

Proceedings of the

International conference Integrated Management of Environmental Resources

Suceava, November 4-6th, 2011

Editura Universității Ștefan cel Mare Suceava

2012

The contributions to this volume have been peer-reviewed.

Referenți / Reviewers:

Ionel Popa - Forest Research and Management Institute (ICAS)

Marian Dragoi – “Ștefan cel Mare” University of Suceava

**Proceedings of the International Conference Integrated Management
of Environmental Resources - Suceava, November 4-6th, 2011**

Editori / Editors: Sergiu-Andrei Horodnic, Mihai-Leonard Duduman, Ciprian Palaghianu

Responsabilitatea integrală privind conținutul lucrărilor prezentate revine autorilor.
Responsibility for the content of these papers rests fully with their authors.

Descrierea CIP a Bibliotecii Naționale a României

**INTEGRATED MANAGEMENT OF ENVIRONMENTAL RESOURCES. International
Conference (2011 ; Suceava) Proceedings of the International conference
Integrated management of environmental resources : Suceava, November 4-
6th, 2011 / ed.: Sergiu-Andrei Horodnic, Mihai-Leonard Duduman, Ciprian
Palaghianu - Suceava : Editura Universității "Ștefan cel Mare", 2012
ISBN 978-973-666-388-8**

I. Horodnic, Sergiu Andrei (ed.)

II. Duduman, Mihai-Leonard (ed.)

III. Palaghianu, Ciprian (ed.)

630(498)(063)

Proceedings

of the International Conference

Integrated Management of Environmental Resources

Suceava, November 4-6th, 2011

Edited by:

Sergiu-Andrei Horodnic

Mihai-Leonard Duduman

Ciprian Palaghianu

„Ștefan cel Mare” University of Suceava, Romania

Table of contents

Managing National Parks in the Czech Republic: Economic Analysis <i>Petra Hlaváčková</i>	4
Forest associations of the National Park Mavrovo in the Republic of Macedonia <i>Jane Acevski, Bojan Simovski</i>	17
The analysis of life quality indicators in the area of natural resources and environment protection in chosen micro-regions of the Czech Republic <i>Jansky Jaroslav</i>	28
Environmental Engineering and Sustainable Forest Management in the Czech Republic <i>Vaclav Kupcak</i>	39
The Illegal Dumping of Waste in Forest Areas - Evidence from Rural Territory <i>Andreea Lămășanu, Florin - Constantin Mihai</i>	46
Current status and prospects of the market with energy woodchips in the Czech Republic <i>Dalibor Šafařík</i>	51
State of the art regarding the ecological and economical assessment of forest sites <i>Alexei Savin</i>	58
Aspects Regarding the Floristic Diversity in the Stands Situated on the Eastern Slope of Stânișoara Mountains and the Influence of the Regeneration Cuttings Upon it <i>Gabriel Dănilă</i>	64

Effects of alterations of Romania's forestry stock area and structure on diurnal Lepidoptera – a GIS approach <i>Andrei Crişan, Cristina Craioveanu, László Rákossy</i>	73
The risk of fire and its management in the forest of Suceava County <i>Ion Burlui</i>	85
Aspects regarding the red deer trophy size (<i>Cervus elaphus</i> L.) in the beech – fir tree mixture areas in comparison with those in the spruce - fir tree areas <i>Nicolae Goicea, Nadia Dănilă</i>	95
Jugglers in statistics of normality <i>Sergiu Andrei Horodnic</i>	102
Restoration Management in Small Forest Watersheds <i>Alice Kozumplikova, Ilja Vyskot, Jiri Schneider</i>	110
Flow-rate estimation of a small watercourse as a basic water balance element of a forest microwatershed <i>Jan Deutscher, Petr Kupec</i>	119
The Romanian Forest Code (Law no. 46/2008, modified). Some opinions about it <i>Viorel-Gheorghe Marinescu</i>	125
Use of building rubble and organic matter mixture as an innovative substrate to improve water regime in degraded soils within processes of land reclamation and reforestation <i>Michal Henek, Miroslav Kravka, Svatava Henková, Radek Dymák</i>	135

Forest associations of the National Park Mavrovo in the Republic of Macedonia

Jane Acevski^a, Bojan Simovski^a

^a University Ss.Cyril and Methodius in Skopje, Faculty of Forestry in Skopje, Department of Botany and Dendrology, bul. Aleksandar Makedonski bb, MK-1000 Skopje, Republic of Macedonia

