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# CONSERVATION STATUS AND POTENTIAL THREATS TO NATURA 2000 FOREST HABITATS IN SLOVENIA

## STATUS ZAŠTITE I POTENCIJALNE UGROŽENOSTI ŠUMSKIH STANIŠTA NA PODRUČJU EKOLOŠKE MREŽE NATURA 2000 U SLOVENIJI

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*SUMMARY: An example of the possible use of selected forest-stand based indicators for evaluation of conservation status was shown in case of the Natura 2000 forest habitats of Slovenia, and the potential threats to habitat types were identified. Using the existing forest-management system, and two levels of ICP Forests monitoring as sources of data on the size of habitat, tree composition, developmental phase and stand regeneration, growing stock and increment, dead wood, and level of naturalness of habitat, an attempt of evaluation of the conservation status of the forest habitat types of EU community interest (Habitat Directive 1992, Natura 2000) is presented.*

*In total, the Natura 2000 forest habitat types in Slovenia represent almost one third of all forest area, and the prevailing forest habitat types are Illyrian* Fagus sylvatica *forests,* Luzulo-Fagetum *beech forests and Illyrian oak-hornbeam forests. Considering the direct influences of human activities and potential effects of climate change the floodplain and lowland forests of Alluvial forests with* Alnus glutinosa *and* Fraxinus excelsior*, Riparian mixed forests of* Quercus robur *and other broadleaves, as well as Illyrian oak-hornbeam forest, are among the most threatened forest habitat types. Taking into account the small area of habitat type and the set of different threats, the priority habitat types of* Tilio-Acerion *forests of slopes, screes and ravines, (Sub-) Mediterranean pine forests and Bog woodland are also endangered.*

*Despite the large number of factors threatening the Slovenian forests, the high level of studied parameters indicates the favourable conservation status of forest habitat types. However, the additional focus on the EU priority habitat types and on rare habitat types on the national level has been suggested to improve the existing forest management planning system, and additional forest-relevant indicators specific to particular habitat types have to be incorporated in the system.*

*Key words: biodiversity, favourable conservation status, habitat type, forest management planning, monitoring, indicators, threats*

Abbreviations – *Kratice*:
EU – European Union
MCPFE – Ministerial Conference of the Protection of Forests in Europe
EEA – European Environment Agency
ICP Forests – International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests

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## INTRODUCTION – Uvod

Currently, pressures and stress on forest biodiversity are noticeably increasing; consequently natural disturbances and human activities (forestry, afforestation of agricultural lands, clearance of forest areas for other land use, industrialisation, etc.) are shaping the biological diversity of European forests (Marchetti 2004b, Groom et al. 2006, Anonymous 2007a, 2008a). Several ongoing international initiatives are covering the development and monitoring of forest biodiversity-related indicators, such as the process of the Ministerial Conference of the Protection of Forests in Europe (MCPFE) process, the European Environment Agency (EEA), the Convention on Biological Diversity (CBD).

### EU Natura 2000 network – *Ekološka mreža EU Natura 2000*

Natura 2000 is a coherent ecological network of special areas, designated under the EU Habitat Directive (Anonymous 1992b) and EU Bird Directive (Anonymous 1979), to assist in the maintenance of biodiversity in European territory. It is now widely recognised that one of the most effective ways of maintaining biodiversity is to preserve habitats in a favourable conservation status (Cantarello and Newton 2006, 2008). These two directives provide an integrated framework for the identification, maintenance and protection of sites of high biodiversity value; they represent the European Union's most concrete act towards the achievement of international biodiversity policy commitments, such as the Convention on Biological Diversity (Anonymous 1992a), and they make standardized ecological monitoring of biodiversity legally binding for the first time (Bock et al. 2005).

With regards to the management of forested Natura 2000 sites, the EC recommends that the quality of each individual site should be periodically monitored and reported on by Member States. For this reason, there is a need to develop measurable indicators of conservation status that are appropriate for use at the site level. However, there is no consensus within the Member States on which indicators should be used to assess conservation status (Cantarello and Newton 2008), and individual Member States have adopted a variety of different approaches and indicators (Anonymous 2004, Ellmauer 2005, Groom 2007). Although the EU Habitat Directive (Anonymous 1992b) provides general guidance on conservation status assessment, a common standard for the implementation of monitoring within the EU has not been created. In many Member States, there is a lack of financial resources to support monitoring efforts, and a lack of a clear understanding about precisely what should be monitored, as well as which methods should be used.

### Forest-stand indicators – *Pokazatelji/indikatori šumskih sastojina*

For maintaining forest habitats and for assessing the effectiveness of conservation measures in terms of achieving favourable conservation status of habitat types (Anonymous 1992b), different sets of indicators might be used (e.g. Anonymous 1992a, 2002, 2007c, 2009, Larsson 2001, Marchetti 2004a, Cantarello and Newton 2006, 2008, Søgaard et al. 2007). The MCPFE process plays a crucial role in developing a set of criteria and indicators for sustainable forest management (Schuck and Rois 2004).

With respect to the loss of biodiversity and its components, which is an issue of global concern (e.g. Anonymous 1992a, 2004, 2008d), tree species composition was recognised as one of the important MCPFE indicators of forest ecosystems (Anonymous 2002). Beside this, the common studied MCPFE indicators and significant elements of forest ecosystems are dead and living wood that play an important role as carbon storage in the context of removal of human-derived $CO_2$ emissions and reduction of the climate change effect (Fan et al. 1998, Hamilton et al. 2002, Nabuurs and Schelhaas 2002, Gutrich and Howarth 2007, Piškur and Krajnc 2007). Moreover, other multifunctional roles of dead wood in forest ecosystems have been recognised (Harmon et al. 1986, Franklin et al. 1987, Crites and Dale 1998, Bormann and Likens 1994, Peterken 1996, Kraigher et al. 2002). To rationalise the provision of these and other biodiversity indicators, the existing monitoring schemes (e.g. NFIs, ICP Forests) could be extensively utilised (Marchetti 2004b).

### Forest management planning – *Gospodarenje šumama*

Close-to-nature forestry, which has been used in Slovenia for over 50 years, promotes the conservation of nature and forests, as nature's most complex creation, while deriving benefits from a forest in such a way as to preserve it as a natural ecosystem of all the diverse life forms and relations formed therein. The idea of forest planning and management oriented towards natural species composition and a very limited share of non-indigenous tree species is widely applicable.

Slovenia has an established tradition of planned management of forests. The first forestry plans for this territory were made in the 18th century (Flamek 1771), while individual edicts for regulating forests were being made as early as the 15th century.

The forest management planning system has been recognised as a potential tool for habitat monitoring in the broad sense (Goldsmith 1991, Corona et al. 2004, Marchetti 2004a). Based on these principles, the forest planning and management practice in Slovenia could serve as a valuable tool for the conservation of forest ecosystems and habitat types (Golob 2006, Kepic and Fučka 2006) in the sense of Natura 2000 (Anonymous 1992b). Most of the indicators relevant for assessing the conservation status of habitat types proposed by Golob (2006) were found to be already in use in the forest management planning system in Slovenia, which covers all forest areas, regardless of ownership (71 % privately owned, 3 % owned by local communities or other organisations, 26 % in state ownership; Lesnik and Matijašić 2006), and the majority of them are also listed by MCPFE (Anonymous 2002, 2007c).

