

**FORMATION OF FOREST EDGE IN THE RECREATIONAL LOADING  
CONDITIONS OF THE STATE ENTERPRISE "BILA TSERKVA  
FORESTRY"**

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*The characteristics of the forest edges and the peculiarities of their formation in the conditions of recreational loading at the State Enterprise "Bila Tserkva Forestry" were presented. Features biometric indicators of forest stands that affect their aesthetic properties were analyzed. Recreational indicators of forest enterprise tree stands on the edges in recreational forests were established. The study was carried out at edges with different stages of recreational digression.*

*The species composition of the tree, shrub and herbaceous storeys were established. The dominant species for each storeys were determined. A significant reduction in the score of aesthetic assessment is due to the predominance of typical species for this area, and the practical absence of rare and exotic species. A list of tree and shrub species which would be enriching the species composition of forest edge is proposed. It includes *Mahonia aquifolium* (PURSH) NUTT., *Chaenomeles japonica* (THUNB.) LINDL. EX SPACH, *Juniperus Sabina* L.*

*The defined depth is about 76-75 m. The dependence of the richness of the species composition on the different stage of recreational digression was shown. It was established that the number of herbaceous species decreases with the increase of the stage of recreational digression. The direction of improvement of the decorative and aesthetic properties of the forest edge was proposed through the implementation of landscape cutting, as well as landings of rare, not typical species for this area.*

**Key words:** *forest edge, recreational indicators, recreational forest, aesthetic evaluation, species composition of tree stand, shrubs and herbal plants.*

A **forest edge** is the transition zone from an area of woodland or forest to fields or other open spaces. The depth of the forest edge can be up to 100 m. As a component of the ecosystem, the forest edge is formed predominantly by natural way and functions specifically [5]. The forest edge is the territory between two ecosystems, in which most of the components are combined (for example, species

composition of plants, animals) due to changes in environmental factors in the transition from a closed forest group to open areas. There is an increase of species diversity, the growth of the density of the population of individual species, their biomass on the forest edges in comparison with the forest and open space [6, 10].

The forest edge, as a natural biological and mechanical barrier, creates a favorable forest environment (microclimate), reduces the strength of air masses (wind) and cleanses them from dust, protects trees from direct sunlight, prevents drying and soil erosion, restrains the negative effects of flooding, prevents the penetration of weeds, pests, diseases and pets. The forest edge isolates the forest from the transport noise, redistributes surface runoff in the forest and reduces the rate of moisture evaporation [4, 10].

The forest edge creates a microclimate not only in the forest, but also in the open space around it.

The forest edge is an attractive place for living many species of animals, birds and insects. The forest edge creates a protective area for them.

It often concentrates significant reserves of valuable species for human of wild plants – medicinal, honey, ethereal, fodder, ornamental forests on the forest edge [5, 6].

**Analysis of research and publications.** Scientific works devoted to studying the ecological situation in suburban forests of Ukraine are concentrated mainly on studying of changes occurring as a result of anthropogenic factors [2, 6, 8].

The study, the systematization and classification of the forest edges was conducted in 1993 by Ukrainian scientists V. Bondarenko, O. Furdichko. The authors have compared the forest with the forest edges. The influence of woodland on the environment has been determined, the species composition and characteristic shrubs of the forest edges was investigated. The classification of the forest edges, which depends on their width and riches of the species composition, was proposed [1].

It should be noted that forest edges in recreational forest of Ukraine were not performed.

**The aim of research** was to provide a general description of the typical forests edge of the State Enterprise "Bila Tserkva forestry" according to biometric and recreational indicators and offer directions for improving their recreational suitability.

**Research Methodology.** The research was carried out in places of mass and intensive recreation of the State Enterprise "Bila Tserkva Forestry". In the course of the study, 6 experimental areas were laid out from the biometric and recreational indicators established on them, the depths and curvature of the forest edges. For establishment of the species composition of herbaceous vegetation, there were laid 10 botanical squares (1m x 1m) with different stages of the recreational digression at each experimental area. Installed recreational potential were based on analysis of recreational indicators [2].

