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# ASSESSMENT OF THE CONDITION OF NATURAL VALUES OF THE FOREST MANAGEMENT UNIT "JASENOVO-BOŽETIĆI" IN THE AREA OF SOUTHWEST SERBIA

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**Abstract:** *This paper presents the assessment of the condition of natural values of forest stands in relation to the origin, structural form, mixedness as well as in relation to affiliation of the forest stand to forest management type. The object of the research is the Forest management unit "Jasenovo-Božetići" which belongs to the Western forest region in Serbia. Assessment of the condition has been performed in accordance with the method developed on the project entitled Contribution of Sustainable Forest Management to Low Emission and Resilient Development (GCP/SRB/002/GEF). The total area on which the assessment of natural values was carried out amounts to 1684.7 ha. Based on the final assessment of biodiversity, the stands of low natural value cover the area of 1205.6 ha (71.5%), the stands of lower medium natural value cover 300.9 ha (17.9%), the stands of higher medium natural value 178.2 ha (10.9%), while stands of high natural value are not registered.*

**Keywords:** natural values, forest stand, forest management type, Southwest Serbia.

# OCENA STANJA PRIRODNIH VREDNOSTI GAZDINSKE JEDINICE „JASENOVO-BOŽETIĆI" NA PODRUČJU JUGOZAPADNE SRBIJE

**Sažetak:** *U ovom radu prikazana je ocena stanja prirodnih vrednosti sastojina u odnosu na poreklo, strukturni oblik, mešovitost kao i u odnosu na pripadnost sastojine gazdinskom tipu. Objekat istraživanja je gazdinska jedinica „Jasenovo-Božetići" koja pripada Zapadnoj šumskoj oblasti u Srbiji. Ocena stanja je vršena u skladu sa metodom koji je razvijen na projektu pod nazivom Doprinos održivog gazdovanja šumama niskim emisijama i prilagodljivom razvoju (GCP/SRB/002/GEF). Ukupna površina na kojoj je vršena ocena prirodnih vrednosti iznosi 1684,7 ha. Na osnovu konačne ocene biodiverziteta, sastojine niske prirodne vrednosti pokrivaju površinu od 1205,6 ha (71,5%), sastojine srednje niže prirodne vrednosti 300,9 ha (17,9%), sastojine srednje više prirodne vrednosti 178,2 ha (10,9%), dok sastojine visoke prirodne vrednosti nisu registrovane.*

**Ključne reči:** prirodne vrednosti, sastojina, gazdinski tip, jugozapadna Srbija

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## 1. INTRODUCTION

In many countries, safeguarding biodiversity has been set as one of the leading principles and goals in forest policy (Kuuluvainen, 2009). Managed forests are a key component of strategies aimed at tackling the climate and biodiversity crises (Asbeck *et al.* 2021).

Forest ecosystems are a critical component of the world's biodiversity as many forests are more biodiverse than other ecosystems. Forest loss is primarily caused by agricultural expansion, while an increase in forest area may occur through natural expansion of forests, e.g. on abandoned agricultural land, or through reforestation (including through assisted natural regeneration) or afforestation. These natural and human-induced changes have different impacts on forest biodiversity (FAO and UNEP, 2020). Under the European Green Deal, the EU's Biodiversity Strategy for 2030 tackles the protection and restoration of nature by making a number of specific commitments and setting several targets. Biodiversity-friendly practices for enhancing the quantity and quality of EU forests are also being promoted. The Biodiversity Strategy announced, among other objectives, guidelines on biodiversity-friendly afforestation, reforestation and tree planting (European commission, 2023).

This paper presents the assessment of the condition of natural values of forest stands in relation to the origin, structural form, mixedness as well as in relation to affiliation of the forest stand to forest management type in the area of the Forest management unit (FMU) "Jasenovo-Božetići" in accordance with the method developed on the project entitled Contribution of Sustainable Forest Management to Low Emission and Resilient Development (GCP/SRB/002/GEF). The assessment of the natural values of forest stands has not been an integral part of forest management planning in Serbia until present. Considering the actual importance of the biodiversity topic, the development of this method and its implementation into a modern forest management planning system contributes not only to the assessment of the current condition, but also the possibility of further monitoring of the changes of condition of natural values.

