ACTA ZOOLOGICA BULGARICA
Acta zool. bulg., Suppl. 5, 2014: 129-136

Forest Habitats in Besaparski Ridove Special Protection Area (Natura 2000), Southern Bulgaria: Characteristics, Status Assessment and Management Recommendations

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Abstract: A survey on the forest habitats on the territory of Besaparski Ridove Special Protection Area (included in Natura 2000 network) is presented. Three types of forest habitats were identified: "91AA *Eastern White Oak Forests", "91M0 Pannonian-Balkanic Turkey Oak – Sessile Oak Forests", and "91Z0 Moesian Silver Lime Woods". Their conservation status was assessed as "Unfavourable bad". The low average age, the lack of old-growth forests, inadequately planned and implemented fellings, removal of dead wood and grazing were the parameters whose values are the major cause for the unfavourable conservation status. The recommendations for improving the conservation status relate mostly to determine the area for conservation of the forest habitats, to determine the amount of dead wood and keep it in the reference values increasing the age of tree species, leaving areas to ensure the formation of old growth forests, shaping area for conservation forest habitats, monitoring of the threats for the purpose of prevention and elimination.

Keywords: phytocoenology, structure and functions, future prospects, NATURA 2000, forests

Introduction

The identification of the forest habitat types and their conservation status is of key importance for the subsequent management of the forests within the Natura 2000 protected area. The measures and recommendations proposed correspond to the modern concepts for management and correlate to the guidelines outlined in the approved "Regimes for sustainable management of forests falling within Natura 2000" (Anonymous 2011a). Some of these regimes and recommendations are based on recently developed normative documents such as Ordinance № 8 for the fellings in forests (Anonymous 2011b) are a significant step towards the management of forest habitats according to the objectives of the Natura 2000 network. Following these recommendations would help achieving favourable conservation status of forest habitats in the next 2-3 decades. Most often, the identification of natural habitats is through plant communities that are essential elements thereof.

Besaparski Ridove Special Protection Area (Besaparski Ridove SPA, BG0002057) is a SPA as per EU Directive 2009/147 (Birds), overlapping and extending beyond the Site of Community Importance (SCI) of Directive 92/43 (Habitats) (Besaparski Vazvishenia SCI, BG0000254). The site is located between the foothills of Western Rhodopes and the southwestern part of the Thracian Valley. The area consists of low, mainly non-wooded hills (350–536 m a.s.l.) on limestone rock. The forests are of coppice origin and are fragmented by shrubs, xerophytic grasslands and arable lands. Forest habitats occupy only 438 ha, or about 3% of the total territory of the site. About 332 ha (2%) of the territory are occupied by forest reforestations, i.e. 228 ha of deciduous and 105 ha of coniferous species (Anonymous 1999,

2007).

The flora and the vegetation of the territory of Besaparski Ridove (= Besaparski Hills), which occupy the main part of the SPA, are relatively well-studied (Stanev 1975, 1976, 1977a, b, 1979, 1980, 1986). Small and scattered forests are important habitat for many birds (Demerdjiev, 2007). This requires to establish, map, monitor, improve and maintain the conservation status of forests. Sustainable management and reconciliation of the socio-economic and conservation functions are a major challenge in the process of development and implementation of the future management plan for Besaparski Ridove SPA.

The goal of this study is to identify the composition and distribution of forest habitats and propose specific measures to secure their adequate management and conservation.