Corresponding author e-mail address: bsimovski@sf.ukim.edu.mk (B. Simovski)

Abstract: In this scientific paper are observed data related to research conducted of the phytocoenological characteristics of the territory of the National Park Mavrovo in the Republic of Macedonia. Therefore, visited and explored were the mountain massifs: Shar Planina, Korab and Bistra. Within the completed surveys, the standard phytocoenological method of *Braun-Blanquet* was used. On the territory of the Park, authors noted and identified 28 forest communities (19% of the 148 identified plant communities in the Republic of Macedonia), i.e. 4 coastal floodplain (riparian) forest communities, 18 typical forest communities and 6 degraded-coppice forests. Coppice forests until now have not been guided in the literature. Also were disclosed forests with virgin forest's character. In addition to natural forest communities, listed are artificial forest stands. Likewise, were discovered new data of certain phytocoenological phenomena, as in the Park, and in Macedonia. New insights arising from this research are particularly important, taking into account the rapid progress of studies on vegetation in Europe (creating ecological networks) and thus solve the important forest ecosystem problems. Extensive scientific work will undoubtedly lead to the creation of a solid and relevant base of phytocoenological data that will provide the conditions for protection of significant forest communities in the Park and thus in Macedonia.

Keywords: forest association, forest community, forest ecosystem, National Park Mavrovo

1. Introduction

The National Park Mavrovo range of 3 mountain massifs- Shar Planina, Korab and Bistra, with an area of about 73,000 ha in north-westernmost part of the Republic of Macedonia. It is characterized by great floristic richness, particularly of dendroflora and forest communities. Part of this plant treasure has a rare, endemic and tertiary relict species (Simovski, 2011). In the paper are observed data related to research conducted of the phytosociological characteristics of the territory of the National Park

Mavrovo. From previous research, that of the authors and their works listed in the references section, in addition to established scientists in the flora and vegetation, it is important to mention the research of Em (1959, 1961, 1962, 1967, 1974, 1985), Dzhekov (1962, 1985), Rizovski (1978, 1985, 1996, 1999), Nikolovski (1991), Micevski (1985, 1993, 1995, 1998, 2001, 2005), particularly those conducted within the Park. In addition to field research, the experts were able to consult with a solid database of existing literature. Of the 148 identified plant communities

in the Republic of Macedonia (Rizovski, 1986), within the boundaries of the Park, paper's authors noted and identified 28 forest communities (19% of the 148 identified plant communities in the Republic of Macedonia), i.e. 4 coastal floodplain (riparian) forest communities, 18 typical forest communities and 6 degraded-coppice forests (Tab.1). Coppice forests until now have not been guided in the literature (Acevski & Simovski, 2010). Also was disclosed forests with virgin forest's character. Ass. *Salicetum cinerreae* B. Jov. 1953 was soaked with flooding of the Mavrovo field, when the dam was built (Dzhekov, 1962; Nikolovski, 1991). In addition to natural forest communities listed are artificial forest stands. New insights arising from this research are particularly important, taking into account the rapid progress

of studies on vegetation in Europe (creating ecological networks) and thus solve the important systematic, synhorological, syndynamical, and synecological problems. Extensive scientific work, as well as consulting relevant literature in terms of classification (according to European programs and comply with their classification methodologies, such as NATURA 2000 - EUNIS, CORINE, etc. will undoubtedly lead to creation of a solid base of phytocoenological data. Furthermore, this will provide the conditions for protection of significant forest communities in the Park and thus in Macedonia, and identify some of the guidelines for the development of the PI National Park Mavrovo.