## 2. MATERIAL AND METHODS

The object of the research is the Forest management unit (FMU) "Jasenovo-Božetići", which belongs to Western forest region. Forest Enterprise „Prijepolje", i.e. Forestry Administation „Nova Varoš" manages the above FMU. Total stocking area of the FMU is 2077.84 ha, which is 55.1% of the total area. High forests occupy 28.6%, coppice forest 13.1%, cultivated forest stands 3.0%, and brushwood 10.4% of the total area of the forest management unit. Unstocked land occupies 1689.88 ha, which equals to 44.9% of the total area of the forest management unit.[4]

The method of assessment of natural values was developed on the project entitled Contribution of Sustainable Forest Management to Low Emission and Resilient Development (GCP/SRB/002/GEF). It should be noted that the mentioned methodology can potentially be upgraded depending on the outputs that will arise as

[4] https://upravazasume.gov.rs/ogs-za-gj-jasenovo-bozetici/

a result of its application. According to the method itself, forest stands are classified into four categories based on the final assessment of natural values, namely:

- Forest stands of high natural value (≥7);
- Forest stands of higher medium natural value (3-6);
- Forest stands of lower medium natural value (1-2);
- Forest stands of low natural value (≤0)

The final marks are obtained by adding up positive and negative marks of attributes (ANNEX 1) which are grouped into five categories, namely:

1) Structure and composition,
2) Valuable biodiversity trees/ Habitat trees,
3) Key and valuable biotopes,
4) Key species,
5) Impacts and threats.

Data processing was carried out using program *OsnovaIN* within software package *Osnova2020* in order to obtain a representation of the assessment of natural values of forest stands in relation to the origin, structural form, mixedness, and affiliation of the stand to management type.

## 3. RESULTS AND DISCUSSION

The assessment of the natural values of FMU "Jasenovo-Božetići" was carried out in 197 sections on the total area of 1684.7 *ha*. Areas registered as brushwood on the total of 393.1 *ha* are excluded from the procedure of assessment of natural values.

**Table 1.** *Assessment of natural values at the level of section*

| Final biodiversity assessment | P (ha) | P (%) |
|---|---|---|
| Low natural value | 1205.6 | 71.5 |
| Lower medium natural value | 300.9 | 17.9 |
| Higher medium natural value | 178.2 | 10.6 |
| High natural value | 0.0 | 0.0 |
| Total | 1684.7 | 100.0 |

From the presented Table 1 it can be seen that in the area of the FMU in question stands with low natural value are the most represented, on the area of 1205.6 *ha* which is 71.5% of the analysed sections. Forest stands assessed as stands with lower medium natural value cover an area of 300.9 *ha* i.e. 17.9%, while stands assessed as stands with higher medium natural value cover 178.2 *ha*, i.e. 10.6 %. Forest stands of high natural value are not registered in the territory of this FMU.

**Table 2.** *Assessment of natural values in relation to the origin of forest stands*

| Origin of the forest stand | Final biodiversity assessment | P (ha) | P (%) |
|---|---|---|---|
| High natural forest stands | Low natural value | 602.7 | 56.0 |
| | Lower medium natural value | 295.4 | 27.4 |
| | Higher medium natural value | 178.2 | 16.6 |
| Total high natural forest stands | | 1076.3 | 100.0 |

| Origin of the forest stand | Final biodiversity assessment | P (ha) | P (%) |
|---|---|---|---|
| Coppice forest stands | Low natural value | 492.7 | 100.0 |
| Total coppice forest stands | | 492.7 | 100.0 |
| Cultivated forest stands | Low natural value | 110.2 | 95.2 |
| | Lower medium natural value | 5.5 | 4.8 |
| Total cultivated forest stands | | 115.7 | 100.0 |
| Total | | 1684.7 | 100.0 |

Table 2 shows the assessment of the natural value of stands based on origin. High natural stands cover an area of 1076.3 ha, of which stands with a low natural value are represented on 56%, i.e. 602.7 ha, stands of lower medium natural value on 27.4%, i.e. 295.4 ha, while stands of higher medium natural value are represented on 16.6%, i.e. 178.2 ha. Coppice forest stands are present on 492.7 ha, where all stands are assessed as low natural value. Cultivated forest stands are represented on 115.7 ha, of which 95.2%, i.e. 110.2 ha, fall into the category of stands of low natural value, while 4.8%, i.e. 5.5 ha, fall into the category of lower medium natural value. The establishment of artificial spruce stands in this area affected the floristic composition of the forest, as the number of vascular flora species decreased compared to natural beech forests (Stajić, S. et al., 2022).