Materials and Methods

The study objects of the current publication were the forest habitats within Besaparski Ridove Natura 2000 site. The forest habitats were defined by parallel analysis of the characteristics, classification and status of the plant communities and environmental conditions (Belev *et al*. 2007). Based on the analysis of the existing maps and charts and then reconnaissance of the territory with the aim to record the existing diversity, a choice of routes and key objects for observations and collecting the necessary information were chosen. Data were collected about the environmental conditions (altitude, exposure, topography, slope, type, humidity, composition and power of the soil, bedrock, etc.). Phytocoenological observations of plant communities including identification of the total species composition, dominant, characteristic and diagnostic species were performed to identify the type of communities and habitats in key areasaccording to Kavrakova *et al.* (2009). Habitats throughout the area were determined by interpolation and extrapolation, as well as expert analysis of environmental and inventory characteristics. To determine the conservation status (CS), we collected data on the presence and nature of threats or favourable factors, types of neighbouring communities or habitats. CS was evaluated using the following criteria: „Structure and functions" and „Future prospects" (Zingstra *et al.* 2009). Since at the time of the survey, data about the area of habitats in past periods were missing, the observed area were taken as reference values for evaluation of the criteria "Area covered within site" during the next inventory and monitoring. The parameter „Amount of deadwood" was estimated by expert assessment during the field survey. Bulgaria has no officially adopted methodology for assessing this parameter, and the available information and observations were not sufficient for an accurate assessment. The same approach was also adopted for assessing the parameters „Presence of old trees" and „Fires". The assessments of the parameters to the criterion „Future prospects" were made as a result of fieldwork, questionnaire data from interviews with the local population and employees in the state forest enterprise, and after analyzing the information from the forest management plans.

During the field studies, data were collected that were needed for identification of the habitats, their spatial boundaries and area of distribution. The mapping was done through GIS modelling and use of forest database (Anonymous 1999, 2007). The algorithm applied was based on: data from forest mensuration (species composition in the first dominant and subsequent tree species, quantitative characteristics such as canopy, completeness, origin of the forest stand, etc.), forestry zoning (altitude, soil type, bedrock) and other specialized information available in the forest management plans. The boundaries of the polygons on habitat types in the model were displayed or plotted again on the basis of the cadastral boundaries of the main forestry units, i.e. the subcompartments (Tzonev *et al.* 2012).

The recommendations for restoration, protection and monitoring are in accordance with the Guidelines for planning the activities in forest lands falling within Natura 2000 (Belev *et al.* 2007).The nomenclature of the plant species is according to Delipavlov *et al.* (2003).

Results and Discussion

On the territory of Besaparski Ridove Natura 2000 site, three forest habitat types included in Annex 1 of Directive 92/43 were identified, including one a priority habitat (Biodiversity Act 2002). They were distributed almost exclusively in the central and south-western part of the area (Fig. 1).

91M0 – Pannonian-Balkanic Turkey Oak – Sessile Oak Forests

In Bulgaria, xerotermic and mezoxerothermic mixed oak forests occur in the hilly plains, foothills and the lower parts of mountains at altitude up to 800 (1000) m (Tzonev 2009, Tzonev *et al.* 2011b). These forests are very often of a mixed type, with dominance of Turkey oak (*Quercus cerris*) and, in some places, of Hungarian oak (*Q. frainetto*). The mixed thermophilic oak forests are located on slopes