By using forest monitoring approaches at the different levels existing in Slovenia (national forest inventory, two monitoring levels of ICP Forests) as a main source, the aims of this study are a) to evaluate the set of stand-based indicators of Natura 2000 habitats to provide a benchmark for the future habitat management; b) to identify the potential threats to habitat type existence; c) based on indicators and threats, to evaluate present evidence of the conservation status of forest habitat types in accordance with the Habitat Directive (Anonymous 1992b), and to suggest adaptation of the existing forest management planning system for the assessment of Natura 2000 habitats.

## STUDY AREA – Područje istraživanja

In terms of relative forest cover, Slovenia is one of the most forested countries in Europe, and its share is continues to increase. Despite rather favourable conditions, the country's forest cover has not always been so high. It began to increase approximately 130 years ago, growing from 737,000 hectares (36 %) in 1875 to 1.16 million hectares (58 %) in 2006. The number of naturally growing tree species determined in Slovenia is 71 (Kotar and Brus 1999). Among these, the following tree species have the highest share of the growing stock: *Fagus sylvatica* L. (32 %), *Picea abies* (L.) Karst. (32 %), *Abies alba* Mill. (8 %) and different species of *Quercus* sp. L. (7 %) (Lesnik and Matijašić 2006).

In Slovenia, the Natura 2000 network covers 36 % of the country, and forest is the prevailing ecosystem type within its area. Forest habitat types to be found

Table 1 List of forest and woodland habitat types (Annex 1 Habitat Directive (Anonymous 1992b)) in Slovenia (priority habitat types are indicated by an asterisk *)

*Tablica 1. Popis šuma i šumskih staništa (Prilog 1 Direktive o staništima, (Anonymous 1992b)) u Sloveniji (prioritetni tipovi staništa označeni su zvjezdicom)*

| | | Remarks<br>*Napomena* |
|---|---|---|
| | RUNNING WATERS – *TEKUĆICE* | |
| 3230 | Alpine rivers and their ligneous vegetation with *Myricaria germanica* | x |
| | SCRUBS – *ŠIBLJAK/GRMLJE* | |
| 4070* | Bushes with *Pinus mugo* and *Rhododendron hirsutum* (*Mugo-Rhododendretum hirsuti*) | Y |
| 5130 | *Juniperus communis* formations on heaths or calcareous grasslands | x |
| | FORESTS – *ŠUME* | |
| 9110 | *Luzulo-Fagetum* beech forests | Y |
| 9180* | *Tilio-Acerion* forests of slopes, screes and ravines | Y |
| 91D0* | Bog woodland | Y |
| 91E0* | Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) | Y |
| 91F0 | Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*) | x[1] |
| 91K0 | Illyrian *Fagus sylvatica* forests (*Aremonio-Fagion*) | Y |
| 91L0 | Illyrian oak-hornbeam forests (*Erythronio-Carpinion*) | Y |
| 91R0 | Dinaric dolomite Scots pine forests (*Genisto januensis-Pinetum*) | Y |
| 9340 | *Quercus ilex* and *Quercus rotundifolia* forests | x |
| 9410 | Acidophilous *Picea* forests of the montane to alpine levels (*Vaccinio-Piceetea*) | Y |
| 9420 | Alpine *Larix decidua* and/or *Pinus cembra* forests | x[2] |
| 9530* | (Sub-)Mediterranean pine forests with endemic black pines | Y |

Remark: Y – habitat type is treated by forest management system; x–not treated by forest management system as an autonomous category; [1]–mostly in 91LO and partly in 91E0*; [2]–mostly in 4070* and partly in 9410

*Napomena: Y – tip staništa je uključen u sustav gospodarenja šumama; x– tip staništa nije uključen u sustav gospodarenja šumama kao samostalna kategorija; [1]– većim dijelom u 91LO te djelomično u 91E0*; [2]– većim dijelom 4070* te djelomično u 9410*

within the Natura 2000 network in Slovenia and considered by forest management planning system are studied. The forest habitat-types classification (Anonymous 1992b, 2007b) was defined based on forest plant communities described by phytosociological studies (e.g. Košir et al. 1974, 2003, Dakskobler 2009) and by detailed forest site mapping covering each forest compartment. All existing forest and woodland habitat types in Slovenia are listed in Table 1. In this study, the term 'habitat type' has been used strictly in the sense of the Habitat Directive (Anonymous 1992b).

## METHODS – Metode rada

### Forest inventory – *Inventura šuma*

The forest inventory in Slovenia is carried out according to the Regulation on Forest Management and Silviculture Plans (Anonymous 1998, 2006a, 2008e). All forests, regardless of ownership, are placed into one of 234 management units, ranging from 2,000 hectares to 9,000 hectares in size. The management units are divided into smaller regulation units called forest compartments, which are from 10 to 30 hectares in size. The total number of forest compartments is 59,250. On the level of forest compartments and forest management units, the data on forests are collected and renewed every 10 years. During the inventory of the forest management unit, the following data are estimated on the level of forest compartments: tree composition and growing stock, stand regeneration and developmental stage (Anonymous 2006b). Following developmental stages are studied: i) Young growth (younger phases of forest, not covered by older trees, also including stands with mean tree diameter at breast high (DBH) up to 10 cm); ii) Thinner pole-stand (mean tree DBH is between 10 and 20 cm); iii) Thicker pole-stand (mean DBH is between 20 and 30 cm); iv) Timber-stand (mean DBH is over 30 cm, also including younger phases covering less than 35 % of whole stand); v) Old-stand in rejuvenation phase (open older phases of forests; also including younger phases covering more than 35 % of whole stand); vi) Selection forests (different phases of forests are mixed on a small scale); vii) Others (wooded land not included in other categories, e.g. coppice, abandoned coppice, litter-raking forests).

The level of naturalness/preservation is estimated as follows: 1-preserved forests (up to 30 % of foreign tree species), 2-changed forests (31–70 %), 3-strongly changed forests (70–90 %), and 4-altered forests (above 90 % of foreign tree species) (Bončina and Robič 1998).

Dead trees are registered on 100,178 permanent sample plots, separately for conifers and for broadleaves, and grouped into three diameter classes (from 10 to 29 cm, 30 to 49 cm, 50 cm and more). A permanent sample plot is an area of 500 $m^2$ in size, containing a small group of trees that are measured every 10 years. The dead trees category includes only dead standing trees and logs, both with useless wood, and does not including stumps, snags, and fallen tree-branches. The volumes of the dead wood trees were estimated using the average volume of each diameter class, taking into consideration the average form height of the key tree species for the particular habitat types (Kotar 2003).

On the national level, which is presented in this paper, all data are agglomerated according to predominant habitat type in each compartment.

### Monitoring of level I and II plots – *Praćenje pokusnih ploha na razini I i II*

In order to follow the main objectives of the pan-European monitoring programme of forest ecosystems, established as ICP Forests monitoring (Anonymous 1985, de Vries et al. 2003a, 2003b), among which is also the biodiversity assessment, a systematic large-scale monitoring network (Level I) and an Intensive Forest Monitoring Programme (Level II) were set up in Slovenia. On 39 plots of a systematic grid (16 × 16 km) of Level I and on 11 Intensive Monitoring (IM) plots of Level II, each of them 400 $m^2$ in size, the diversity of woody species (shrubs, trees, woody climbers) and the cover of vertical vegetation layers (total cover of all layers, cover of ground layers including shrub, herb and moss layer, separate cover of tree and shrub layer) have been studied. The site parameters (elevation, slope, share of surface covered by rocks) have also been estimated. The source of the plant species nomenclature was Martinčič et al. (2007).