**Table 3.** *Assessment of natural values in relation to the structural form of forest stands*

| Structural form | Final biodiversity assessment | P (ha) | P (%) |
|---|---|---|---|
| Even-aged | Low natural value | 1091.5 | 92.1 |
| | Lower medium natural value | 93.4 | 7.9 |
| Total even-aged forest stands | | 1184.9 | 100.0 |
| Uneven-aged | Low natural value | 114.1 | 22.8 |
| | Lower medium natural value | 207.5 | 41.5 |
| | Higher medium natural value | 178.2 | 35.7 |
| Total uneven-aged forest stands | | 499.8 | 100.0 |
| Total | | 1684.7 | 100.0 |

Table 3 shows the assessment of natural values based on the structural form of the forest stand. Even-aged stands are represented on the area of 1184. 9 ha, 92.1% of which, i.e. 1091.4 was assessed as low natural value, while forest stands of lower medium natural value cover the area of 93.4 ha i.e. 7.9 %. Uneven-aged forest stands are present on 499.8 ha, 22.8%, i.e. 114.1 ha of which are stands of low natural value, stands of lower medium natural value are present on 207.5 ha, i.e. 41.5%, while stands assessed as higher medium natural value are represented on 178.2 ha i.e. 35.7%.

In the boreal forests of Europe, in order to preserve biodiversity, as an alternative, continuous-cover forestry practices have been suggested, which are often based on selective cutting and can create mixed-aged and mixed-species stands. The

additional challenges for forestry arising from climate change produce not only trade-offs (e.g., between natural wildfire disturbances and timber production), but also opportunities (e.g., a shift from rotation forestry to continuous-cover forestry supports carbon storage, sequestration, and biodiversity conservation). The management of trees, deadwood, and soil will be critical to biodiversity in forest ecosystems (Hylander *et al.* 2022). The highest species richness was found in old forest stands with a species-rich regeneration layer and downed deadwood (positive correlations with quadratic mean diameter at breast height, species richness within the regeneration layer and downed deadwood in most of the analysed strata) (Storch *et al.* 2021).

**Table 4.** *Assessment of natural values in relation to mixedness of forest stands*

| Mixedness | Final biodiversity assessment | P (ha) | P (%) |
|---|---|---|---|
| Pure | Low natural value | 1108.5 | 79.9 |
| | Lower medium natural value | 181.8 | 13.1 |
| | Higher medium natural value | 97.1 | 7.0 |
| Total pure forest stands | | 1387.4 | 100.0 |
| Mixed-species | Low natural value | 97.2 | 32.7 |
| | Lower medium natural value | 119.1 | 40.1 |
| | Higher medium natural value | 81.1 | 27.3 |
| Total mixed-species forest stands | | 297.4 | 100.0 |
| Total | | 1684.7 | 100.0 |

Table 4 shows an overview of the assessment of natural values of stands in relation to mixedness. The area of pure forest stands amounts to 1387.4 ha, out of which the area of 1108.5 ha or 79.9% is covered by forest stands of low natural value, stands of lower medium natural value cover 181.8 ha or 13.1%, while stands of higher medium natural value cover 97.1 ha i.e. 7.0 %. Mixed-species forest stands cover 297.4 ha, out of which stands of low natural value cover 32.7% or 97.2 ha, forest stands of lower medium natural value cover 40.1% i.e. 119.1 ha, and stands of higher medium natural value cover 27.3 % or 81.1 ha.