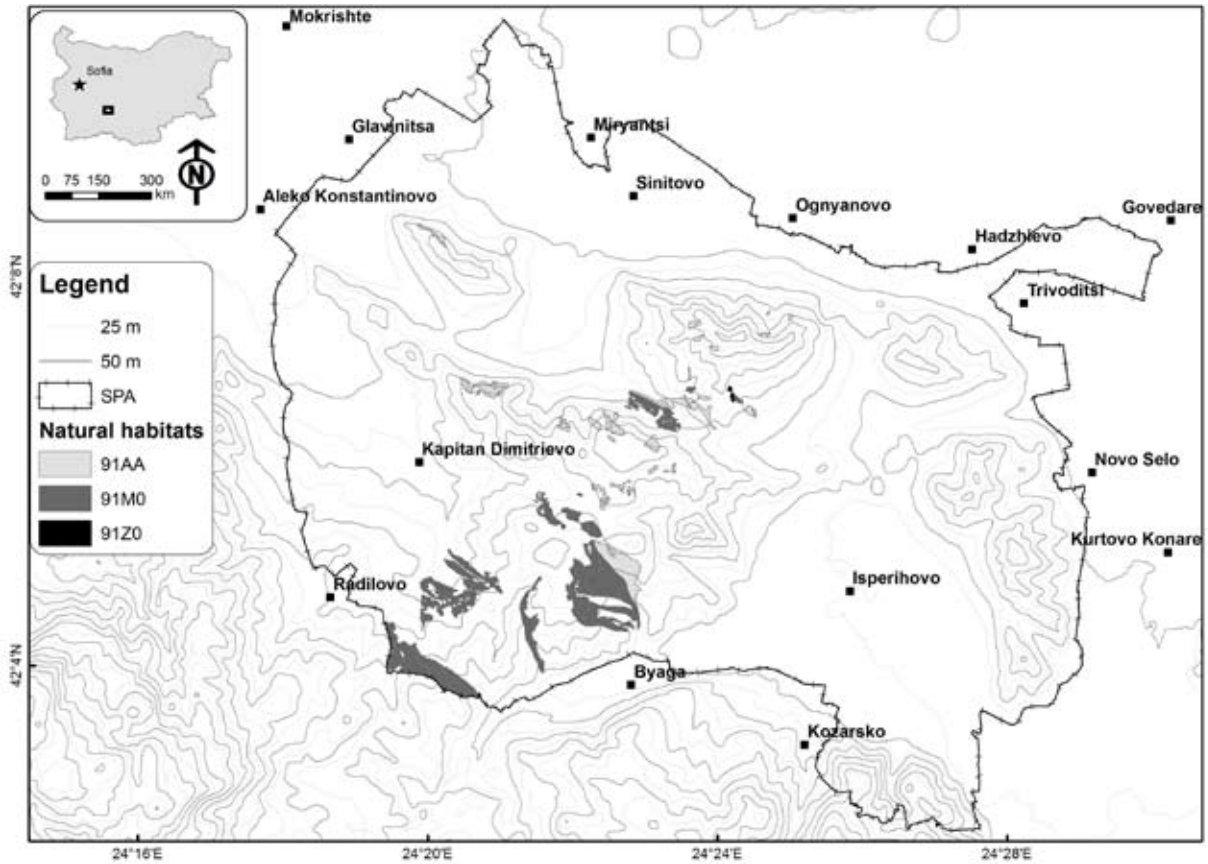

Fig. 1. Distribution of forest habitats in Besaparski Ridove Special Protection Area

with different exposure and ridges of the uplands. With intensification of the erosion and impoverishment of the soil and on the driest places, they are replaced by phytocoenoses dominated by Pubescent oak (*Quercus pubescens*) and Oriental hornbeam (*Carpinus orientalis*). The grass and shrub layers are dominated by species typical for the xerotermic oak forests. With increasing altitude and the air and soil humidity in the composition of xerothermic oak forests appear different mesophilic species. In geographical, floristic and ecological aspect, three subtypes are distinguished (Tzonev 2009, Tzonev *et al.* 2011b). The current survey recorded that on the territory of Besaparski Ridove SPA, the habitat is represented by the subtype "Thracian Thermophilic Mixed Oak Forests". The relatively great presence of Hungarian oak is typical, which on some places forms the edificatory floor together with the Turkish oak. At higher altitudes or in the southern parts of the country, co-dominant or dominant is the Durmast oak (*Q. dalechampii*). Thracian oak forests occupy the slopes of different exposure and crests of hills. With the increasing erosion, on the driest and poorest areas, they are being replaced by phytocoenoses dominated by *Acer monspessulanum, Carpinus orientalis, Quercus pubescens*, and extreme degradation represent communities of *Bothriochlo aischaemum* (= *Dichanthium ischaemum), Chrysopogon gryllus, Juniperus oxycedrus, Paliurus spina-christi* (Tzonev *et al.* 2011b).

