, armed conflicts, and wars are one of the most severe man-made disasters, primarily for the territories where combat operations are directly conducted. The forest of the territories of

hostilities occupied or those that were under occupation, lost a significant part of its economic and socio-ecological natural potential, which, negatively affected the overall potential of the entire ecosystem of Ukraine.

According to the State Forestry Agency, even by a preliminary estimate, more than 20% of Ukrainian forests and forest territories suffered damage and destruction of various natures and extent during the Russian-Ukrainian war. The situation is worsened by the fact that it is not possible to actively carry out forest reproduction measures due to the threat to human

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life and health caused by the consequences of mines and shelling of territories. Thus, currently, the issue of finding ways to reproduce the forest of armed conflict territories, both as an important component of the national and regional ecosystems and as a source of material resources, is relevant. The solution to such a problem requires an active response at the state level through the adoption of relevant legislative acts and state programs, which cannot be done without thorough research on the scale and nature of damage and destruction and the ways for their elimination – reproduction of the economic and social-ecological potential of the forest in the areas of armed conflict.

The position of an object in any system is determined by its status. If we take the existing system of dividing forests according to the main functions, which, in turn, are determined by the natural resource of these forests, then the status of such an object as a forest on the territory of armed conflict can be defined as “a forest with a deferred economic and socio-ecological resource”. If you determine the status of such a forest in the forest management system, it can be interpreted as a “forest with a special management mode”.

The types and scale of damage and destruction of individual areas (objects) of the forest in the territory of the armed confrontation, the level of potential threats, and, accordingly, the opportunities for the organization of the work of forestry entities on such objects are determined by the nature of the impact. There is a wide range of signs of the impact of hostilities on forest objects starting from the destruction of objects because of engineering and fortification works, ruptures of rackets, shells, and bombs of various calibers and types, and ending with the hazardous consequences of mining, toxic fumes, fires, etc. Purposeful work on the assessment of the state of forest objects in the territories of armed conflict is possible precisely when grouping such objects by certain common signs of influence into appropriate categories. This, in turn, makes it possible to plan works on the restoration of forest objects, starting with categories with signs of minimal potential hazard. That is, these are signs of influence that are accumulated in the concept of “category of the object” that allow us to thoroughly solve the problem of choosing the mode of activity of business entities regarding the restoration of the natural resource potential of forest objects in the territories of armed conflict.

## II. MATERIAL AND METHODS

In studies [1, 2], the term “status” is interpreted as the position, or rank of an object in any hierarchy, structure, system, time, etc.

It is most often used in legal, political, and social spheres. In the meta language of forestry theory, the term “status” is widely used when determining the significance of particularly valuable for conservation (PVC) forests, forest territories, tree species, etc. The compliance of forestry management in the company’s forests, in particular in forests (areas) with the status of particularly valuable for conservation, according to the criteria and principles of the Forest Stewardship Council (FSC) – an international organization of responsible forest management, is approved by a special certificate.

The term “category” is somewhat narrower in scope – it defines a group, genus, or order of homogeneous objects, persons, or phenomena, or their important common feature [3-4.] The existing division of forests of Ukraine by the main functions is based on the concept of category. The forests that grow on the same territory and meet the conditions and signs of being assigned to different categories must belong to the one for which a more limited forest use mode is established according to the law [5].

The forest’s ability to meet the needs of society is determined by its natural resource potential, which includes both tangible and intangible components. The tangible component adapts to the economy, while the intangible to the ecological and social aspects of human life [6]. The peculiarities of the resource potential of the forest area are that the tangible component of the resource is at the same time the carrier of the intangible, therefore the damage and destruction of trees, and the destruction and pollution of forest territories carry a whole range of economic and socio-ecological negatives.

Forest reproduction is carried out by forest owners or permanent forest users in forest areas by restoring forest areas that were covered with forest vegetation, and in lands that were not previously occupied by forests and are suitable for creating forest plantations, by afforestation, as well as by tenants and users of land plots on which there are field protection forest strips [7]. Regeneration of forests is carried out according to state programs and projects, which provide for the use of the most expedient methods of creating highly productive forests in the shortest possible time.

The problem of restoration of forest objects in the territories of armed conflict is worsened by the fact that, along with visible damage and destruction, there is a hidden potential hazard associated with mining, toxic fumes, sudden resumption of fires, landslides, falling trees, etc. Accordingly, a potentially hazardous object is considered an object of increased hazard of the corresponding class if the value of the total mass of hazardous or several hazardous substances that are used or manufactured, processed, stored, or transported at the object is equal to or exceeds the established threshold mass standard [8]. The situation of forest objects in the territories of armed conflict does not fully correspond to the above messages regarding objects of increased hazard, especially concerning the identification of such objects, as it is quite difficult to even collect the necessary information for such a procedure, but as certain guidelines for the organization of management on such objects, they make sense [9].