The biodiversity of Europe's forests over large areas critically depends on the species composition of stands aged below 100 years. Increasing the shares of oak trees, in habitats suitable for them, would significantly increase the biodiversity of managed forests in Central Europe. This could be achieved primarily by increasing the share of oak at the expense of Scots pine, the species that least promotes the formation of microhabitats and bird richness in mature stands below 100 years old. An alternative strategy might be to allow pines to achieve greater ages. Our findings also suggest that increasing the shares of hornbeam and birch may benefit forest biodiversity. In managed forest, trees of lower commercial value, such as hornbeam and birch, should be promoted in management plans, in addition to other measures such as setting aside of old growth stands and retention of dead wood and living trees (Piechnik *et al* 2022).

Table 5 represents the assessment of natural values based on the management type. The highest average score 3 was given to management type High mixed-species forests of beech, fir and common spruce, as well as management type High mixed-

species forests of common spruce – High forests of coniferous and deciduous trees, while management type Coppice mixed-species forests of beech obtained the lowest grade -1.9.

By studying the connection between forest management and biodiversity indicators, 14 measures for preservation of biodiversity has been defined (Oettel and Lapin, 2021):

- Provide horizontal and vertical structural heterogeneity;
- Adapt tree species composition;
- Promote deadwood quantity and quality;
- Provide habitat structures;
- Increase tree species diversity;
- Conserve habitat trees and veteran trees;
- Provide spatial heterogeneity at landscape level;
- Reduce understory density;
- Provide unmanaged forest patches;
- Increase rotation period;
- Provide uneven-aged forests under continuous forest cover;
- Avoid forest fragmentation and habitat isolation;
- Adapt habitat management for indicator species;
- Perform active monitoring.

**Table 5.** *Assessment of natural values in relation to the management type of forest*

| Management type of forest | Final biodiversity assessment | Average score | P (ha) | P (%) |
|---|---|---|---|---|
| Mixed-species coppice forest of beech | LNV | -1.9 | 399.5 | 100.0 |
| | Total | | 399.5 | 100.0 |
| Mixed-species coppice forest of beech - High forests of beech and other deciduous and coniferous trees | LNV | -1.7 | 69.2 | 100.0 |
| Mixed-species coppice forests of oaks | LNV | -1.7 | 24.0 | 100.0 |
| Brushwood and bushy vegetation | / | / | 393.1 | 100.0 |
| High mixed-species forests of pines | LNV | -1.8 | 53 | 90.6 |
| | LMNV | 1 | 5.5 | 9.4 |
| | Total | -1.6 | 58.5 | 100.0 |
| High mixed species forests of pines – High forests of deciduous and coniferous trees | LNV | -1.5 | 47.4 | 100.0 |
| High mixed-species forests of beech | LNV | -0.9 | 100.5 | 48.0 |
| | LMNV | 1.3 | 65.7 | 31.4 |
| | LMNV | 4 | 42.9 | 20.5 |
| | Total | 0.2 | 209.1 | 100.0 |
| High mixed-species forests of other soft deciduous trees | LNV | 0 | 13.6 | 100.0 |
| High mixed forests of other conifers | LMNV | 1 | 29.5 | 100.0 |
| High mixed forests of common spruce | LNV | -0.4 | 487 | 61.6 |
| | LMNV | 1.1 | 200.2 | 25.3 |
| | HMNV | 3 | 103.4 | 13.1 |
| | Total | 0.3 | 790.6 | 100.0 |
| | LNV | 0 | 11.5 | 40.2 |
| | HMNV | 3 | 17.1 | 59.8 |

| Management type of forest | Final biodiversity assessment | Average score | P (ha) | P (%) |
|---|---|---|---|---|
| High mixed forests of common spruce – High forests of deciduous and coniferous trees | Total | 1 | 28.6 | 100.0 |
| High forests of beech, fir and common spruce | HMNV | 3 | 14.7 | 100.0 |
| | | | 2077.8 | 100.0 |

*LNV-Low natural value; LMNV-Lower medium natural value; HMNV-Higher medium natural value

## 4. CONCLUSION

Based on the presented results, it is concluded that stands of high natural value are not registered, the largest percentage of the area (71.5%) is occupied by stands of low natural value, then stands of lower medium natural value (17.9%), while the smallest percentage of the area (10, 6%) cover stands of higher medium natural value.