For each plot, the species richness and the Shannon [$H = - \sum (p_i \log (p_i))$] diversity index were estimated, where $p_i$ means share of plant species *i* of total. Regarding habitat types, the site parameters, cover of vertical vegetation layers and plant species diversity parameters have been analysed. The main diversity and compositional gradients of selected plots and habitat types were extracted by using detrended correspondence analysis (DCA, PC-ORD) (Hill and Gauch 1980, McCune and Mefford 1999, McCune and Grace 2002). The Spearman correlation coefficients (r) between the DCA axes (plot scores) and the studied parameters were calculated.

### Evaluation of threats – *Procjena ugroženosti*

The risk levels of threats has been estimated per habitat type based on evaluation of actual danger states at global to continental scales (Groom et al. 2006, Anonymous 2008a) and on the regional scale (Čater et al. 2003, Simončič et al. 2008, Lorz et al. 2010), partly assessed by ICP Forests monitoring (Anonymous 1985, de Vries et al. 2003a, 2003b) and the long-term assessment of the forest ecosystems by the forest management planning system, and taking into account the prediction of climate-change impacts on forests (Anonymous 2008a, Kutnar et al. 2009, Kutnar and Kobler 2011). Following the criteria for the assessment of habitat quality approach (Groom et al. 2006, Anonymous 2008b, Lengyel et al. 2008a, 2008b), the impacts of the following threats have been assessed: climate change, fragmentation, pollution, invasive species, over-exploitation, and fires.

## RESULTS – Rezultati

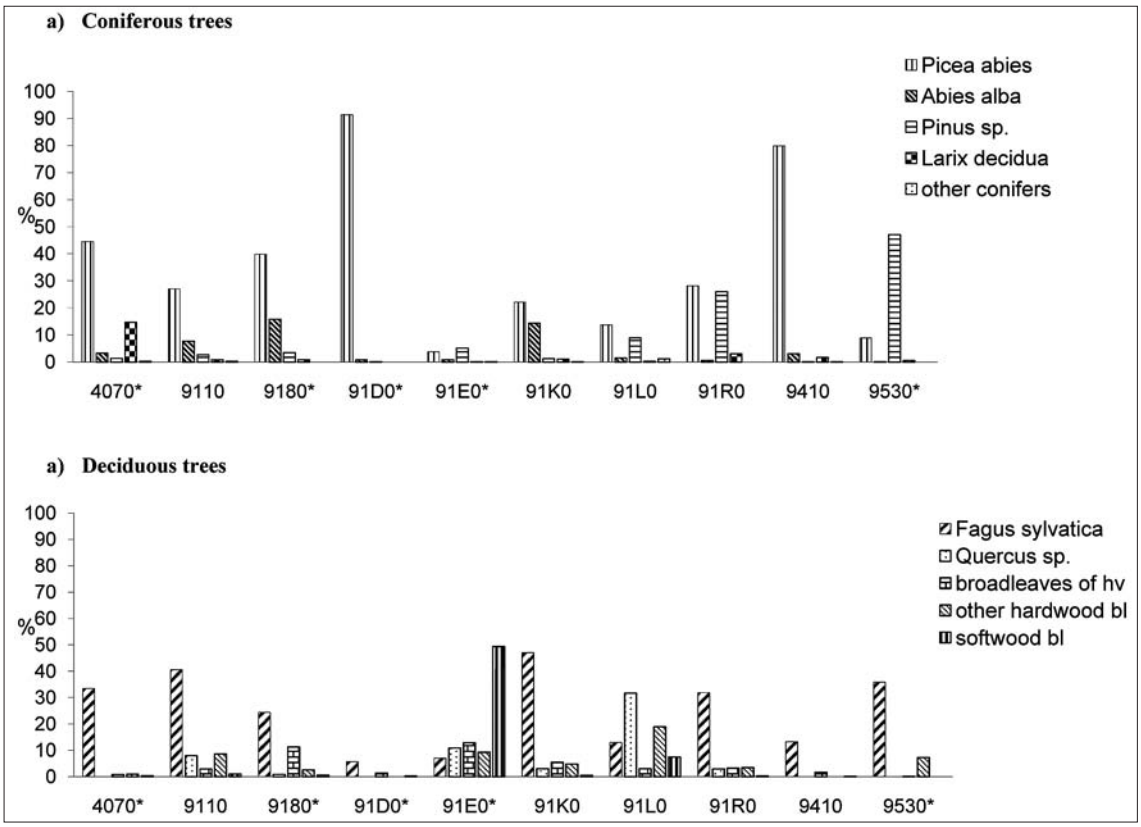
### Forest inventory and threats – *Inventura šuma te pregled ugroženosti*

The most extensive habitat types in the Natura 2000 network in Slovenia are the following: 91K0 Illyrian *Fagus sylvatica* forests (75.6 % of all forest habitat-types area), 9110 *Luzulo-Fagetum* beech forests (9.1 %) and 91L0 Illyrian oak-hornbeam forests (7.2 %). The share of minor habitat types, for example 9180* *Tilio-Acerion* forests of slopes, screes and ravines, 91D0* Bog woodland, and 9530* (Sub-) Mediterranean pine forests with endemic black pines, does not exceed 0.3 % of the total habitat-types area (Table 2). Some of minor habitats are not treated by the forest management system as an autonomous category, e.g. 91F0, 9420. The habitat type 91F0 Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*) is included in 91LO and in 91E0*. The habitat type 9420 Alpine *Larix decidua* is in 4070* and in 9410. Such merging of habitats might be a source of data inaccuracy for some habitats.

Table 2 Area of habitat type, and volume of growing stock and dead wood per habitat type (source: Anonymous 2006b)
*Tablica 2. Površina tipa staništa te volumen drvne zalihe i mrtvog drveta po tipu staništa (izvor: Anonymous 2006b)*

| Habitat *Stanište* | Area (hectare) *Površina (ha)* | Share of all forests (%) *Udio šuma (%)* | Number of sample plots *Broj pokusnih ploha* | Growing stock ($m^3$ per hectare) *Drvna zaliha ($m^3$/ha)* | Volume of dead wood ($m^3$ per hectare) *Volumen mrtvog drveta ($m^3$/ha)* | Dead wood vs. growing stock (%) *Udio mrtvog drveta u volumenu sastojine (%)* |
|---|---|---|---|---|---|---|
| 4070* | 15,313 | 1.29 | 142 | 84 | 5.0 | 5.9 |
| 9110 | 31,541 | 2.66 | 2,653 | 308 | 8.6 | 2.8 |
| 9180* | 485 | 0.04 | 81 | 289 | 1.8 | 0.6 |
| 91D0* | 356 | 0.03 | 28 | 298 | 6.5 | 2.2 |
| 91E0* | 5,486 | 0.46 | 468 | 226 | 2.4 | 1.1 |
| 91K0 | 265,075 | 22.38 | 24,575 | 286 | 12.3 | 4.3 |
| 91L0 | 24,857 | 2.10 | 2,089 | 261 | 7.8 | 3.0 |
| 91R0 | 2,482 | 0.21 | 63 | 163 | 5.1 | 3.1 |
| 9410 | 2,016 | 0.17 | 244 | 331 | 6.9 | 2.1 |
| 9530* | 754 | 0.06 | 8 | 183 | 24.2 | 13.2 |
| Habitats *Staništa* | 348,365 | 29.42 | 30,351 | 276 | 11.4 | 4.1 |
| Other forests *Ostale šume* | 835,816 | 70.58 | 69,827 | 266 | 9.6 | 3.6 |
| All forests *Sve šume* | 1,184,181 | 100.00 | 100,178 | 269 | 10.1 | 3.8 |