Thermophilic oak forests on low hills in theThracian Plain, Tundzha plain and southern slopes of Sredna Gora (Stara Zagora), which grow in conditions of transition-continental climate, show transitional characteristics between continental and transitional Mediterranean thermophilic oak forests. In their floristic composition dominate species, which are widespread in xerothermic oak forests, which in floristic aspect are similar to the communities of this type presented in North Bulgaria. Although rarely, some Mediterranean elements are also presented that cannot be found in the similar phytocoenoses of North Bulgaria. These include, e.g. *Arum orientale*, *Clematis viticella*, *Digitalis ferruginea*, *Fritillaria pontica*, *Genista carinalis*, *Hypericum montbretii*, *Lonicera etrusca* and *Scilla autumnalis*.

On the territory of SPA, this habitat occupies a small area (328.19 ha or 2.22%) mainly in the south-western part of the area between the villages of Capitan Dimitrievo, Radilovo and Byaga (Fig. 1). The edificatory floor is formed by Hungarian and Durmast oaks, and in some areas Pubescent oak and

Table 1. Summary matrix for assessing Favourable Conservation Status (FCS) of forest habitats within the Besaparski Ridove Special Protection Area

Habitats		**91AA**	**91M0**	**91Z0**
Criteria & Parameters	Measurable units / FCS threshold for assessing the condition of parts / polygons			
Criterion 1. Area within site				
Parameter 1.1. Area covered within site	Hectars	108	328.19	1.58
Criterion 2. Structure and functions				
Parameter 2.1. Canopies (density) (weighted average) of the primary wood floor	Expressed as units from 1 to 10	0.47	0.7	0.6
Parameters 2.2. Composition of the first forest floor (weighted average)	Participation in units of1 to 10	7.8	7.4	6.5
Parameter 2.3. Average age of first wood floor (weighted average)	Years	41	37.5	13.7
Parameter 2.4. Old Growth Forests	% of the total habitat in site planning	0%	0%	0%
Parameter 2.5. Amount of dead wood	Not less than 8% of stock of the stands at least 10 the number of trees per ha are standing	Unfavourable bad	Unfavourable bad	Unfavourable bad
Parameter 2.6. Presence of old trees	At least 10 trees per ha	Unfavourable bad	Unfavourable bad	Unfavourable bad
Parameter 2.7. Ground cover		The composition is typical for the habitat	The composition is typical for the habitat	The composition is typical for the habitat
Comprehensive evaluation Criteria 2		Unfavourable bad	Unfavourable bad	Unfavourable bad
Criterion 3. Future perspectives (threats and impacts)				
Parameter 3.1. Inadequately planned and implemented fellings, poaching		Affect habitat area > 1% per year	Affect habitat area > 1% per year	Affect habitat area > 1% per year
Parameter 3.2. Removal of dead wood		Affect habitat area > 1% per year	Affect habitat area > 1% per year	Affect habitat area > 1% per year
Parameter 3.3. Reforestation with exotic and non-native species		Absence of threat	Absence of threat	Absence of threat
Parameter 3.4. Fires		Insufficient information	Insufficient information	Insufficient information
Parameter 3.5. Recreation and tourism		Absence of threat	Absence of threat	Absence of threat
Parameter 3.6. Construction and Infrastructure		Absence of threat	Absence of threat	Absence of threat
Parameter 3.7. Grazing		Affect habitat area > 1% per year	Affect habitat area > 1% per year	Affect habitat area > 1% per year
Parameter 3.8. Natural disturbances and trends		Absence of threat	Absence of threat	Absence of threat
Parameter 3.13. Presence of successional processes		Presence of oriental hornbeam	Presence of oriental hornbeam	Absence of threat
Parameter 3.14. Unauthorized and improper extraction of non-timber forest resources (acorns and leaves feed)		Absence of threat	Absence of threat	Absence of threat
Comprehensive evaluation criteria 3		Unfavourable bad	Unfavourable bad	Unfavourable bad
Overall assessment of the three criteria of FCS		Unfavourable bad	Unfavourable bad	Unfavourable bad

Oriental hornbeam have relatively high share; single trees can be observed of Common maple (*Acer campestre*), Silver lime (*Tilia tomentosa*), South European Flowering Ash (*Fraxinus ornus*), Aspen (*Populus tremula*) and Wild Service Tree (*Sorbus torminalis*). Most often in the grass cover are found *Physospermum conubiense, Alliaria petiolata, Viola odorata, Polygonatum latifolium, Chelidonium majus, Geum urbanum, Galium aparine, Lapsana communis, Silene alba, Campanula trachelim, Bupleurum prealtum, Lathyrus niger* and *Brachypodium sylvaticum*. It can be assumed that these are parts of larger in area thermophilic forests of Hungarian and Durmast oaks, degraded into forests and shrubs of Oriental hornbeam under the influence of human activity.