**Results of research.** Placed on the border of the forest and the open space, the forest edges have a significant decorative value [8]. In the recreational forests, the forest edges of the enterprise are a favorite place for recreation of the urban population. For comfortable rest of the population, forests should be equipped appropriately [7, 9], but now there is no improvement on the forest edges of the enterprise.

Species composition of forest plants is represented mainly by *Pinus sylvestris* L., *Quercus robur* L. (Table 1). The basal area of the investigated forest edges were 0.7-0.8. The age structure of these forests varies from 61 to 120 years.

The research was conducted on the forest edges, which in the past 20 years have undergone a significant recreational load. During this period, the recreational digression stage have reached a critical point in most experimental areas. On two experimental areas, forest stands have undergone significant changes and self-healing is not possible in them.

The depth of the forest edge in the study region varies within 56-75 m (Table 2). According to the well-known classification, all investigated edges are multicomponent, that is, complex.

The curvature of the edge does not depend on any of the established indicators and is one of the indicators of the decorative and aesthetic properties of the edge.

## 1. The average biometric indicators and stage of recreational digression

| Test area number | Composition of tree stand  | Age, years | Average   |              | Index productivity, by M. Orlov | Basal area | stage of recreational digression |
|------------------|--|------------|-----------|--------------|---------------------------------|------------|----------------------------------|
|                  |  |            | Height, m | Diameter, sm |                                 |            |                                  |
| 1                | 100% <i>Pinus sylvestris</i> L., singly <i>Quercus robur</i> L.  | 61         | 23        | 28           | I <sup>a</sup>                  | 0.8        | 3                                |
| 2                | 100% <i>Quercus robur</i> L.   | 120        | 24        | 36           | III                             | 0.7        | 4                                |
| 3                | 100% <i>Pinus sylvestris</i> L., singly <i>Betula pendula</i> Roth., <i>Quercus robur</i> L.                                   | 69         | 26        | 32           | I <sup>a</sup>                  | 0.7        | 3                                |
| 4                | 90% <i>Pinus sylvestris</i> L., 10% <i>Quercus robur</i> L.  | 69         | 23        | 28           | I                               | 0.8        | 3                                |
| 5                | 90% <i>Quercus robur</i> L., 10% <i>Pinus sylvestris</i> L.  | 81         | 29        | 32           | II                              | 0.7        | 2                                |
| 6                | 90% <i>Quercus robur</i> L., 10% <i>Carpinus betulus</i> L., singly <i>Robinia pseudoacacia</i> L., <i>Tilia cordata</i> Mill. | 105        | 27        | 36           | II                              | 0.7        | 4                                |

The most common forest edge shrubs that grow in relatively rich soil conditions are *Euonymus europaeus* L., *Sambucus nigra* L., *Frangula alnus* L., *Sorbus aucuparia* L., *Corylus avellana* L., *Euonymus verrucosus* Scop., *Rosa canina* L. The mentioned shrubs have the ability to intensive vegetative recovery, which positively affects the stability of the forest edges in places of mass recreation.

In general, the species composition of herbaceous plants at the forest edges is from 15 to 34 pieces.

The wealth of species of herbaceous plants (primarily forest) depends on the stage of recreational digression (Figure 1). This dependence is expressed by the equation  $y = -5,4602x + 32,858$  with value  $R^2 = 0,8257$ .

The herbaceous storey of the woodland consists of plants that form different proportions of steppe, meadow and, more rarely, forest species. At the research sites, the most resistant to recreational loads among forest species of herbaceous plants were: *Convallaria majali* L., *Pulmonaria obscura* Dumort., *Rubus fruticosus* L., *Asarum europaeum* L., *Stellaria holostea* L.