The share of Norway spruce (*Picea abies* (L.) Karst.) in growing stock appears to be the highest in habitat types of 91D0* Bog woodland, 9410 Acidophilous *Picea* forests, and 4070* Bushes with *Pinus mugo* and *Rhododendron hirsutum*, while common beech (*Fagus sylvatica* L.) dominates in 91KO Illyrian *Fagus sylvatica* forests and in 9110 *Luzulo-Fagetum* beech forests. In the habitat type 91R0 Dinaric dolomite Scots pine forests, the share of beech and spruce is about the same (Fig. 1). The group of different softwood deciduous trees has the highest share of growing stock in 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*, the oak species (*Quercus* sp.) in 91L0 Illyrian oak-hornbeam forests, and the pine species (*Pinus* sp.) in 9530* (Sub-) Mediterranean pine forests with endemic black pines.




Legend: broadleaves of hv (high value): *Acer sp., Fraxinus sp., Ulmus sp*., other hardwood bl (broadleaves): *Carpinus betulus, Ostrya carpinifolia, Sorbus sp.*, softwood bl (broadleaves): *Salix sp., Populus sp., Alnus sp. Legenda: bjelogorica visoke vrijednosti (high value): Acer sp., Fraxinus sp., Ulmus sp., ostala bjelogorica (tvrdo drvo): Carpinus betulus, Ostrya carpinifolia, Sorbus sp., ostala bjelogorica (mekano drvo): Salix sp., Populus sp., Alnus sp.*

Figure 1 Tree species share of growing stock (%) per habitat type, a) for coniferous trees and b) for deciduous trees.
*Slika 1. Udio vrsta drveće u drvnoj zalihi (%) po tipu staništa, a) za crnogoricu b) za bjelogoricu.*

The mean growing stock per habitat type is between 84 m$^3$ per hectare in the 4070* Bushes with *Pinus mugo* and *Rhododendron hirsutum* to 331 m$^3$ per hectare in the 9410 Acidophilous *Picea* forests. The relative high growing stock of scrublands of 4070* is related to the merging of habitats and agglomeration of data on the compartment level (including also some spruce stands, larch stands and beech stands). The mean annual increment of wood is between 1.3 and 8.0 m$^3$ per hectare (Fig. 2).

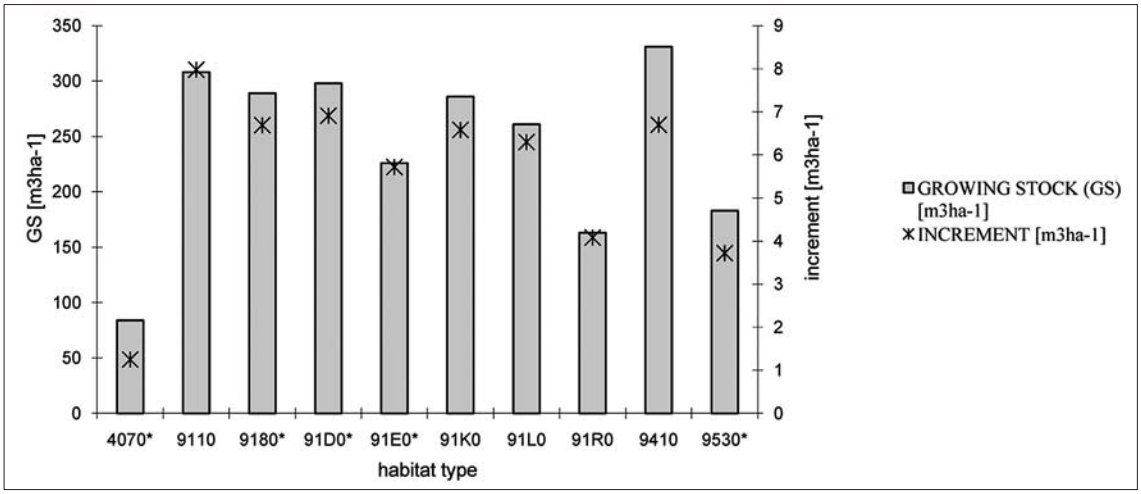



Figure 2 Mean growing stock (GS) and mean increment of wood per habitat type (habitat-type labels according to Table 1) (source: forest inventory conducted by Slovenian Forest Service)
*Slika 2. Prosječna drvna zaliha (GS) i prosječni prirast po tipu staništa (oznake tipa staništa sukladno tablici 1) (izvor: inventura šuma Šumarske službe Slovenije/Zavoda za gozdove Slovenije)*

The average volume of dead wood trees per hectare varies from 1.8 $m^3$ (9180*) to 24.2 $m^3$ (9530*) and is 11.4 $m^3$ per hectare for all forest habitat types (Table 2). However, due to the low number of sample plots in habitat type 9530*, and in comparison to the average quantity of dead wood for all forests, it might be overestimated. The share of dead wood versus growing stock varies from 0.6 % to 13.2 %, and the mean share is 4.1 %.

The duration of a particular developmental phase varies depending on the site conditions and the tree species composition. It has been estimated that the general duration for the phase of young growth is until the age of about 30 years. The majority of trees in the phase of thinner pole-stand are between 20 and 50 years, in the phase of thicker pole-stand are between 40 and 70 years, in the phase of timber-stand are from 60 to 140 years, and in the phase of rejuvenation of timber stand are from 90 to 160 years. The thicker pole-stands or timber stands prevail in all habitat types (Table 3). Regarding the specific site and stand characteristics of the 4070* Bushes with *Pinus mugo* and *Rhododendron hirsutum*, a high share of younger pole stands is expected. The share of young growth in this habitat type, and in 9530* (Sub-) Mediterranean pine forests and in 9180* *Tilio-Acerion* forests is very low. The share of the last category (Others) in Table 3 consists of somewhat degraded forest stands, is relatively high in the 91L0 habitat type.