The conservation status of the habitat is „Unfavourable bad" (Table 1). The criterion „Structure and functions" was assessed as „Unfavourable bad", since the weighted average age of the primary woodfloor is 37.5 years, while the reference value for the parameter „Average age" above 60 years is FCS, 60–40 years is „Unfavourable inadequate" and for those less than 40 years old is „Unfavourable bad"; „Old Growth Forests" are missing. The assessment under criterion „Future prospects" is „Unfavourable bad", due to the estimates of the parameters „Inadequately planned and implemented felling", „Removal of dead wood" and „Grazing";(there is evidence of their impact on habitats in an area larger than 1%) as well as „Presence of successional processes" due to the development of Oriental hornbeam.

91AA – *Easthern White Oak Forests

This habitat includes open xerothermic oak forestsd ominated by Pubescent oak (*Quercus pubescens*) on limestone hills in areas with trans-mediterranean, trans-continental and euxine climate (Tzonev 2009, Tzonev *et al.* 2011a). The habitat is presented in Southern Bulgaria – Thracian Valley, Tundzha Hilly Plain, Eastern Rhodopes, Black Sea coast and in the valleys of Struma and Mesta. It occupies rocky areas with diverse bedrock (limestone and silicate) and poor, sometimes eroded lithosols, rendzinas and rankers. These forests are sparse, bright and in varying degrees of anthropogenic degradation. The influence of human activities is great. Their species composition includes many trees, grass and shrub species that penetrate from the surrounding woods, bushes, meadows and open rocky terrain. Among them there are species, which are widespread in the xerothermic communities in Bulgaria but also species, which have southern (Mediterranean) origin. The number of the latter is the largest in the southern parts of the country, especially in the Eastern Rhodopes and the valley of the Struma River. The wood layer, dominated or co-dominated by the Pubescent oak, usually reaches a height of 5–6 m. The trees are branched and often have crooked stem. Often, together with the Pubescent oak, other trees with similar ecology co-dominate, i.e. *Quercus virgiliana, Carpinus orientalis* and *Fraxinus ornus*. Oriental hornbeam is co-dominant in many of the communities of the habitat, and on most eroded and poor areas the Pubescent oak disappears and is replaced by mono-dominant, low shrub communities of *Carpinus orientalis*.

Oak forests at lower elevations in the Thracian valley, the Tundzha Hilly Plain and the southern slopes of Sredna Gora (Stara Zagora) have mixed characteristics between Continental and Mediterranean communities. In their floristic composition dominate species, which are widespread in xerothermic oaks forests, but on the other hand are found, albeit rarely, some Mediterranean elements (which do not present in similar phytocoenoses in Northern Bulgaria) such as *Arum orientale*, *Clematis viticella* and *Jasminum fruticans. Paliurus spina-christi* has a significantly more important role in the shrub layers than in the oak forests in Northern Bulgaria (Tzonev 2009, Tzonev *et al.* 2011a).

Eastern forests of Pubescent oak on the territory of the SPA covered small area (108 ha, 0.73%) and had fragmented distribution mainly in the central part of the zone (Fig. 1). In the tree story, Durmast oak, Flowering ash, Field elm, Birch, Silver linden and Hungarian oak can also be found, either as single trees or in groups. In certain areas, the role of edificator and co-dominant is played by the Oriental hornbeam and, in some places, the Jerusalem Thorn is with increased participation. The most typical shrub species are *Ligustrum vulgare, Cotinus coggygria* and *Coronilla emerus.* In some phytocoenoses, typical facies dominated by *Dictamnus albus* are present in the grass layer. Dominant and constant species are *Brachypodium pinnatum, Melica nutans, Teucrium chamaedrys* and*, Bituminaria bituminosa*.