The analysis of scientific achievements known to the authors of the work regarding the determination of the state of objects and possible influences on its changes or adjustment indicates the need for their adaptation to the forest situation of the territories of armed conflict both in the characteristics (signs) of such a situation and in regulatory influence on the situation. Therefore, the purpose of the article is to determine and develop approaches to the assessment of the state of forest objects in the territories of armed conflict, which consider the special signs of the impact on the object and, accordingly, determine the possibilities and directions of response to the situation of forestry entities.

Criteria	Indicators	Content of indicators
Sphere of status implementation	Forestry	The forest of the territories of armed conflict is an integral part of the forest fund of Ukraine
Form of the status presentation	Non-formal	Not established by legislative acts, formed according to the definition of a forest specialist
Status type	Natural and economic	Loss of a significant part of a natural resource, a special mode of activity of a business entity regarding the restoration of a lost resource
Level of status acquisition	Achieved	All the consequences that led to the loss of resource potential are available, and the factors that determine the level of hazard and, accordingly, the management mode are identified
Status significance	Major	Related to the main activity of forestry enterprises

**Fig. (1).** Profile of the forest status of the territories of the armed conflict.

### III. RESULTS

In most cases, the concept of “status” is used to determine the importance, special or priority position of an object in any system. In the system of international relations, the position of a state with the status of a member of the UN Security Council is a priority, and the position of a state with the status of a neutral state is special, in the system of economic relations, the priority position of an enterprise is the status of a market leader, the position of an enterprise with the status of a public joint-stock company is special. In the social sphere status is defined as a set of rights and obligations of an individual or social group, associated with their performance of certain social roles and the most cultivated personal status, for example, the status of a political party leader or the status of a public activist.

In the theory of forestry, the concept of “the status of independent forests land” is quite widespread, incorporating into it the features of the natural formation of independent forests, their property of greater resistance to the actions of adverse factors, compared to artificial forests, and the classification of the territories of such forests as agricultural lands.

The activation of the program of certification of forestry enterprises according to international standards contributed to the emergence of the concept of “the status of particularly valuable for conservation”. This status positions the forest in the forestry system according to the following characteristics: it contains important biodiversity centers or unique forest landscapes at the global, national, or regional level; contains rare or hazarded ecosystems; provides basic natural protective functions; is decisive for meeting the basic needs of the traditional cultural identity of local communities.

The introduction of the term “forest status of the territories of armed conflict” into the conceptual apparatus does not pretend to define any high rank or significance of such a forest in the existing system of forest division, but, on the contrary, aims to bring society and the state back to face the deep problems of such forests. As a rule, a holistic understanding of the status of any object or subject when determining its profile according to the following criteria: scope of application of the status; the form of presenting the status – formal, defined by legislative acts or informal – developed based on the determination of experts in this field or the public; type – signs of the state that distinguishes the object of this status from the set of objects of the scope of application (system); degree of acquisition of status identification fea-

tures – achieved – declared features are present, not achieved – declared features in the process of acquiring defined characteristics; importance – the major one is related to the main activity, the marginal one is related to the minor activity.

Under such approaches, the forest status of the territories of armed conflict will have the following profile: Fig. (1).

Formation of the forest status profile of the territories of the armed conflict was carried out using the following scientific methods: the method of system analysis – when determining the position of the research object in the existing forest management system; expert survey – when collecting information about the state of the forest in the territories of hostilities and those that were under occupation; grouping – when aggregating a large amount of information about the consequences of hostilities into separate groups according to the nature of the impact and the level of hazard of the consequences.

Forest objects should be understood as separate areas or sections of territories with certain properties, signs, or the state of their natural resources. In most cases, when classifying forest objects or forests, researchers focused on the functional orientation – the satisfaction of certain needs or the genesis of forest territories – restoration or age-related changes. The United Nations Environment Program, or UNEP (United Nations Environment Program), created within the framework of the UN, to coordinate, first of all, ecologically justified the use of forest land and its protection, has developed a generalized and simplified classification of the world’s forests. In this version of the classification, all forest ecosystems are combined into two large groups, in which 26 large forest types are defined. The first group includes forests of regions with a temperate climate and northern forests, and the second group includes tropical and subtropical forests.

According to the Forest Code of Ukraine (2017), the forests of Ukraine are divided into categories according to their ecological and socio-economic values and depending on the main functions they perform. They are protective forests (mainly perform water protection, soil protection, and other protective functions); recreational and health forests (mainly perform recreational, sanitary, hygienic, and health protection functions); forests of nature protection, scientific, historical, and cultural purpose (perform special nature protection, aesthetic, scientific functions, etc.); exploitation forests.