2. Materials and methods

The most important tasks of this research is determining, describing and

Tab. 1 List of the forest associations determined in the NP Mavrovo

Coastal floodplain/riparian forest communities	
Ass. <i>Tamarici-Myricarietum</i> Em 1976	Ass. <i>Fraxino-Alnetum glutinosae</i> Lj. Micevski 1978
Ass. <i>Salicetum incanae</i> Jov. 1963 (= <i>Epilobio dodonaei-Salicetum elaeagni</i> Em 1976)	Ass. <i>Aesculo hippocastani-Ostryetum</i> Em 1965
Typical forest communities	
Ass. <i>Quercu-Carpinetum orientalis macedonicum</i> Rudski 1939 apud. Ht. 1954	Ass. <i>Seslerio-Ostryetum carpinifoliae</i> Ht. et H-ić 1950
Ass. <i>Quercu-Ostryetum carpinifoliae</i> Ht. 1938	Ass. <i>Corylo columnae-Ostryetum carpinifoliae</i> Blečić 1958
Ass. <i>Orno-Quercetum cerris macedonicum</i> Em 1964	Ass. <i>Orno-Quercetum petraeae</i> Em 1968
Ass. <i>Festuco heterophyllae-Fagetum</i> Em 1965	Ass. <i>Seslerio autumnalis-Fagetum moesiaca</i> Blečić et Lakušić 1970
Ass. <i>Luzulo-Fagetum macedonicum</i> Em 1976	Ass. <i>Calamintho grandiflorae-Fagetum</i> Em 1965
Ass. <i>Fagetum subalpinum scardo-pindicum</i> (Ht. 1938, Tregubov 1957) Em 1961	Ass. <i>Abieti-Fagetum macedonicum</i> Em (1962) 1985
Ass. <i>Abieti-Fagetum</i> subass. <i>Pinetosum nigrae</i> nomen nudum	Ass. <i>Abieti-Piceetum scardicum</i> Em (1958) 1985
Ass. <i>Fago-Abietetum meridionale</i> Em 1973	Ass. <i>Castanetum sativae macedonicum</i> (Rudski 1938) Nikolovski 1951
Ass. <i>Aceri-Fraxinetum excelsioris</i> Cernj. et B. Jov. 1950	Ass. <i>Aceri obtusati-Fagetum</i> Em 1965
Coppice forests	
Thickets of <i>Juniperus communis</i> and <i>J. intermedia</i>	Thickets of <i>Juniperus oxycedrus</i>
Thickets of <i>Cytisus leucanthus</i>	Thickets of <i>Corylus avellana</i>
Heaths of <i>Juniperus sabina</i>	Heaths of <i>Vaccinium spp.</i> and <i>Juniperus nana</i>

mapping the forest communities and their localities which are determined by the sites, assessing the degree of their endangerment, recommendations for their protection and other linkages with forests and forest communities within the NP Mavrovo. Within the completed surveys, the standard phytocoenological method of *Braun-Blanquet* was used. For conducting field surveys mostly are used topographic maps S=1:25000, satellite and aero photo imagery, GPS measurements and more, in the most part provided by modern forestry-geomatic laboratory techniques in GIS Lab at the University of Ss. Cyril and Methodious – Faculty of Forestry in Skopje.

3. Results and discussion

The forest communities are determined from the conducted field studies, and some of the most important forest associations are listed below, with an overview of their phytocoenological characteristics.

Ass. *Aesculo hippocastani-Ostryetum* Em 1965

G1.A46222 (EUNIS)

This arctotercieric relict and endemic community notes directly by the flow of river Garska Reka, with the largest population of common horse chestnut around the place called Tri Cheshmi (*Photo 1*). Almost all of the wild common horse chestnut trees because of its mesophilic nature, are next to the river at an altitude of about 830 m. Vegetation cover is thick. Despite the rocky carbonates due to the shadowy area, in fact by the accumulation of hummus soil layer by

the river (river sediment soils) and humidity in the air, at the floor of the trees there are many tree species. The ground floor is represented by the typical species of coastal flora.

Ass. *Quercus-Ostryetum carpinifoliae* Ht. 1938

G1.7C11 (EUNIS)

Represents one of the more commonly participated communities in the Park. It develops on steep slopes in areas where there is a conflict of the moderate cold climate area with submediterranean climate. It is a local environmental and orographic conditioned phenomenon. The geological background is mostly composed of Mesozoic limestone of which are formed shallow rendzinas or calcomelanosols. It conditions the emergence of calciphilic species adapted to these sites. Vegetation cover varies and is closely correlated with local site conditions. Forest vegetation cover ranges from 50 to 70%. At the most prominent forms of relief, where the soil is relatively shallow, almost always floor of trees is absent. However, on slightly inclined slopes, in valleys with higher relative humidity, as well as negative relief forms (shaped depressions, karstic fields, etc.), where by default the soil is deeper, clearly shows floor differentiation. At some sites this community is found on higher altitudes, i.e. 1000-1400 m altitude. At the floor of the trees are observed the following types: *Ostrya carpinifolia*, *Quercus pubescens*, *Q. cerris*, *Acer obtusatum*, *Tilia tomentosa*, etc. At the floor of the shrubs are found drought resistant shrubs. The greatest



Photo 1 *Aesculus hippocastanum*, locality Tri Cheshmi, NP Mavrovo

significance of this forest community is in its protective role.

Location: over the village Selce, place called Golubarnik above the forest road to the crest, hardly accessible terrain: very old trees of *Ostrya carpinifolia*, virgin forest.