The participation of Pubescent oak in secondary phytocoenoses of Oriental hornbeam and grasses indicates that their distribution is reduced as a result of human activity. In some areas (plots), reforestations of coniferous species, mainly Macedonian pine, Atlas cedar and Black locust replaced Pubescent oak forests.

The conservation status of the habitat is „Unfavourable bad" (Table 1).

The criterion „Structure and functions" was as-

sessed as „Unfavourable bad“ since the „Weighted average participation“ is 4.7, the „Weighted average age of the first wood layer“ is 41 years and „Old Growth Forests“ are missing. The criterion „Future prospects“ (threats and impacts) is evaluated as „Unfavourable bad“ based on data regarding the impact on the habitat at the area bigger than 1% as per the parameters „Inadequately planned and implemented felling“, „Removal of dead wood“ and „Grazing“. In 2.87% of the area, the participation of the Oriental hornbeam and Jerusalem Thorn is higher that 4, and in 17.29% of the area the share of Jerusalem Thorn and Oriental hornbeam is 2-3.

91Z0 – Moesian silver lime woods

Silver lime woods are distributed mainly in the Danube Valley and north-eastern Bulgaria (Ludogorie Region), more limited in the Eastern Fore-Balkan and elsewhere in the range between 50–60 and 800–1000 m (Tzonev 2009, 2011). It is found in hilly and foothill areas on loess or limestone substrate. These forests occupy mainly slopes exposed to the north and to the east, with inclination of 5 to 45°. More rarely (in Ludogorie), silver lime forests occur on the ridges and relatively flat terrains. Soils have well developed humus horizon and are well moistened. Depending on the local conditions, these phytocoenoses can be defined as mesoxerophytic to xerophytic. Lime woods are monodominant.

Besides the main tree species, i.e. *Tilia tomentosa*, several other tree species (*Quercus cerris, Fraxinus ornus, Acer campestre* and *Quercus robur*) participate relatively often in the wood floor. In some phytocoenoses on more eroded limestone terrains, *Tilia tomentosa* forms mixed communities with *Carpinus orientalis*. Shrub species involved in the composition of lime coenoses are *Berberis vulgaris, Cornus mas, C. sanguinea, Corylus avellana, Crataegus monogyna, Ligustrum vulgare, Viburnum lantana* and *Staphylea pinnata*. A herbaceous layer is not formed, but more often some shadow-resistant species occur. Massive development of spring ephemeroids, which may form a short-term layer with coverage up to 80% at certain places, is characteristic for this habitat. Such species are *Helleborus odorus*, *Scilla bifolia*, *Ranunculus ficaria*, *Isopyrum thalictroides*, *Corydalis bulbosa*, *C. solida*, *Anemone ranunculoides*, *Polygonatum latifolium*, *Convallaria majalis, Viola odorata*, *Lamiastrum galeobdolon*, *Galanthus elwesii, Pulmonaria officinalis, Viola reichenbachiana* and *Gagea minima.*

Due to its good regeneration ability, including by root cuttings, rapid growth and competitiveness, the lime tree has maintained and expanded its presence in natural forests, in which in the past probably different oaks had co-dominant role (Tzonev 2009, 2011).

This habitat is represented by a locality situated in the middle of a line linking the villages of Capitan Dimitrievo and Trivoditsi (Fig. 1) and occupies a very small area (1.58 ha or 0.01%) on the territory of Besparski Ridove SPA. The sprouts and the participation of *Tilia tomentosa* in habitats 91AA and 91M0 suggests the probable loss of area of certain habitats and the formation of another habitat from Annex 1 of the Biodiversity Act. This type of dynamics of the phytocoenoses (and the related habitat) is not considered with the necessary details by Directive 92/43 EEC. In this case, it can be assumed that the fragments of 91Z0 habitat are formed on the place of the habitat “91M0 Thracian thermophilic oak forests”, where conditions are very similar. In terms of biodiversity, it is recommended that future management plan provides activities tolerating the development of the habitat 91Z0.

