FORESTRY

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Platonova M.A.[1], Platonov A.A.[2] *, Shcheblykin P.N.[3]

[1] Voronezh Institute of High Technologies, Voronezh, Russia;
[2, 3] Voronezh State University of Forestry and Technologies named after G.F. Morozov, Voronezh, Russia

* Correspodning author (paa7[at]rambler.ru)

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PRACTICAL IMPLEMENTATION OF THE METHODOLOGY FOR ASSESSING THE DENSITY OF UNWANTED GROWTH IN THE OVERGROWING OF INFRASTRUCTURE FACILITIES

Research article

Abstract

Before performing work on the removal of unwanted tree and shrub vegetation from the territories of linear infrastructure facilities, the degree of overgrowth of these territories is often identified. The article presents the results of a practical test of the methodology developed by the authors for determining the density of growing undesirable vegetation, which provides for the identification of the occurrence of its species. The operability and suitability for the production application of the specified technique are shown. It has been established that in the surveyed territories of infrastructure facilities in Central Russia, to a greater extent, we should expect the growth of such types of unwanted vegetation, such as, for example, Mapple ash-leaved (occurrence 25...33%), Elm smooth (5...19%) and Elm squat (1...15%), Ash common (5...6%) and others prone to reproduction by stump growth or root offspring. It was found that 82.1% of the surveyed plots have a dense and medium degree of overgrowth, which necessitates the organization of priority work on the removal of vegetation in these areas.

Keywords: infrastructure facilities, unwanted vegetation, occurrence, degree of overgrowth, definition.

Платонова М.А.[1], Платонов А.А.[2] *, Щеблыкин П.Н.[3]

[1] Воронежский институт высоких технологий, Воронеж, Россия;
[2, 3] Воронежский государственный лесотехнический университет имени Г.Ф. Морозова, Воронеж, Россия

* Корреспондирующий автор (paa7[at]rambler.ru)

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ПРАКТИЧЕСКАЯ РЕАЛИЗАЦИЯ МЕТОДИКИ ОЦЕНКИ ГУСТОТЫ НЕЖЕЛАТЕЛЬНОЙ ПОРОСЛИ ПРИ ЗАРАСТАНИИ ОБЪЕКТОВ ИНФРАСТРУКТУРЫ

Научная статья

Аннотация

Перед выполнением работ по удалению нежелательной древесно-кустарниковой растительности с территорий линейных инфраструктурных объектов нередко осуществляют выявление степени зарастания указанных территорий. В статье представлены результаты практической проверки, разработанной авторами методики определения густоты произрастающей нежелательной растительности, предусматривающей выявление встречаемости её видов. Показана работоспособность и пригодность к производственному применению указанной методики. Установлено, что на обследованных территориях объектов инфраструктуры Центральной России в большей степени следует ожидать произрастания таких видов нежелательной растительности, как, например, Клён ясенелистный (встречаемость 25…33%), Вяз гладкий (5…19%) и приземистый (1…15%), Ясень обыкновенный (5…6%) и иных, склонных к размножению пневой порослью или корневыми отпрысками. Выявлено, что 82,1% обследованных участков обладают густой и средней степенью зарастания, что обуславливает необходимость организации на данных территориях первоочередных работ по удалению растительности.

Ключевые слова: инфраструктурный объект, нежелательная растительность, встречаемость, степень зарастания, определение.

1. Introduction

Currently, as part of the proper maintenance of a number of such infrastructure facilities as the right of way of roads and railways, the linear parts of gas and oil pipelines, as well as product pipelines and routes of overhead power lines, work is often organized to clean up the territories of the above objects from growing unwanted vegetation (which we in this study understood as trees and / or shrubs up to 4 meters high). It should be noted that before deciding whether it is necessary to perform the specified works on a particular section of the infrastructure facility the problem of assessing the dominance of the most common types of unwanted vegetation in the cleared area with the identification of the degree of its overgrowth continues to be quite relevant. At the same time, the qualitative determination of these indicators contributes to the reasonable appointment of the most optimal technological scheme for the removal of vegetation, as well as the corresponding machines and equipment [1].