Table 3 Share of developmental phases (in %) in respect of habitat type
*Tablica 3. Dio razvojnih stadija (u %) po tipovima staništa*

| | Young growth *Mlade sastojine* | Thinner pole-stand *Tanje srednjedobne sastojine* | Thicker pole-stand *Deblje srednjedobne sastojine* | Timber-stand *Starije sastojine* | Old-stand in rejuvenation phase *Stare sastojine u pomlađivanju* | Selection forest *Preborne sastojne* | Others *Ostalo* |
|---|---|---|---|---|---|---|---|
| | (%) | (%) | (%) | (%) | (%) | (%) | (%) |
| 4070* | 1.0 | 43.9 | 44.8 | 7.9 | 1.1 | 0.0 | 1.3 |
| 9110 | 7.0 | 1.4 | 33.3 | 46.4 | 9.3 | 0.8 | 1.8 |
| 9180* | 2.0 | 0.0 | 22.6 | 53.9 | 21.1 | 0.4 | 0.0 |
| 91D0* | 11.5 | 10.5 | 30.1 | 41.7 | 6.2 | 0.0 | 0.0 |
| 91E0* | 10.0 | 4.5 | 49.3 | 29.1 | 3.1 | 0.0 | 4.0 |
| 91K0 | 5.2 | 3.4 | 36.0 | 39.5 | 9.5 | 1.9 | 4.5 |
| 91L0 | 4.6 | 2.3 | 37.8 | 40.6 | 4.0 | 0.0 | 10.7 |
| 91R0 | 4.0 | 6.5 | 55.1 | 31.4 | 2.0 | 0.0 | 1.0 |
| 9410 | 3.5 | 5.4 | 19.8 | 60.2 | 11.1 | 0.0 | 0.0 |
| 9530* | 0.2 | 3.6 | 85 | 7.9 | 2.4 | 0.0 | 0.9 |

On average, more than three quarters of the forests in the Natura 2000 area are estimated to be preserved (Table 4). In all habitat types, a low share of altered forests has been estimated. The habitat types with shares of changed and strongly changed forests higher than one third are the following: 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*, 91L0 Illyrian oak-hornbeam forests, 9110 *Luzulo-Fagetum* beech forests, and 4070* Bushes with *Pinus mugo* and *Rhododendron hirsutum*. A relatively low share of changed forests was found in the dominant habitat type of 91K0 Illyrian *Fagus sylvatica* forests. However, we must stress that the relatively high share of changed forest in 4070* is partly also due to data collecting methods. The naturalness level is calculated regarding the model tree species composition and the actual situation/state within a compartment. As the data are related to the compartment levels (which can be composed by more different stands – spruce stands, beech stands, larch stands, *Pinus mugo* stands etc.), a bias in naturalness level is possible, especially for habitat types with lower areas (also 4070*).

The evaluated threat status of the forest habitat types based on long-term assessment and on different studies

Table 4 Share of habitat types in respect to estimation of naturalness level
*Tablica 4. Udio tipova staništa prema stupnju prirodnosti*

| Naturalness level *Stupanj prirodnosti* | 4070* | 9110 | 9180* | 91D0* | 91E0* | 91K0 | 91L0 | 91R0 | 9410 | 9530* |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 61.0 | 62.8 | 82.1 | 74.4 | 59.1 | 77.6 | 60.6 | 70.1 | 81.6 | 98.4 |
| 2 | 26.3 | 33.5 | 16.5 | 21.1 | 40.1 | 18.6 | 35.9 | 18.2 | 15.4 | 1.6 |
| 3 | 11.6 | 3.4 | 1.4 | 4.5 | 0.8 | 3.5 | 2.9 | 11.6 | 1.3 | 0.0 |
| 4 | 1.1 | 0.3 | 0.0 | 0.0 | 0.0 | 0.4 | 0.5 | 0.0 | 1.7 | 0.0 |

Legend: Naturalness level: 1-preserved forests (up to 30 % of foreign tree species), 2-changed forests (31–70 %), 3-strongly changed forests (70–90 %), and 4-altered forests (above 90 % of foreign tree species)
*Legenda: Stupanj prirodnosti: 1- očuvane šume (do 30 % stranih vrsta drveća), 2- djelomično izmijenjene šume (31–70 %), 3- jače izmijenjene šume (70–90 %) i 4 – izmijenjene šume (više od 90 % stranih vrsta drveća)*

Table 5 Evaluation of the potential threats to existence of habitat types (higher risk is marked as ***, medium risk as **, and very low risk as *)

*Tablica 5. Procjena potencijalnih prijetnji očuvanju tipova staništa (veći rizik označen je sa ***, srednji rizik sa **, i nizak rizik sa *)*

| | 4070* | 9110 | 9180* | 91D0* | 91E0* | 91K0 | 91L0 | 91R0 | 9410 | 9530* |
|---|---|---|---|---|---|---|---|---|---|---|
| Climate changes<br>*Klimatske promjene* | ** | ** | *** | *** | *** | ** | *** | * | *** | * |
| Fragmentation<br>*Fragmentacija* | ** | * | *** | *** | *** | * | ** | ** | * | *** |
| Pollution<br>*Zagađenje* | * | ** | ** | *** | *** | * | ** | ** | *** | * |
| Invasive species<br>*Invazivne vrste* | * | ** | ** | * | *** | * | ** | * | * | * |
| Overexploitation<br>*Prevelika eksploatacija* | * | ** | *** | ** | ** | * | ** | * | ** | * |
| Forest fires<br>*Šumski požari* | ** | * | * | * | * | * | ** | *** | * | *** |

by is presented in Table 5. The highest risks/threats have been evaluated for the habitat type 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*. Furthermore, the 91L0 Illyrian oak-hornbeam forests, and small-sized habitat types of 9180* *Tilio-Acerion* forests of slopes, screes and ravines, and 91D0* Bog woodland might be also potentially endangered by different threats.

## Level I and level II plots – *Pokusne plohe na razini I i II*

On 39 study plots of Level I and 11 plots of Level II, we found a total of 102 woody species, of which 46 were tree species, and 56 were shrubs and woody climbers. The most common species are *Fagus sylvatica* L. and *Picea abies* (L.) Karst., both occurring on 39 plots (78 %). One of the very common species is *Acer pseudoplatanus* L., present on 37 plots but mostly in ground layers (in tree layer only on 21 plots). Other more frequent species that have been found include the following: *Quercus petraea* (Matt.) Liebl. (21 plots), *Prunus avium* L. (20), *Abies alba* Mill. (19), *Carpinus betulus* L. (18), *Fraxinus excelsior* L. (17), *Sorbus aucuparia* L. (17), *Sorbus aria* (L.) Cr. (16), *Castanea sativa* Mill. (15), and *Fraxinus ornus* L. (15).

The mean species richness per plot is 14.8 ± 7.0, ranging from 2 to 36 woody species.

Based on the diversity of woody species, a DCA ordination of the plots has been extracted (Fig. 3). The mesic *Fagus sylvatica* plots are centrally placed in the ordination space. Plots of the 91K0 Illyrian *Fagus sylvatica* forests obtain a middle DCA1 score, and middle to low scores of DCA2. Plots of the 9180* *Tilio-Acerion* forests have higher scores along the first axis,