The special status of the forest of the territories of the armed conflict, which positions the forest in the system of forest

The number of categories	Category criterion	Category indicator
Category one	The impact of engineering fortification and logistical measures	Destruction of the soil, destruction of vegetation, damage to the root systems of trees, mass felling of trees to strengthen engineering structures, destruction of traditional forest roads, disruption of natural watercourses, and air pollution of forests with harmful emissions
Category two	Rocket and bomb raids	Destruction and damage to trees, changes in terrain, negative impact on fauna, numerous forest fires, and centers of poisonous vapors of explosive substances
Category three	Artillery shelling	Tree damage, soil destruction, fires, hidden hazards of unexploded ordnance
Category four	Mining	Significant areas of damage, hidden hazard, difficulty in eliminating the consequences

**Fig. (2).** Categories of objects according to the characteristics of the influence of situations and factors of armed conflict.

division according to the lost or overdue resource and opportunities for its restoration, determines the need to find new approaches to the classification of its objects. The main reasons for the loss of the natural potential of such a forest are the situations and factors of armed struggle – engineering and fortification structures, logistics networks, rocket-bombing and artillery raids, mining, etc. Each of the above situations and factors has its character of impact on the natural potential of the object it affected, namely: engineering works destroy soils, destroy vegetation, damage the root systems of trees, and are accompanied by massive felling of trees to strengthen engineering structures; logistics networks break up traditional forest roads, disrupt natural drainage channels, and pollute the air of forests with harmful emissions; rocket-bombing and artillery raids destroy and damage trees, change the topography of the area, have a catastrophic effect on forest fauna, cause numerous forest fires, and carry foci of poisonous vapors of explosive substances; demining carries a potential threat and practically makes it impossible to work on such objects before carrying out a demining operation, which is especially difficult to carry out in forested areas. Under such conditions, it is possible and justified, in terms of expediency, to determine the management mode – the classification of forest objects by the signs of the influence of situations and factors of armed conflict. According to the nature of the influence of the situations and factors of the armed confrontation, the forest objects of the territory of the armed conflict are divided into four categories:

- category one – objects whose natural potential was destroyed under the influence of engineering fortification and logistical measures during the preparation and conduct of hostilities;
- category two – objects that were under the influence of rocket-bomb raids;
- category three – objects with the consequences of artillery raids;
- category four – objects whose territory has been mined.

The problem with such an approach to classification is that in many cases, objects are subject to complex effects of situations and factors of hostilities, and it is necessary to decide to which category such an object should be assigned, as this is decisive for adopting a management mode concerning the restoration of the natural potential of the object, the solution to this problem will be proposed below.

The categories of objects based on the characteristics of the influence of situations and factors of armed conflict are shown in Fig. (2).

The above approach to the classification of forest objects in the territories of armed conflict allows identifying the objects by the signs of the influence on their natural potential of situations and combat factors.

Regardless of the horrors that the war brought to the forests of Ukraine, nature is alive and needs help. The scale of such assistance only in terms of areas in the zone of hostilities and occupation amounts to about 1,849 thousand hectares of forests. Destruction, damage, fires, and pollution of forests of the territories of the armed conflict led to great losses of the natural potential of such forests. Their restoration requires significant financial and material costs, as well as organizational efforts. The war does not consider the nature protection status of forests and forest territories, on the contrary, in most cases, the places of concentration of troops and equipment were determined precisely in forests, to conform their camouflage properties. This led to violations of the main functions of 812 nature protection zones with an area of about one million hectares, which is 20% of the area of all protected areas of Ukraine. Almost 170,000 square meters of forest territories where hostilities took place or were under occupation were “contaminated” by explosive objects and mines.

Demining units primarily cover populated areas, so forest demining is slowing down. All this is, requires, on the one hand, the active actions of forestry entities and the entire society to restore the natural potential of the forest in the territories of armed conflict, at least to the pre-war level, and on the other hand, the organization of such activity considering the threats that are possible due to the different nature of the impact on objects of economic activity. With a sufficient argumentation of the nature of the impact on the forest objects of the territories of the armed conflict and the grouping of the objects according to the signs of influence, we can eliminate the problem of choosing the management mode (organization of work) on the objects that have undergone a certain type of impact, as well as on the objects of the compass influence of war situations and factors.