Our analysis of domestic and foreign studies devoted to this problem revealed the absence of uniform approaches to assessing the degree of overgrowing with unwanted tree and shrub vegetation (UTSV) of the surveyed areas. In the works of F.K. Abdrazakov [2] and V.V. Fomin [3], the authors note the expediency of dividing the territories cleared from UTSV into several groups, taking into account the laboriousness of the work performed, and in the study by Merzlova O.A., it is proposed to take into account the degree of coverage of the total area of the cleared area with crowns of trees and shrubs (rare – 5... 30%, medium – 31... 60% and dense – 61... 100%). A number of foreign studies (for example, [4], [5]) were devoted to the issue of increasing the efficiency of remote (using unmanned aerial vehicles) monitoring of the quantitative assessment of the density of woody vegetation. Aspects of the floristic and structural characteristics of woody vegetation (including its species richness, diversity, and density) were considered in [6]. A team of Chinese authors [7] was engaged in monitoring the activity of unwanted vegetation using indicators of its condition, the effect of vegetation cover density and composition on soil characteristics was studied by [8], and [9] indicated the possibility of assessing the composition of vegetation around water sources in pine forest plantations using identified indicator species.

Taking into account the above diversified focus of research on assessing the degree of overgrowing of a number of territories with unwanted vegetation, we have developed a Method for assessing the quality and efficiency of work to remove unwanted tree and shrub vegetation from the territories of linear infrastructure facilities (LIF), an integral part of which is a method for determining the degree of overgrowing of these territories.

The purpose of the research was the practical testing of the methodology for determining the degree of overgrowth of undesirable vegetation on the territories of linear infrastructure facilities.

2. Methods

As objects of study, we took specimens of undesirable tree and shrub vegetation growing in the territories of linear infrastructure facilities. The research of a number of sections of these objects was carried out in 2018-2021 by the route method in accordance with a number of generally accepted provisions, considered for example in [10], at the same time, before conducting a study of UTSV types, we selected such areas of the LIF that met the criteria we developed to the maximum extent (Figure 1), a detailed presentation of which is not included in the goals and objectives of this article:

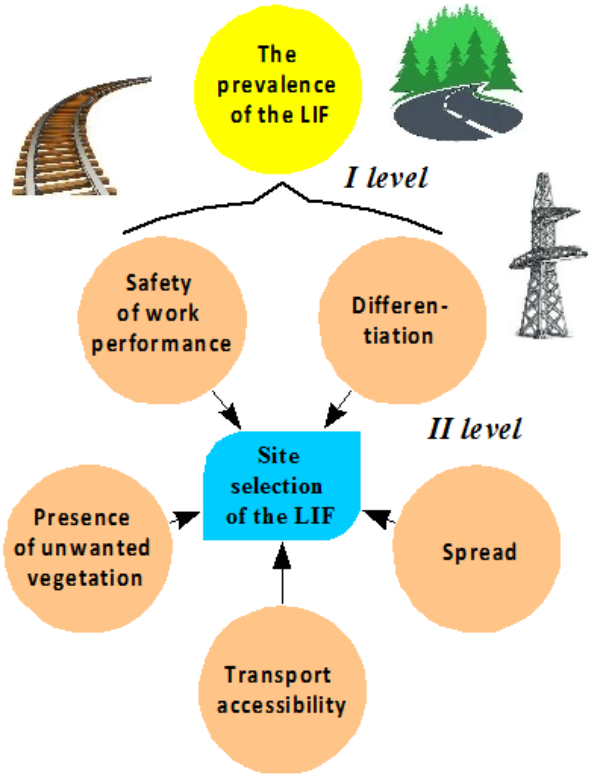

Fig. 1 – Criteria for selecting a section of an infrastructure facility

After taxation surveys (with the identification and registration of the type and number of UTSV by the method of registration sites) of the respective territories, the number of specimens of the identified undesirable tree and shrub vegetation K_{UTSV} in terms of 1 hectare was determined::

$$K_{UTSV} = \sum_{i=1}^{N_{ra}} N_i^{utsv} \cdot 10000 \Big/ \sum_{i=1}^{N_{ra}} S_{ra\,i} \quad (1)$$

where N_i^{utsv} is the number of instances of undesirable vegetation on the *i*-th registration area, pieces; $S_{ra\,i}$ – square of the *i*-th registration area, m^2; N_{ra} is the total number of registration areas.

After that, depending on the size of the UTSV (namely, the average trunk diameter and average height) and the obtained value K_{UTSV}, the degree of overgrowing of the surveyed area of the LIF territory with unwanted vegetation was determined.

When assessing the dominance of one or another type of unwanted vegetation, one of the determining indicators was the occurrence of the species $p_i = m_{ra\,i} / N_{ra}$, where $m_{ra\,i}$ is the number of registration areas on the territory of which the *i*-th species was found.