Ass. *Sesleria autumnalis*-*Fagetum moesiaca* Blečić et Lakušić 1970

G1.69 (EUNIS)

This forest community in the Park is located in small rocky areas on western river flow of the Radika river. This forest is a locally environmental conditioned. Formed on carbonate rocks have the same characteristics of submontane beech forest, despite the fact that *Fagus sylvatica* ssp. *moesiaca* is met as an edificator. In ground floor vegetation is encountered the *Sesleria autumnalis*.

The significance of the forest community is identical with the submontane beech forest, but because of the difficult accessibility it has features of a virgin forest.

Ass. *Fagetum subalpinum scardopindicum* (Ht. 1938, Tregubov 1957) Em 1961

G1.6913 (EUNIS)

This forest community in the Park occupies a relatively small area. On mountain Bistra it is encountered on the peak Veli Vrv, on a locality called Golem Bardezh. In addition, it is noted on Korab, in a very narrow band at high altitudes (above 1800 m), with small areas of many sites. The forest is developing at extremely roughly sites, primarily due to unfavorable climatic conditions (strong winds and heavy snow drifts). The forest is a border

zone between forest and alpine meadows and is a frequent target of anthropo-zoogenic factor, i.e. cutting and destruction for the needs of farmers who graze livestock in the zone of alpine pastures. It settles carbonate and silicate rocks. The carbonate is observed mostly on calcomelanosols, and silicate - ranker. Adverse climatic conditions have a strong impact on floral physiognomy and composition of this forest. Often going to the floor of the trees absent or it is with trees that are strongly deformed. The canopy closure, i.e. density of the forest usually establishes shrubs. From a wood production perspective, pre-alpine beech forest has no particular economic value, due to small area and small amount of wood volume. On the other hand, its ecological (erosive control) role is very significant, so these forests in the future will be protected. In recent years there is a noticeable expansion of these forests in elevation (amplitude) terms (up to 2000 m a.s.l.), and as a reason for this is the reduced number of pastoralists in the alpine pastures and global climate change (warming). It contributes to move (extend) the limits of beech pre-alpine community.

**Ass. *Abieti-Fagetum macedonicum*
Em (1962) 1985**

G1.6A1 (EUNIS)

Beech-fir forest community in the Park is represented on major areas: the slopes of Bistra, Korab, and upper parts of r. Radika. To emphasis is that this forest community is in expansion, so in recent decades has expanded its range of distribution. It forms and settles on rock silicate substrate,

usually on eutric and dystric cambisol and ranker, and on rock substrate of carbonate-brown soils on limestone and browned calcomelanosols. These forests settle expressed mesophilic sites in the zone of beech forest region of 1100 to 1600 m a.s.l., primarily in north, northwest and northeast exposure. Forests are densely assembled (canopy closure), from 0.9 up to 1. Beech-fir forest communities are characterized by clearly marked floral structure. The floor of trees is in absolute dominance of *Fagus sylvatica* ssp. *moesiaca* (Balkan beech) and *Abies borisii regis* (fir). At the floor of shrubs, because of the large forest canopy closure, the number of species is relatively small, and mostly characterized by shadetolerant species. In these forests there is a clear hostility to the spread of fir, and it manifests itself mostly with high emergence of offspring. This results due to many factors, primarily on:

- ✓ Reduced antropo - zoogenic influence, especially in the last fifty years,
- ✓ Changing climate conditions and
- ✓ Changes in light regime across these forests, which requires and provides opportunity for fir, with high shade-tolerance, very easy to reproduce.

Based on the current state of these forests, we can conclude that in the past have been prevalent in many large areas, so today, when favourable conditions are on the horizon, again returned as one of the most productive, but also as a permanent stage of the syndynamic of these sites. Forests are with extremely high commercial significance, since they are most

productive, easily renewable (large vegetative ability of the beech, great reproductive ability of the seed-fir) and importance in biodiversity.

Ass. *Abieti-Fagetum* subass.

***Pinetosum nigrae* nomen nudum**

This black pine stand occupies a very small area near Strezimir (Border Police Checkpoint). From a scientific standpoint, it is a very interesting phenomenon that deserves more intensive research to determine the reason for its propagation (primary or secondary origin). This stand has developed on silicate rock area, where the black pine (*Pinus nigra*) has no competition from other species, and adjacent to well-developed mesophilic beech-fir forests, and even had been seen individual trees of spruce (*Picea abies*).