By analysing the obtained results of the assessment of natural values of stands by origin, structural form, mixedness and management type, the following can be concluded:

- Stands of high origin proved to be stands of greater importance for the preservation of natural values compared to stands originating from coppice forest and cultivated stands,
- By comparing uneven-aged and even-aged stands it can be concluded that uneven-aged stands are better from the aspect of preservation of natural values,
- The composition of the stands indicates the presence of three categories of stands (low, lower medium and higher medium natural value) in both pure and mixed-species stands. However, observing the percentage ratio of these categories, it can be clearly seen that the share of stands with a mark of lower medium and higher medium natural value is higher in mixed-species stands compared to stands that are pure in composition. Therefore, it is concluded that mixed-species stands have a more beneficial effect on biodiversity preservation.
- On the basis of the marks given to the stands in relation to affiliation to management type, the statement that the mixed-species stands of uneven-aged structural form and high origin have a favourable effect on the preservation of natural values is confirmed.

Taking in consideration the obtained results, it is recommended to investigate the assessment of natural values at the silvicultural group level in the future.

**Acknowledgement:** *For the preparation of this paper the data was used from the research performed within the project entitled: Contribution of Sustainable Forest Management to Low Emission and Resilient Development (GCP/SRB/002/GEF)*

**ANNEX 1.** *Presentation of attributes and manner of scoring of natural values*

| Biodiversity indicators | | Structural and other attributes | Score | |
|---|---|---|---|---|
| Structure and composition | Structural form of forest stand | Uneven-aged stand | +1 | |
| | | Selection stand | +1 | |
| | | Virgin forest | +3 | |
| | Stand layers | Multi-layered forest stands (≥2 layers) | +1 | |
| | Young crop | Patches of natural regeneration (young plants H >3 m with d.b.h. ≤5 cm) | +1 | |
| | Dead wood | Standing dead wood (d.b.h. > 30 cm) | +1 | |
| | | Laying dead wood (diameter >30 cm) | +1 | |
| | | Part of laying dead wood (diameter > 50cm, length > 2 m) | +1 | |
| | | Breakage (diameter >30 cm, height > 1m) | +1 | |
| | | Absence of any dead wood | | -1 |
| | Naturalness | First regime of protection | +3 | |
| | | High natural forest | +1 | |
| | | Number of tree species (<2, monocultures) | | -1 |
| | | Artificial stands (non-natural) | | -1 |
| Valuable biodiversity trees /Habitat trees | Living special trees | Trees of exceptional dimensions | +1 | |
| | | Large solitary sun-exposed trees with wide crown | +1 | |
| | Tree microhabitats | Standing dying back old trees | +1 | |
| | | Old trees with damaged/broken top | +1 | |
| | | Old trees with damaged or coarse bark | +1 | |
| | | Nesting trees | +1 | |
| | | Hollow trees, trees with cracks or cavities (cavity D>30 cm) | +1 | |
| | Trees with fungi, mosses, lichen, lianas and parasites/semi parasites on the trunk | Significant moss cover on tree stem (>40%) | +1 | |
| | | Significant lichen cover on tree stem (>30%) | +1 | |
| | | Presence of fungi species on tree stem | +1 | |
| Key and valuable biotopes | Valuable biotopes within forest stand | Areas with high concentration of old growth and dead wood (>0.2 ha) | +1 | |
| | | Wetlands - marsh, fen; small pools, ponds, wet zones (>0.2 ha) | +1 | |
| | | Natural springs | +1 | |
| | | Seasonal or permanent streams | +1 | |
| | | Steep slopes (inclination >30 degrees) | +1 | |
| | | Cliffs or ravines (>0.2ha) | +1 | |
| | | Caves | +1 | |
| | | Large rocks with significant mosses/lichens coverage (>2m3) | +1 | |
| Key species | Protected wild species | Strictly protected and protected wild species | +1 | |
| Impacts and threats | Invasive species | Presence of any invasive species | | -1 |
| | Non-native tree species | Presence of any non-native or introduced tree species | | -1 |
| | Threats from negative impacts | Significant presence of anthropogenic negative impacts | | -1 |
| | SCORE OF NATURAL VALUES ASSESSMENT (SUM OF POSITIVE AND NEGATIVE POINTS) | | | |