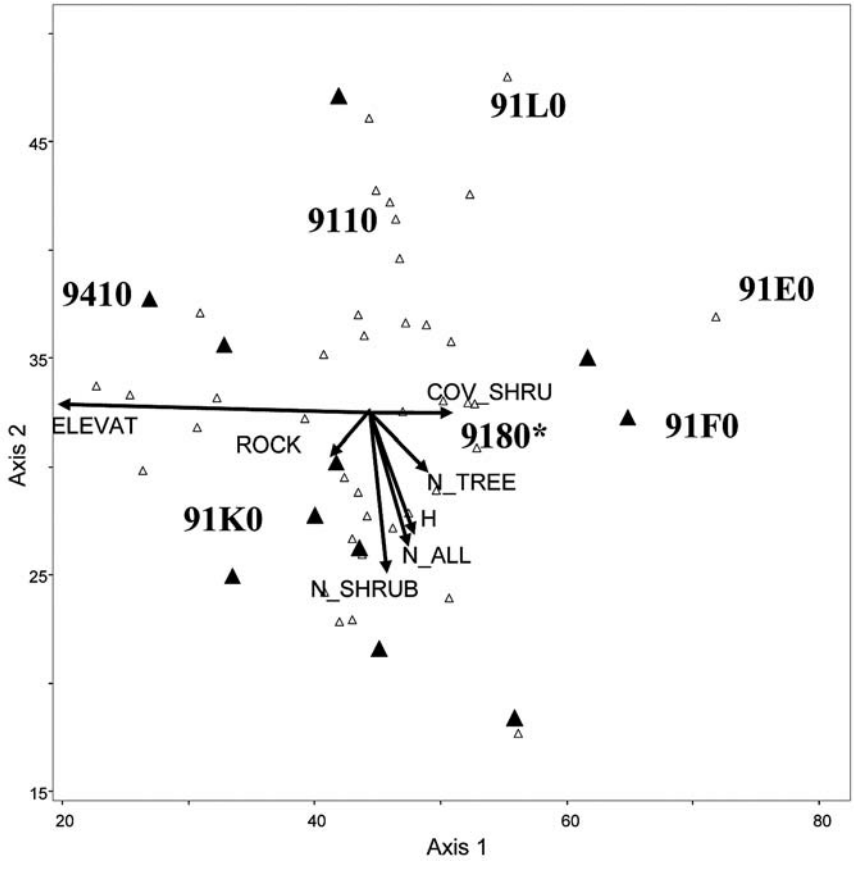



Figure 3 DCA ordination of the Level I (Δ) and Level II (▲ ) plots based on diversity of woody species for Axes 1 and 2. The biplot overlay shows vectors related to diversity and to site parameters. The forest habitat types (see Table 1) of Annex 1 are indicated.

*Slika 3. DCA ordinacije ploha razine I (Δ) i razine II (▲ ) na osnovi različitosti vrsta drveća za os 1 i 2. Vektori su u odnosu prema parametrima različitosti i staništa. Označeni su tipovi šumskih staništa (vidi Tablicu 1) Aneksa 1.*

and the plots of lowland forest habitats of 91F0 and 91E0* have the highest scores along the first axis. In contrast, the 9410 Acidophilous *Picea* forests of the montane to alpine levels have low DCA1 scores. Beside the plots with predominantly *Picea abies* trees, *Fagus sylvatica* and *Abies alba*-plots of high montane zone also occur on the left side of the ordination space. In the upper part of ordination space, the plots of 9110 habitat type of acidophilic beech forest and 91L0 Illyrian oak-hornbeam forests are placed.

On average, in the lower part of the ordination space are placed plots/habitat types with higher values of diversity parameters, while in the upper part are those with lower values of these parameters (Fig. 3). Significant negative correlations were found between the second axis and the parameters of species diversity: total number of woody species (N_ALL, r = -0.620***); number of shrub and climber species (N_SHRUB, r = -0.653***); number of tree species (N_TREE, r = -0.459***); Shannon diversity index (H, r = -0.619***). The first axis correlates closely with elevation of the plots (ELEVAT–height above sea level; r = -0.891***), and with shrub-layer cover (COV_SHRU; r = 0.475***). The second axis correlates negatively with the rock share (ROCK; r = -0.592***). Other parameters not presented on Fig. 3 have no clear tendency.

## DISCUSSION – Rasprava

### Forest management of habitat types – *Gospodarenje šumskim staništima*

Based on the studied forest-specific parameters, we can assume that most woodland and forest habitat types in Slovenia are considered appropriate by the existing forest management planning system. Important indicators relevant for the favourable conservation system of habitat types are already in use by forest management planning system in all forests. Some additional indicators, not included in forest inventory system, are tested on different monitoring-levels (e.g. ICP Forests). However, some of them (e.g. threats) have to be adapted for forest inventory use in all Slovenian forests.

In Slovenia, the ideas of forest planning and management oriented towards the natural species composition and natural forest regeneration have an important place in sustainable forest management. The relatively large volume of growing stock is stimulated by forest management, and a high share of dead wood of different sizes has to be kept in forest ecosystems. Nevertheless, the estimation of forest-stand parameters to evaluate the status of Slovenian forest habitats revealed some weak points. Taking into account some mapping and classification problems (e.g. some habitats are inadequately treated; some habitat types are not well defined), the evaluation of some parameter values might be biased. The data are more reliable for the forest habitat types with larger areas, such as 91K0 Illyrian *Fagus sylvatica* forests, 9110 *Luzulo-Fagetum* beech forests and 91L0 Illyrian oak-hornbeam forests. However, the forest habitats with larger areas encompass diverse site and stand situations, and indicator values on levels of habitat type could be only informative. For instance, the largest habitat type of 91K0 Illyrian *Fagus sylvatica* forests is characterised by broad ecological amplitude and an array of forest associations; ranging from thermophilic beech forest in the Sub-Mediterranean region to subalpine beech forest in Julian Alps. In such cases, instead of the entire habitat type, the indicators of favourable conservation status should at least be tested for group of associations.

The EU priority habitat types, such as 4070* Bushes with *Pinus mugo* and *Rhododendron hirsutum*, 9180* *Tilio-Acerion* forests of slopes, screes and ravines, 91D0* Bog woodland, 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*, 9530* (Sub-) Mediterranean pine forests with endemic black pines, should be brought more into focus. Moreover, the level of mapping accuracy of EU priority habitat types and rare habitats on the national level requires significant improvements.

For example, unambiguous distinctions must be made between the 91L0 Illyrian oak-hornbeam forests and scattered fragments of the 91F0 Riparian mixed forest of *Quercus robur* and other broadleaved species growing in the lowland of the eastern part of Slovenia (Čater et al. 2001, Kutnar 2006); and between 4070* Bushes with *Pinus mugo* and *Rhododendron hirsutum* and 9420 Alpine *Larix decidua* forests (Dakskobler et al. 2010). Special attention has to be given to some other woodland habitat types of low economic interest but of high conservation importance, such as very rare patches of the 9340 habitat type of Mediterranean *Quercus ilex* forests in the western part of Slovenia (Dakskobler 1997) and 5130 *Juniperus communis* formations on heaths or calcareous grasslands.

### Indicators – *Pokazatelji*

A comparison of the actual tree species composition of habitat types to the relevant information on forest plant associations as a benchmark (Bončina and Robič 1998) indicates that the major part of forests are well preserved. The forests with more than 70 % of inappropriate tree species cover only 4 % of all habitat type area. The preserved forests with low shares of foreign tree species represent 74 % of all Natura 2000 forests in Slovenia, and the share of such forests is even higher in the dominant habitat type of 91K0 Illyrian *Fagus sylvatica* forests. Due

to intensive human impact, the habitat types of 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*, and 91L0 Illyrian oak-hornbeam forests, both occurring in lowland and hilly area, incorporate the lowest share of preserved forests.

The diversity of developmental phases and the balance between them is an important issue in the sustainability of forest habitats (Müller-Kroehling et al. 2004). Age structure (age class distribution) and regeneration are important MCPFE indicators of habitat types (Anonymous 2002, 2007c), but the specific site and stand conditions of each habitat type have to be taken into account. For instance, it is obvious that the 4070* habitat type of bushes with *Pinus mugo* and *Rhododendron hirsutum* cannot reach the timber stand phase, except those patches which are colonised by *Larix decidua* and *Picea abies*. Generally, however, natural regeneration plays an important role in the stability and sustainability of a forest habitat type, and it seems that the lack of young growth could pose a threat to it. From that point, the share of younger stands (young growth and younger pole stand) in the 9180* *Tilio-Acerion* forests of slopes, screes and ravines, and in 9530* (Sub-) Mediterranean pine forests with endemic black pines is low. However, the developmental phases are balanced in the most extensive habitat type of 91K0 Illyrian *Fagus sylvatica* forests, and also in the 9110, 91D0* and 91E0* habitat types.