The problem of choosing a management mode on a certain object of the forest of armed conflict is, to a large extent, solved by giving situations and factors of influence, and,

Hazard rank (category) of objects	Management mode at the objects	The content of the management mode at the objects
Hazard rank one (objects of category four)	The mode of “conserved (expired) resource”	A complete ban on work and, even, presence directly on the objects, observation of the self-renewal of the forest from the air, seeding of the areas of burned objects from the air
Hazard rank two (objects of category three)	“Partial impact” mode	It is allowed to carry out restoration measures on the territories of objects with a hard surface, where the probability of non-explosion and concealment of such projectiles is small, after the inspection of the objects by relevant specialists
Hazard rank three (objects of category two)	“Information security” mode	Work on objects is allowed after analyzing their condition based on images of the territories by space vehicles and updating space intelligence data with the intelligence data of unmanned aerial vehicles.
Hazard rank four (objects of category one)	“Advisory and informational security” mode	Work on objects is allowed after consultation with military specialists.

**Fig. (3).** Possible management modes depending on the level of hazard.

accordingly, the object that has undergone such an influence, the so-called rank of hazard, which determines the level of threats of the situation or factor for the business entity’s activity at this facility.

Based on experience and consultations with specialists of the department for emergencies, the following ranks of hazard have been determined for categories of objects by the nature or signs of impact:

- hazard rank one (objects of category four) – mined territories. The consequences are hidden, their elimination requires a long time and executors with special training. Work and even presence in the territories of such objects is strictly prohibited before demining;

- hazard rank two (objects of category three) – territories of artillery shelling, the threat can be carried by shells that have exploded, in most cases, in territories with soft soil, as a rule, they are in the ground at a depth of up to two meters, are allowed partial works on the territories with a hard surface after the survey of the territories by relevant specialists;

- hazard rank three (objects of category two) – areas of missile fire and aerial bombardment. Large eruptions from ruptures and the significant size of such means of destruction make it possible to assess the state of hazard of the object according to the data of space reconnaissance and aerial reconnaissance of unmanned aerial vehicles, after assessment, it is allowed to organize works to restore the natural potential of the object;

- hazard rank four (objects of category one) – areas affected by engineering and logistical measures. The work is allowed only after consultation with military specialists outside the boundaries of fortifications and routes of the logistical transport network.

In case of a complex impact on the object of situations and factors of hostilities, the category of the object is determined by the rank of the most hazardous impact.

According to the degree of hazard, the management mode is determined as follows:

- hazard rank one – the mode of “conserved (expired) resource” – a complete ban on work and, even, presence directly on the objects, observation of the self-renewal of the

forest from the air, seeding of the areas of burned objects from the air.

- hazard rank two – “partial impact” mode – it is allowed to carry out restoration measures on the territories of objects with a hard surface, where the probability of non-explosion and concealment of such projectiles is small, after the inspection of the objects by relevant specialists.

- hazard rank three – “information security” mode – work on objects is allowed after analyzing their condition based on images of the territories by space vehicles and updating space intelligence data with the intelligence data of unmanned aerial vehicles.

- hazard rank four – “advisory and informational security” mode – work at objects is allowed after consultation with military specialists.

Possible management modes depending on the level of hazard are listed in Fig. (3).

Determining the management mode is a mandatory condition for the restoration of forest objects that are threatened by war situations and factors. The initial step to the assessment of the management mode is the assessment of the state of the forest in the territories of the armed conflict in terms of its status and categories of objects by the nature or signs of the impact.

#### IV. DISCUSSION

The authors of the work consider promising the research on the application of the above approaches to determine the impact of situations and factors of war on forest objects of the territories of armed conflict of different structures in terms of tree species and the level of forest cover, forests of different natural territories, and different functional orientations.

It is interesting to determine the boundaries of the territories of forest objects, according to the situations and factors of the war, objects where combat operations were directly conducted, or those that were under occupation.

Research on the development of a legal framework for the reforestation of the territories of armed conflict may be relevant.

The contribution of the authors is theoretical research on approaches to the assessment of the state of the forest in the territories of armed conflict and the formulation of the final ones.

## V. CONCLUSIONS

Approaches have been developed to assess the state of the forest in the territories of armed conflict as a necessary condition for choosing a management mode and territories that were under the influence of war situations and factors of various nature and levels of hazard. Stages of the forest condition assessment process have been proposed and substantiated. They include the determination of the status of such a forest in the forest division system; grouping of forest objects into categories according to the nature or signs of impact; the determination of the rank of categories of objects according to the level of hazard.

The status of the forest in the territories of the armed conflict was presented from the standpoint of the state of its natural potential and possible impacts on its restoration.

The object categories included objects with certain signs of the influence of war situations and factors.

The hazard rank of the category of objects determined the level and nature of threats regarding the implementation of measures to restore the natural potential of objects.

Such a sequence of the research process made it possible to consistently reach an important result – the management mode at the objects of various degrees of hazard as an im-

pediment to intensify restoration work on forest objects of the territories of armed conflict.

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