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COMMISSION STAFF WORKING DOCUMENT GUIDELINES ON BIODIVERSITY-FRIENDLY AFFORESTATION, REFORESTATION AND TREE PLANTINGhttps://ec.europa.eu/transparency/documentsregister/detail?ref=SWD(2023)61&lang=en

Forest Management Plan for FMU "Jasenovo-Božetići" https://upravazasume.gov.rs/ogs-za-gj-jasenovo-bozetici/

# ASSESSMENT OF THE CONDITION OF NATURAL VALUES OF THE FOREST MANAGEMENT UNIT "JASENOVO-BOŽETIĆI" IN THE AREA OF SOUTHWEST SERBIA

*Miloš RAČIĆ, Branko KANJEVAC, Nikola MARTAĆ, Dejan MILETIĆ, Nenad PETROVIĆ*

## Summary

This paper presents the assessment of the condition of natural values of forest stands as indicators for biodiversity assessment in relation to the origin, structural form, mixedness as well as in relation to affiliation of the forest stand to forest management type. The object of the research is the Forest management unit "Jasenovo-Božetići" which belongs to the Western forest region in Serbia. The main goal of this work is to show how the strcuctural characteristics of the stands affect the preservation of natural values.

Assessment of the condition has been performed in accordance with the method developed on the project entitled Contribution of Sustainable Forest Management to Low Emission and Resilient Development (GCP/SRB/002/GEF). The total area on which the assessment of natural values was carried out amounts to 1684.7 ha. Based on the final assessment of biodiversity, the stands of low natural value cover the area of 1205.6 ha (71.5%), the stands of lower medium natural value cover 300.9 ha (17.9%), the stands of higher medium natural value 178.2 ha (10.9%), while stands of high natural value are not registered. Areas registered as brushwood on the total of 393.1 *ha* are excluded from the procedure of assessment of natural values. On the basis of the marks given to the stands in relation to affiliation to management type, the statement that the mixed-species stands of uneven-aged structural form and high origin have a favourable effect on the preservation of natural values is confirmed.

# OCENA STANJA PRIRODNIH VREDNOSTI GAZDINSKE JEDINICE „JASENOVO-BOŽETIĆI" NA PODRUČJU JUGOZAPADNE SRBIJE

*Miloš RAČIĆ, Branko KANJEVAC, Nikola MARTAĆ, Dejan MILETIĆ, Nenad PETROVIĆ*

## Rezime

U ovom radu prikazana je ocena stanja prirodnih vrednosti sastojina kao indikatora za ocenu biodiverziteta u odnosu na poreklo, strukturni oblik, mešovitost kao i u odnosu na pripadnost sastojine gazdinskom tipu. Objekat istraživanja je gazdinska jedinica „Jasenovo-Božetići" koja pripada Zapadnoj šumskoj oblasti u Srbiji. Glavni cilj ovog rada je prikaz kako utiču navedene strukturne karakteristike sastojina na očuvanje prirodnih vrednosti. Ocena stanja je vršena u skladu sa metodom koji je razvijen na projektu pod nazivom Doprinos održivog gazdovanja šumama niskim emisijama i prilagodljivom razvoju (GCP/SRB/002/GEF). Ukupna površina na kojoj je vršena ocena prirodnih vrednosti iznosi 1684,7 ha. Na osnovu konačne ocene biodiverziteta, sastojine niske prirodne vrednosti pokrivaju površinu od 1205,6 ha (71,5%), sastojine srednje niže prirodne vrednosti 300,9 ha (17,9%), sastojine srednje više prirodne vrednosti 178,2 ha (10,9%), dok sastojine visoke prirodne vrednosti nisu registrovane. Površine koje su registrovane kao šikare i šibljaci na ukupno 393,1 ha izuzete su iz postupka ocene prirodnih vrednosti. Na osnovu ocena koje su ponele sastojine u odnosu na pripadnost gazdinskom tipu, potvrđuju se navodi da sastojine visokog porekla, mešovitog sastava i raznodbnog strukturnog oblika povoljno utiču na očuvanje prirodnih vrednosti.