Generally, increasing the quantity of wood is an important issue of forest management. In Slovenia, the share of forest and growing-stock quantity are relatively high, and they have been constantly increasing in recent decades (Perko 2004, Anonymous 2005, Lesnik and Matijašić 2006), playing an important role as carbon storage (Fan et al. 1998, Hamilton et al. 2002, Nabuurs and Schelhaas 2002, Gutrich and Howarth 2007, Piškur and Krajnc 2007).

The estimated volume of dead wood of 11.4 $m^3$ per hectare in Slovenia is comparable to other studies (e.g. Kirby et al. 1998, Fridman and Walheim 2000, Marage and Lemperiere 2005, Anonymous 2007c). Also, according to the forest management planning system in Slovenia, dead wood has been accepted as one of the crucial elements of stable forests (Papež et al. 1997), playing multifunctional roles and being a very significant factor of biodiversity of forest ecosystems (Harmon et al. 1986, Franklin et al. 1987, Crites and Dale 1998, Bormann and Likens 1994, Peterken 1996, Kraigher et al. 2002, Kutnar et al. 2002, Ódor and van Doort 2002, Piltaver et al. 2002). The amount of dead wood suggested by Papež et al. (1997) for Slovenian forests is between 0.5 % and 3 % of growing stock. However, the evaluation of dead wood per habitat type showed an even higher average share of 4.1 %, ranging between 0.6 % and 13.2 % per habitat type. In managed forests, the amounts of dead wood are much lower than in unmanaged forests (Kirby et al. 1998, Fridman and Walheim 2000, Marage and Lemperiere 2005); for example, the amount of dead wood in studied forest reserves in Slovenia, mostly located in 91K0 Illyrian *Fagus sylvatica* forests, varies from 69 to 568 $m^3$ per hectare, while the growing stock ranges from 525 to 813 $m^3$ per hectare (Hahn and Christensen 2004). However, dead wood is a very important functional and biodiversity element of managed forests as well, and the share of it could even be increased in some habitats (e.g. 9180*, 91E0*).

A comparison of the woody species diversity of Level I and Level II plots to the biodiversity states of other countries involved in the Intensive Monitoring Programme (Dobremez et al. 1997, de Vries et al. 2003b, Fabiánek 2004, Seidling 2005, Soriano et al. 2005), using the same ICP Forests methodology (Anonymous 1985, de Vries et al. 2003a), proved the high species diversity of Slovenian forest habitat types. On Level I and Level II plots, the variation in diversity of species is closely related to bedrock type and soil conditions. Generally, the plots and habitat types with high values of diversity parameters (number of species, and diversity index) are located on different types of carbonate bedrock, for example limestone and dolomite; those with low values are placed on different non-carbonate bedrock (e.g. sandstone, claystone).

## **Existing and potential threats** – *Postojeća i potencijalna ugroženost*

In the context of conservation of habitat types and of biodiversity, the pressure of a large set of different threats is a major concern (Groom et al. 2006, Anonymous 2007a). Among the most frequently monitored causes underlying the potential changes of habitat types from the data obtained in the habitat monitoring schemes (Lengyel et al. 2008a) were land use, fragmentation, pollution, and invasive species. In general, minor habitat types like 91D0* Bog woodland, 9180* *Tilio-Acerion* forests of slopes, screes and ravines, and 9530* (Sub-) Mediterranean pine forests are more endangered than habitat types with larger areas. Since the rare patches of bog ecosystems in Slovenia are situated at the southern border of the Sphagnum-mire distribution in Europe (Kutnar and Martinčič 2003), the effects of predicted climate warming for this area (Bergant 2007, Anonymous 2008c, Kutnar et al. 2009, Kutnar and Kobler 2011) might have dramatic consequences. Beside the effect of elevated temperature on the hydrology status of peat bogs and peat decomposition, high atmospheric nitrogen deposition also accelerates the peat decomposition processes (Bragazza et al. 2004, 2006).

Mountain ecosystems are especially vulnerable (Anonymous 2007a, 2008c, Čas 2010), and the significant changes in response to climate changes might be expected at the upper-tree line (Körner 1998, Grace et al. 2002, Dullinger et al. 2004), which is, in Slovenia, dominated by the habitat type of 4070* Bushes with *Pinus mugo* and *Rhododendron hirsutum*. Moreover, climate change will more or less affect all forest habitat types. Different simulations of climate change effects predict the shift of forest vegetation belts (Brzeziecki et al. 1995, Kienast et al. 1996, 1998, Dow and Downing 2006, Anonymous 2008c), and significant changes in the distribution of forest habitat types in Slovenia driven by climate change have been predicted (Kutnar et al. 2009, Kutnar and Kobler 2011). In the Sub-Mediterranean region of Slovenia, forest fires cause significant damage (Mavsar et al. 2005, Jakša 2006). The thermophilic forests of this region, such as 9530* (Sub-) Mediterranean pine forests with endemic black pines, are very sensitive to fires (Urbančič and Dakskobler 2001).

Some of the most threatened ecosystems are floodplain and lowland forests corresponding to the 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*, 91F0 Riparian mixed forests of *Quercus robur* and other broadleaves, and 91L0 Illyrian oak-hornbeam forest, which have always sustained heavy anthropogenic impacts (Klimo and Hager 2001, Čater et al. 2001). In Slovenia, the share of converted or partly converted forests to forests of foreign tree species (predominantly spruce) is the highest in the habitat types of 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*, and 91L0 Illyrian oak-hornbeam forests (in forest-management analysis including also 91F0). Floodplain forest ecosystems in Slovenia have experienced watercourse regulation, resulting in the termination of floods and groundwater table decrease. They were decreased in favour of agriculture, often to the level of strip-like riparian stands. The interaction between forests and intensively managed agricultural land in their immediate vicinity is demonstrated in the increased input of various substances, particularly through wind erosion and drift from fields to forests. In the Slovenian floodplain forests, many invasive species are successfully out-competing native species and affecting habitats; this problem is also increasingly regarded as one of the major threats to biodiversity on the global level (Groom et al. 2006, Anonymous 2007a). The 91L0 Illyrian oak-hornbeam forests in the hilly zone of the country are being pressured by a similar process of degradation as previous ones. The relatively high share of coppice, litter-raking and other degraded forests in the habitat type reflects the negative human impact in this area. For optimal functioning of forest ecosystems, human-induced and all other threats have to be monitored and excluded as much as possible. In the first step, the management planning system has to recognise the existing and potential negative impacts on forest ecosystems.

The majority of studied forest-stand parameters indicate the favourable conservation status of forest habitat types. Therefore, the Slovenian forest management system represents a case of good practice in the monitoring and maintaining of forest habitat types. However, some improvements of the existing forest management planning system with special attention to the EU priority habitats (e.g. 9180*, 91D0*, 4070*) and the rare habitats in Slovenia (e.g. 9340, 91F0) have to be made. In addition to the studied parameters, some additional, e.g. habitat specific parameters/indicators need to be estimated to achieve the goals of Natura 2000.