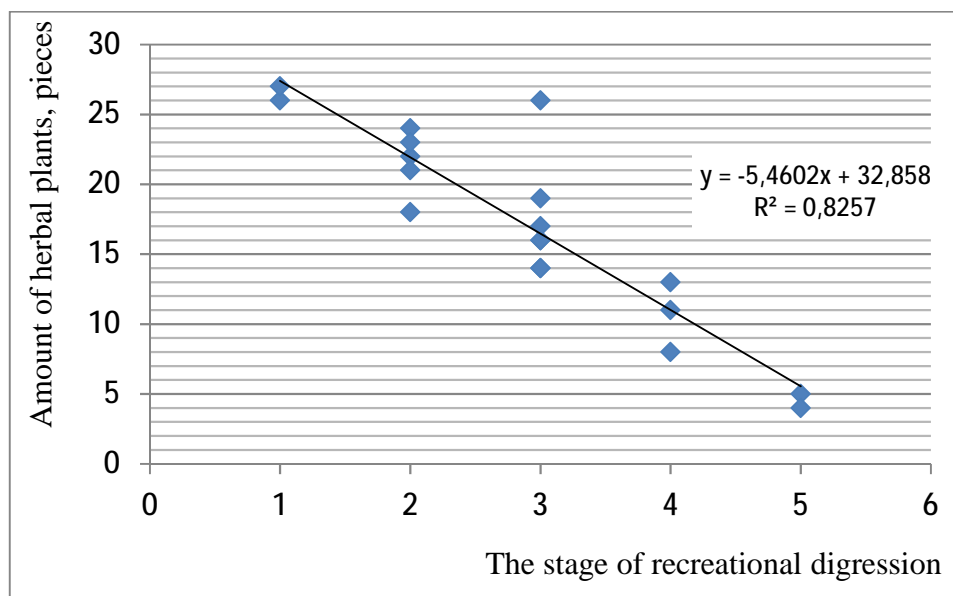
The implementation of appropriate forest management measures is essential for maintaining the functioning of the forest edges in conditions of recreational loading, their ecological and recreational functions.

## 2. The general characteristics of the forest edge

| Test area | Wood species   | Herbal plants  |   | Depth, m | Curvi-linear |
|-----------|--|----------------|---|----------|--------------|
|           |  | Amount, pieces | Prevailing species  |          |              |
| 1         | <i>Pinus sylvestris</i> L.,<br><i>Quercus robur</i> L.,<br><i>Sambucus nigra</i> L.,<br><i>Crataegus monogyna</i> Jacq.,<br><i>Euonymus europaeus</i> L.,<br><i>Sorbus aucuparia</i> L.,<br><i>Pyrus communis</i> subsp. <i>pyraster</i> (L.) EHRH.                      | 16             | <i>Chelidonium majus</i> L.,<br><i>Asarum europaeum</i> L.,<br><i>Urtica dioica</i> L.,<br><i>Pteridium aquilinum</i> (L.) Kuhn,<br><i>Ficaria verna</i> L.,<br><i>Pulmonaria obscura</i> Dumort.   | 63       | +            |
| 2         | <i>Quercus robur</i> L.,<br><i>Sambucus nigra</i> L.,<br><i>Corylus avellana</i> L.,<br><i>Euonymus verrucosus</i> Scop.   | 11             | <i>Urtica dioica</i> L.,<br><i>Fragaria vesca</i> L.,<br><i>Poa trivialis</i> L.,<br><i>Lamium album</i> L.   | 75       | +            |
| 3         | <i>Pinus sylvestris</i> L.,<br><i>Betula pendula</i> Roth.,<br><i>Quercus robur</i> L.,<br><i>Corylus avellana</i> L.,<br><i>Pyrus communis</i> subsp. <i>pyraster</i> (L.) EHRH.,<br><i>Sorbus aucuparia</i> L.,<br><i>Sambucus nigra</i> L.,<br><i>Acer negundo</i> L. | 26             | <i>Agrimonia eupatoria</i> L.,<br><i>Artemisia absinthium</i> L.,<br><i>Carex pilosa</i> Scop.,<br><i>Urtica dioica</i> L.,<br><i>Lamium album</i> L.,<br><i>Trifolium alpestre</i> L.,<br><i>Poa trivialis</i> L.,<br><i>Festuca ovina</i> L.<br><i>Chelidonium majus</i> L.,<br><i>Agrimonia eupatoria</i> L.,<br><i>Taraxacum officinale</i> Wigg. | 71       | -            |
| 4         | <i>Pinus sylvestris</i> L.,<br><i>Quercus robur</i> L.,<br><i>Sambucus nigra</i> L.,<br><i>Crataegus monogyna</i> Jacq.,<br><i>Rosa canina</i> L.,   | 14             | <i>Asarum europaeum</i> L.,<br><i>Chelidonium majus</i> L.,<br><i>Plantago media</i> L.,<br><i>Urtica dioica</i> L.,<br><i>Trifolium alpestre</i> L.,<br><i>Rubus fruticosus</i> L.,<br><i>Artemisia vulgaris</i> L.  | 56       | -            |
| 5         | <i>Quercus robur</i> L.,<br><i>Pinus sylvestris</i> L.,<br><i>Crataegus monogyna</i> Jacq.,<br><i>Rosa canina</i> L.,<br><i>Sambucus nigra</i> L.,<br><i>Philadelphus coronarius</i> L.  | 22             | <i>Asarum europaeum</i> L.,<br><i>Rubus fruticosus</i> L.,<br><i>Artemisia vulgaris</i> L.,<br><i>Galium odoratum</i> (L.) Scop.,<br><i>Poa angustifolia</i> L.,<br><i>Stellaria holostea</i> L.,<br><i>Achillea millefolium</i> L.   | 59       | -            |
| 6         | <i>Quercus robur</i> L.,<br><i>Carpinus betulus</i> L.,<br><i>Robinia pseudoacacia</i> L.,<br><i>Tilia cordata</i> Mill.,<br><i>Frangula alnus</i> L.,<br><i>Euonymus europaeus</i> L.,<br><i>Sambucus nigra</i> L.  | 13             | <i>Stachys sylvatica</i> L.,<br><i>Athyrium filix-femina</i> L.,<br><i>Oxalis acetosella</i> L.,<br><i>Convallaria majali</i> L.,<br><i>Carex pilosa</i> L.,<br><i>Asarum europaeum</i> L.  | 71       | +            |