3. Results

During the route survey, we identified 36 species of UTSV, which in the overwhelming majority of cases belong to flowering plants (Magnoliophyta, 35 species, 97.2% of the total number). Only one species identified by us belonged to gymnosperms (Pinophyta, 2.8%). The total number of instances of shrubs, small forests, undergrowth and overgrowth identified in the LIF territories (railway right of way, security zones of power lines and right of way of roads located in the Central part of Russia) amounted to more than 13750 pieces.

An analysis of the distribution of the occurrence of species of undesirable tree and shrub vegetation growing in the indicated territories LIF, obtained by us, taking into account the actual presence of at least one UTSV species in one or another registration area, made it possible to establish the following (Figures 2, 3).

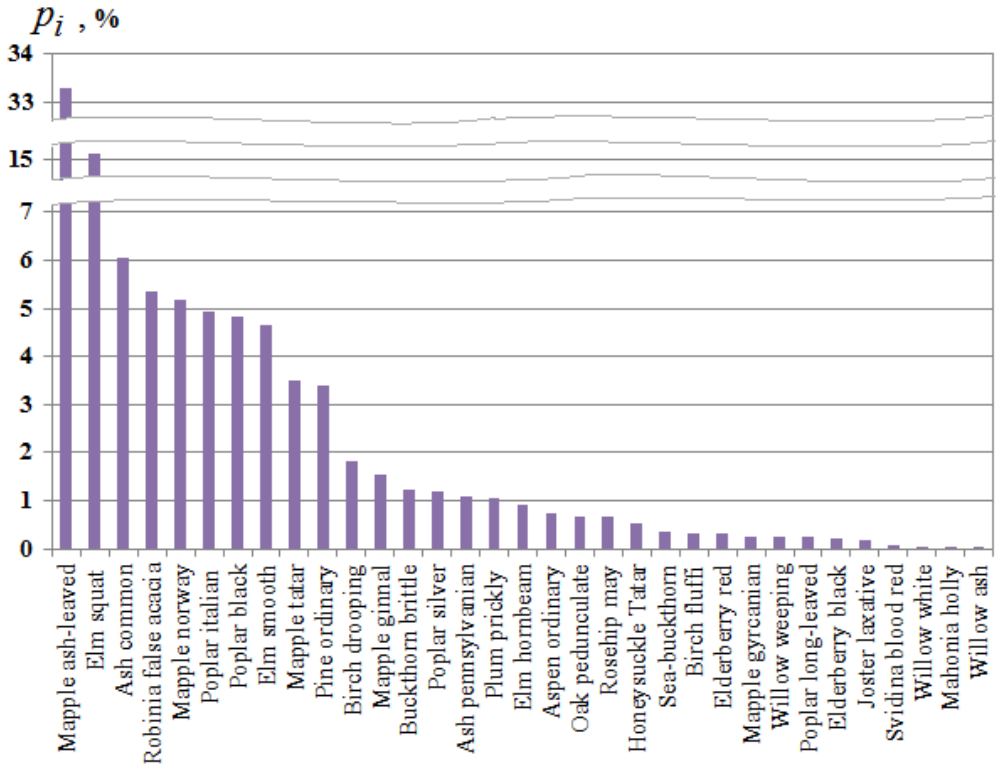

Fig. 2 – Distribution of occurrence of species of UTSV growing in the right of way of railways

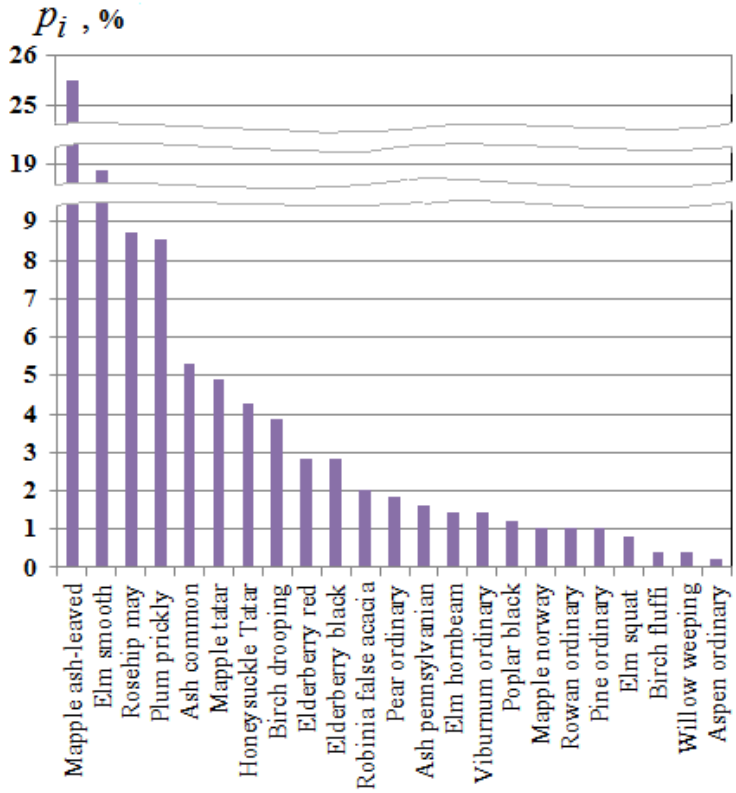

Fig. 3 – Distribution of occurrence of species of UTSV growing in security zones of power lines and right of way of highway