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*SAŽETAK: NATURA 2000 je jedinstvena ekološka mreža, koja obuhvaća područja važna za očuvanje ugroženih vrsta i stanišnih tipova Europske Unije. Određena je u skladu s EU Direktivom o staništima (Anonymous 1992b) te EU Direktivom o pticama (Anonymous 1979) s ciljem očuvanja biološke raznolikosti na europskom teritoriju. EU Direktiva o staništima (Anonymous 1992b) preporučuje procjenu statusa zaštite tipova staništa unutar područja NATURA 2000. Za procjenu statusa zaštite potrebno je izabrati primjeren skup pokazatelja, koji su već usklađeni unutar država EU. Međutim, zajednički standard za nadgledanje i kontrolu staništa nije još bio usklađen na EU razini (Cantarello i Newton 2008), tako da su pojedine države članice usvojile različite pristupe i pokazatelje (Anonymous 2004, Ellmauer 2005, Groom 2007).*

*Sustav upravljanja šumama prepoznat je kao mogući način za nadgledanje i kontrolu staništa u širem smislu (Goldsmith 1991, Corona et al. 2004, Marchetti 2004a). Na temelju tih načela, način upravljanja šumama u Sloveniji može poslužiti kao dragocjeno oruđe za očuvanje šumskih ekosustava i stanišnih tipova (Golob 2006, Kepic i Fučka 2006) na područjima ekološke mreže NATURA 2000 (Anonymous 1992b). Za većinu je indikatora, koji su relevantni za procjenu statusa zaštite stanišnih tipova, (Golob 2006) utvrđeno da su oduvijek bili sastavni dio tradicionalnog sustava upravljanja šumama, bez obzira na vlasništvo. Veći dio njih također je naveden u popisu MCPFE (Anonymous 2002, 2007c).*

*Ciljeve istraživanja postavili smo uzevši u obzir dvije razine nadzora i kontrole upravljanja šumama u Sloveniji (inventura šuma, dvije razine "ICP Forests" monitoringa): a) ocijeniti skup pokazatelja staništa na području ekološke mreže NATURA 2000 te osigurati standarde budućeg upravljanja tih staništa, b) identificirati moguće prijetnje opstanka određenog tipa staništa c) na temelju pokazatelja i ugroženosti, ocijeniti stanje šumskih stanišnih tipova u skladu s Direktivom o staništima te predložiti moguće prilagodbe postojećeg sustava upravljanja šumama za područja stanišnih tipova ekološke mreže NATURA 2000.*

*Upotrijebljeni su podaci o površini staništa, vrstama drveća, razvojnim stadijima sastojina i pomladku, drvnoj zalihi, prirastu, mrtvom drveću i stupnju prirodnosti šuma.*

*Šumski tipovi staništa NATURA 2000 u Sloveniji predstavljaju skoro trećinu cjelokupne površine šuma. Glavni šumski tipovi staništa su 91K0 Ilirske*

*šume bukve (*Fagus sylvatica*), 9110 Šume bukve na staništu* Luzulo-Fagetum *te 91L0 Ilirske šume hrasta i bjelograbića. Udio manjih stanišnih tipova, na primjer 9180* Tilio-Acerion šume velikih nagiba i klanaca, 91D0* Cretne šume na sfagnumskom cretu, i 9530* Sub-mediteranske šume crnog bora, ne prelazi 0,3 % ukupne površine svih stanišnih tipova. (Tablica 2).*

*Prosječna drvna zaliha po tipovima staništa iznosi od 84 $m^3$/ha (tip 4070*) do 331 $m^3$ $m^3$/ha (tip 9410). Srednja vrijednost volumena mrtvog drveta iznosi 11,4 $m^3$ po hektaru, od 0,6% do 13,2 % od drvne zalihe po tipu staništa (Tablica 2). Na plohama ICP monitoringa utvrdili smo visok stupanj različitih vrsta drveća i grmlja: zajedno smo utvrdili 102 drvenastih biljaka, od toga 46 različitih vrsta drveća.*

*Uzevši u obzir neposredan utjecaj ljudskih aktivnosti te potencijalni učinak klimatskih promjena, možemo reći da su poplavne i nizinske šume johe (*Alnus glutinosa*) i velikog jasena (*Fraxinus excelsior*), mješovite šume hrasta (*Quercus robur*) i ostale bjelogorice na riječnim obalama, kao i ilirske šume hrasta i bjelograbića, među najugroženijima unutar tipova staništa NATURA 2000. Uzevši u obzir malu površinu tipova staništa te različite uzroke ugroženosti, ocjenjujemo da su najugroženija i prioritetna staništa Tilio-Acerion šuma velikih nagiba i klanaca, Sub-mediteranskih šuma crnog bora i cretnih šuma (Tablica 4 i 5).*

*Unatoč velikom broju različitih čimbenika koji ugrožavaju slovenske šume, velik je broj istraženih parametara pokazao povoljan status očuvanja šumskih tipova staništa. U Sloveniji je udio šuma (te njihova drvna zaliha) relativno velik, njihov rast traje već desetljećima (Perko 2004, Anonymous 2005, Lesnik and Matijašić 2006). Očuvane šume s niskim postotkom stranih vrsta drveća predstavljaju 74 % svih šuma na području ekološke mreže NATURA 2000, a udio takvih šuma još je veći kod dominantnog tipa 91K0 Ilirske bukove šume.*

*Usporedba raznolikosti vrsta drveća na plohama Razine I i Razine II sa stanjem biološke raznolikosti drugih zemalja, koje također sudjeluju u programu intenzivnog nadzora/motrenja (Dobremez et al. 1997, de Vries et al. 2003b, Fabiánek 2004, Seidling 2005, Soriano et al. 2005) te koriste istu ICP Forests metodologiju (Anonymous 1985, de Vries et al. 2003a), pokazala je veliku raznolikost vrsta slovenskih šumskih staništa.*

*Ipak, procjena parametara šumskih sastojina kod ocjene statusa slovenskih šumskim staništa, otkrila je određene slabe točke. Uzevši u obzir određene probleme kartiranja i klasifikacije (npr. upravljanje nekih staništa je neprimjereno, neki tipovi staništa nisu dobro definirani), procjene nekih parametara mogu biti pristrane.*

*Sa tog stajališta, predlažemo dodatna istraživanja tipova staništa, koji su na prioritetnoj listi EU (e.g. 9180*, 91D0*, 4070*) te onih koji su važni s nacionalnog stajališta (e.g. 9340, 91F0), sve u smislu poboljšanja sustava upravljanja šumama.*

*Sustav upravljanja šumama je u Sloveniji usmjeren u očuvanje šumskih tipova staništa. Unatoč tomu, smatramo da ga je potrebno poboljšati na način da aktivno reagiramo na sve prijeteće negativne čimbenike u smislu očuvanja staništa. Zbog toga je potrebno definirati nove pokazatelje nadzora, posebno za svaki šumski tip staništa, te ih uključiti u sustav upravljanja šumama. Neki od tih pokazatelja (npr. ugroženost) moraju biti uključeni u inventuru šuma u Sloveniji.*

*K l j u č n e r i j e č i : biološka raznolikost, povoljan status očuvanja, tip staništa, upravljanje šumama, nadzor, pokazatelj, ugroženost*