Improvement of the architectural and artistic appearance of the forest is achieved through regular landscaping and the selection of forest species for landscaping. The main purpose of improving the aesthetic properties of the forest edge is to increase the contrast between individual plots, to create a stepposter tree

canopy and curvature of its edges. Landscaping is carried out by removing background and extra trees and shrubs. The intensity of felling can vary from 20 to 60 %, depending on the existing completeness of the forests, and provided that it maintains its multicomponent structure and the richness of the groups in it.



**Figure 1. Dependence of the herbaceous species number of the recreational digression stage**

Reconstruction of the forest edges are carried out on a selective basis, that is, not completely, but only on those areas requiring reconstruction. The desirable type of forests of the recreational forest is multicomponent with more than 20 species of woody and shrub species. It is advisable not only to use indigenous tree species, but also to decorative species that are not widely used in forestry (*Mahonia aquifolium* (PURSH) NUTT., *Chaenomeles japonica* (THUNB.) LINDL. L.). Formation of the forest edges and care for them requires a creative approach taking into account the individual characteristics of individual types of forest park landscapes.

### **Conclusions and Prospects**

In general, the forest edges play an important role in ensuring the sustainability of forests to adverse factors of anthropogenic and natural origin. Recreational activity of the person primarily affects the grass cover, reducing the number of species. The decorative and aesthetic properties of the forest edges are influenced by biometric

and recreational indicators, the richness of the species composition, the depth and curvature of the forest edges.

In order to improve the decorative and aesthetic properties of the forest edge and increase their resistance to environmental factors in the conditions of recreational load it is necessary: regularly form the forest edge by holding landscape thinning of the ratio of landscapes types; reduce the recreational load by arranging places for rest on the forest edges; perform landscaping in degraded locations by gradually replacing existing trees and shrubs with more aesthetically attractive, rare and more resistant to recreational loads. To perform landscaping in degraded forest stands by gradually replacing existing trees and shrubs with more aesthetically attractive, rare introduced tree species that are more resistant to recreational loads.

Such measures will allow creating the forest edge with high aesthetic properties, resistant to recreational loads.