Overall rating the conservation status is “Unfavourable bad” (Table 1). The criterion „Structure and functions“ is assessed as Unfavourable bad. In the communities studied, the „Canopy density“ is 6 (for reference> 6 for FCS). The „Average age of the primary wood floor” is only 14 years, and there are no old-growth forests. The ground cover is slightly modified due to the involvement of ruderal species. For the rest of the parameters, there is not enough information at present. The criterion „Future prospects“ (threats and impacts) is assessed as „Unfavourable bad“. An impact of more than 1% of the area of the habitat has been determined for the following parameters: „Inadequately planned and implemented felling“(mainly illegal logging), „Removal of dead wood“, „Grazing“ and „Presence of successional processes“.

Outside of the forest area that was studied, we detected a fragment of natural vegetation in a wet valley. Its dendrological composition is relatively diverse for its limited area, i.e. White poplar, White willow, Hungarian oak, Field maple, Oriental hornbeam and others. The grass cover includes species typical of the habitat „91M0 Pannonian-Balkanic Turkey oak – sessile oak forests“ such as *Buglossoides purpurocoerulea*, *Melica uniflora, Dactylis glomerata, Arum maculatum, Tamus communis* and others. The presence of old and broken trees give the appearance of an old-growth forest. Surrounded by open areas and grasslands and occupying part of a heavily accessible sprout, the area can perform the role of a bio-corridor and is a potential refuge for various ani-

mal species.

Recommendations for conservation

The following general recommendations can be made regarding the restoration and protection of forest habitats within Besaparski Ridove SPA: no change in the purpose and the land use of the areas within the Natura 2000 site; determination of the amount of deadwood necessary to maintain the overall biodiversity and natural cycling of matter and energy and ensure its maintenance; leaving not less than 10% "Old Growth Forests" of each type of forest habitat and, if possible, relatively evenly distributed; exploration and transformation when opportunity presents of the existing forest reforestations and secondary communities of Oriental hornbeam into forests close to the natural ones, and planning corresponding activities; monitor invasive species (e.g. Tree of heaven) and replace them if necessary; monitor the status of the habitats and their characteristic species; carry out forest management planning with planned activities consistent with the maintenance of the conservation status; conduct training of the staff of the State Forest Enterprise, the Regional Forest Directorate and the Regional Inspectorate of Environment and Water, with the aim to enable them to carry out the management and monitoring activities in the Natura 2000 site.

For the implementation of the proposed recommendations and with the aim to restore and protect the natural forest habitats occurring within Besaparski Ridove site, we suggest to establish a zone for protection of the forest habitats, in which non-intervention management is applied (e.g. no sylvicultural activities). For sustainable management of forest habitats, it is necessary the formation of a separate zone, which includes all forest reforestations. To improve the conservation status of the habitats, it is necessary, wherever possible, to implement restoration of the areas by transforming forest reforestations and secondary communities of Oriental hornbeam into forests close to the habitats found in the site. The effect of the implementation of the activities, as well as the conservation status should be monitored by observing the threats, with the aim to prevent and eliminate them. Monitoring should also include planning and implementation of activities related to the maintenance, improvement and restoration of natural habitats.

It is necessary to take adequate measures to protect forest habitats. Otherwise, the main objective in the management of forest habitats in the SPA, i.e. the Favourable Conservation Status, will not be achieved.

Acknowledgements: The study is conducted within the framework of the Project "Conservation of globally important biodiversity in high nature value semi-natural grasslands through support for traditional local economy", GEFSEC Project №43595, implemented by the Bulgarian Society for Protection of Birds. We express our appreciation and gratitude to Georgi Popgeorgiev for logistical support and assistance in mapping. The authors thank the reviewers for critical remarks and recommendations.

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