Most often, on sections of the right of way of railways, Mapple ash-leaved (occurrence of the species $p_i \approx 33\%$ in all areas occupied by vegetation) and Elm squat ($p_i \approx 15\%$) can be detected. In addition, in the right of way of railways, the following types of unwanted tree and shrub vegetation should be expected to a greater extent (in descending order of their occurrence and dominance): Ash common, Mapple norway, Poplar italian, Poplar black, Elm smooth, Mapple tatar and Pine ordinary.

In areas of security zones of power lines and right of way of highway, most often can be found Mapple ash-leaved (occurrence of the species $p_i \approx 25\%$ in all areas occupied by vegetation) and Elm smooth ($p_i \approx 19\%$). In addition, in the security zones of power lines and right of way of highway, the following types of UTSV should be expected to a greater extent: Rosehip may, Plum prickly, Ash common, Mapple tatar, Honeysuckle tatar, while all of them are prone to renewal by stump growth and root offspring.

An analysis of the results of determining the density of UTSV growing in the indicated territories LIF revealed the following (Figure 4).

The highest density of growing UTSV was found in the right of way of the Otrozhka-Usman railway (OtU, Figure 5a; K_{UTSV} = 23403 pcs./1 ha, Figure 4) with predominant (in fact, the only one: share 98.07%) growth of Mapple ash-leaved and with single inclusions of Willow weeping, Mapple norway and Ash common, the proportion of which in the surveyed area was 0.59%, 0.89%, and 0.45%, respectively. In accordance with the indicators of the degree of UTSV overgrowth of LIF territories considered in the above Methodology, with an average trunk diameter of 1...3 cm and an average height of 1...4 m, this vegetation in the surveyed area «provided» a dense degree of overgrowth.

Slightly inferior to the previous one in terms of overgrowth was the section of the right of way of the Gotnya – Belgorod2 railway (GoB2, K_{UTSV} = 22512 pcs./1 ha; Figure 4) with the predominant growth of Mapple ash-leaved (share 46.98%).

In the whole group of studied sections of right of way of railways with an average number of UTSV instances (K_{UTSV} = 9378...15272 pcs./1 ha; Figure 4), we have identified both dense and medium degree of their overgrowth with a very high correlation (correlation coefficient R = 0.93) between the UTSV dimensions (namely, the average trunk diameter and average height) and the degree of overgrowth of these areas.

Among all the surveyed areas of power line security zones, the largest number of UTSV instances was found in the substations Vostochnaya – Zemsnaryad (VtZ, K_{UTSV} = 14737 pcs./1 ha; Figure 4) with the predominant growth of Mapple ash-leaved (share 25%) and with rather large shares of Plum prickly (12.5%) and Elm smooth (12.5%). Taking into account the UTSV parameters identified by us in this area, the indicated vegetation «provided» a dense degree of overgrowth in this area.