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## **ФОРМУВАННЯ УЗЛІСЬ В УМОВАХ РЕКРЕАЦІЙНОГО НАВАНТАЖЕННЯ У ДП «БІЛОЦЕРКІВСЬКЕ ЛІСОВЕ ГОСПОДАРСТВО»**

**О. В. Токарева, К. І. Романовська**

*Проведено дослідження з формування узлісь у насадженнях ДП «Білоцерківське лісове господарство» в умовах рекреаційного навантаження. Дослідження проведені у відносно багатих ґрунтових умовах зростання (свіжі та вологі складні суборі). До об'єктів дослідження належать лісові ділянки з різними стадіями рекреаційної дигресії. Деревостани, що вивчалися мають пристигаючий та стиглий вік. Проаналізовано лісівничо-таксаційні особливості лісостанів, які впливають на їхні естетичні властивості. Встановлено рекреаційні показники лісостанів підприємства на узліссях рекреаційно-оздоровчих лісів.*

*Встановлено склад деревного, чагарникового та трав'яного ярусів. Визначені переважачі види для кожного ярусу. Суттєве зниження балу естетичної оцінки відбувається у зв'язку з переважанням у складі деревостану типових для даної місцевості деревних видів та практичною відсутністю інтродуцентів та малопоширених деревних видів. Запропоновано перелік деревних видів для збагачення чагарникового ярусу узлісся. До них належать *Mahonia aquifolium* (PURSH) NUTT., *Chaenomeles japonica* (THUNB.) LINDL. EX SPACH, *Juniperus sabina* L.*

*Виміряна глибина узлісної частини. Вона становить близько 56-75 м. Встановлена залежність багатства видового складу від стадії рекреаційної дигресії лісової ділянки. Кількість рослинних видів зменшується зі збільшенням стадії рекреаційної дегресії.*

*Запропоновані напрями покращення архітектурно-художніх якостей і естетичних властивостей узлісь шляхом проведення ландшафтних рубок, а також висадки рідкісних, не типових для даної місцевості видів.*

**Ключові слова:** *узлісся лісу, рекреаційні показники, рекреаційний ліс, естетична оцінка, видовий склад деревостану, чагарників та трав'яних рослин.*

## **ФОРМИРОВАНИЕ ОПУШЕК В УСЛОВИЯХ РЕКРЕАЦИОННОЙ НАГРУЗКИ В ГП «БЕЛОЦЕРКОВСКОЕ ЛЕСНОЕ ХОЗЯЙСТВО»**

**О. В. Токарева, К. И. Романовская**

*Проведено исследование по формированию опушек ГП «Белоцерковское лесное хозяйство», которые растут в условиях рекреационной нагрузки. Исследования проведены в относительно богатых почвенных условиях роста (свежие и влажные сложные суборы). К объектам исследования относятся*



лесные участки с различными стадиями рекреационной дигрессии. Изучаемые древостои имеют дозревающих и спелый возраст. Проанализированы лесоводственно-таксационные особенности древостоев, которые влияют на их эстетические свойства. Установлены рекреационные показатели древостоев предприятия на опушках рекреационно-оздоровительных лесов.

Установлен состав древесного, кустарникового и травяного ярусов. Определены преобладающие виды для каждого яруса. Существенное снижение балла эстетической оценки происходит в связи с преобладанием в составе древостоя типичных для данной местности древесных видов и практическим отсутствием интродуцентов и редких древесных видов. Предложен перечень древесных видов для обогащения кустарникового яруса опушки. К ним относятся *Mañonia aquifolium* (PURSH) NUTT., *Chaenomeles japonica* (THUNB.) LINDL. EX SPACH, *Juniperus sabina* L.

Измеренная глубина опушечной части. Она составляет около 56-75 м. Установленная зависимость богатства видового состава от стадии рекреационной дигрессии лесного участка. Количество растительных видов уменьшается с увеличением стадии рекреационной дегрессии.

Предложенные направления улучшения архитектурно-художественных качеств и эстетических свойств опушек путем проведения ландшафтных рубок, а также высадки редких, не типичных для данной местности видов.

**Ключевые слова:** лесная опушка, рекреационные показатели, рекреационный лес, эстетическая оценка, видовой состав древостоя, кустарников и травяных растений.