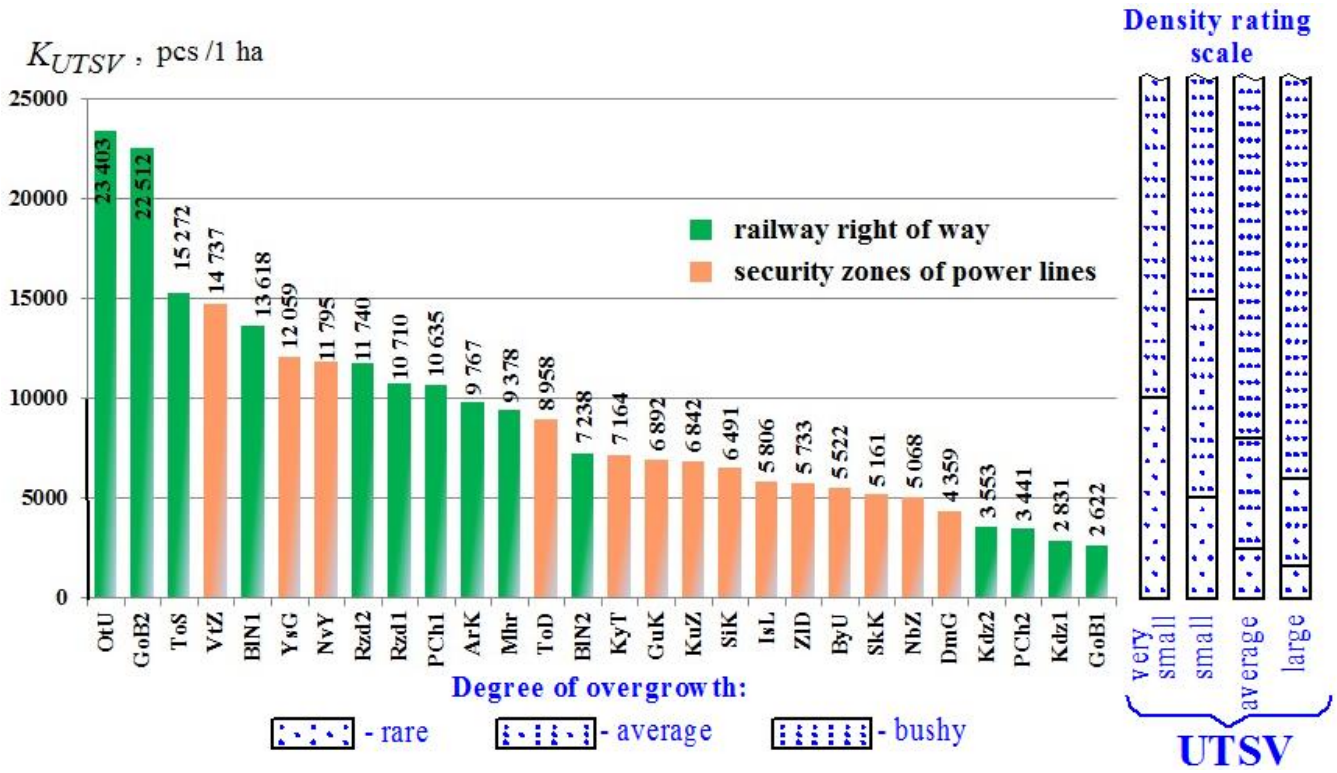

Fig. 4 – Number of UTSV instances growing in LIF territories

a *b*

Fig. 5 – Visualization of overgrowth of LIF plots

The average number of UTSV instances was noted by us at the substations Yasenki – Gorshechnoye (YsG) and Novaya – Yuzhnaya (NvY), characterized by a dense degree of overgrowth. However, we note the high share of distribution in the indicated areas of the Rowan ordinary (plot YsG; share 13.89%), Poplar black (plot NvY; 16.22%) and Pine ordinary (plot NvY; 13.51%). At the same time, in view of the fact that the presence of these UTSV species was revealed by us only in the indicated areas, their growth cannot be recognized as characteristic of the studied LIF types in the Central part of Russia, and therefore the density of UTSV in the above areas was largely formed by uncharacteristic species.

It should also be noted that during the research, we identified individual UTSV instances whose height exceeded 4 m (for example, Elderberry red, plot of the substations Novobryanskaya – Zheleznogorskaya (NbZ), support № 542; Figure 5b), however, the number of such "tall" undesirable vegetation instances was low, which determined the average UTSV size across the surveyed areas.

In general, the conducted studies found that a number of plots of the right of way of highway and railways and security zones of power lines (23 plots; 82.1%) have a dense and medium degree of overgrowth, which necessitates the organization of priority work in these areas to remove UTSV. Taking into account the occurrence of such types of undesirable vegetation that we have identified, such as Mapple ash-leaved, Elm smooth and squat, Ash common and others (having a tendency to reproduce by stump growths or root offspring), to clean the surveyed areas, it is advisable to apply techniques and methods that provide for the mechanical removal of the above undesirable vegetation along with the roots.

4. Conclusion

1. The practical determination of the qualitative (types) and quantitative (occurrence and density) characteristics of UTSV confirmed the operability and suitability for industrial use of the methodology for identifying the degree of overgrowth of undesirable vegetation in the areas of linear infrastructure facilities.

2. It was found that 82.1% of the surveyed LIF plots have a dense and medium degree of overgrowth, which necessitates the organization of priority work on the removal of UTSV in these areas.

3. It has been shown that in the LIF plots of the Central part of Russia, to a greater extent, the growth of a number of UTSV species prone to reproduction by stump growths or root offspring should be expected.

Conflict of Interest **Конфликт интересов**

None declared. Не указан.

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