Ass. *Abieti-Piceetum scardicum* Em (1958) 1985 G3.1E1 (EUNIS)

This forest community is one of the most interesting and most researched forest communities in the Park. Namely, the spruce-fir forest is interesting from several aspects. From synhorological aspect, this community represents the southernmost spruce forest in its European range (distribution). In this regard, it is found only in the basin of a river Adzhina Reka at an altitude of 1400 to 1800 m (*Photo 2*). The site characterizes with silicate base, on which are formed acid (acidophilic) - dystic cambisols, characterized by deep soil profile and good water-air regime. The spruce-fir forest is a relic from the last period of glaciation, recorded in these areas. There are a number of reasons



Photo 2 Ass. *Abieti-Piceetum scardicum*, locality Adzhina Reka, NP Mavrovo (withering of the spruce- on the right)

that conditioned the survival of this forest in this region to date, although it spent a long period of glaciation. As part of those reasons would be cited:

- ✓ Exposure, i.e. positioning of the woods, with north-northwest exposure, or is in constant shade,
- ✓ Climatic conditions, i.e. the area where the forest extends has a specific microclimate, characterized by relative high humidity of the air and soil throughout the year and the reason for this is that this area is a zone of so-called rain shadow, moist air masses that penetrate the Adriatic always cause heavy rainfall and snow and high relative humidity and
- ✓ Antropo-zoogenic impact, i.e. as a result of a rare population of this area was not subject to degradation processes (cutting, burning, uproot, destroy, etc.).

The spruce-fir forest has a clearly marked floral composition. Floor of the trees is characterized by large forest canopy closure and it is dominated by *Picea abies* (Norway spruce), which can reach heights up to 25 m, and *Abies borisii regis* (Balkan fir). At this floor there is very small presence of other species, primarily due to spruce-fir dominance and expressed shade tolerance. At the ground floor vegetation are encountered number of expressed mesophilic and acidophilic species.

The forest has great scientific significance which derives from its location in the overall distribution of spruce forests. Today, in it are observed processes of extinction, especially drying large number of

spruce individuals (*Photo 2*). There is decrease in the population of spruce offspring, and an aggressive expansion of the fir. Reasons for this are many, and as a part of them are:

- Change of the microclimate and light regime in the population,
- Achieving the climax of the old spruce trees and
- Aggressive competition by fir.

These are only partial views of the reasons for reduction (disappearance) of the spruce of these areas. To discover all the reasons that contribute to the withering of this important scientific spruce forest, it is necessary to set up monitoring stations for detailed monitoring of all environmental factors and based on it will adopt appropriate and sustainable measures for further management and protection of these forests. As an indicator that there are major environmental changes in this area, will say that in the immediate vicinity of this forest has the appearance of species that are drought resistant species i.e. represent a steppe floral element (*Berberis vulgaris*), which unambiguously indicates alert to take timely measures to protect this rare forest. In the performance of field research, in the basin of the river Adzhina Reka, near the spruce-fir forest - concluded an initial stage of spreading of the Macedonian pine (*Pinus peuce*). Namely, from a single pine tree, with age of 30-40 years, with a height of about 10 m and reached reproductive maturity, there are clearly noticeable intense spreading offspring of 150-200 new trees with great vitality, which in the future will create

Macedonian pine forest with great scientific importance.

Ass. *Fago-Abietetum meridionale* Em 1973

Pure fir forests in the researched area, although they represented a small area, are an important phenomenon. They are found in several localities along the valley of the river Radika. This forest populates northern, northwest, western and eastern exposures, on steep slopes with altitude from 1000 to 1600 m a.s.l. Rock is mostly silicate and soils that are formed have extremely acidic reaction. Site conditions are characterized by strong mountain climate with mesophilic attributes. In the summer, there is no noticeable occurrence of summer drought. The forest of fir has a very dense canopy closure (0.9 to 1), where the floor of the trees is an absolute dominance of fir (*Abies borisii regis*). Very rarely are found single or small groups of trees of beech (*Fagus sylvatica* ssp. *moesiaca*), *Acer pseudoplatanus* and *A. platanoides*. The localities where this forest is in initial stage, also are observed pioneering remnants of *Prunus avium* and *Salix caprea*. Floor of shrubs is poorly differentiated due to the dense canopy closure. Ground floor vegetation is characterized by a small number of species. Pure fir forests have great economic importance because the timber has a great industrial value. A positive feature is that these forests are in progressive succession, with massive fir spread in dense closure of common juniper (*Juniperus communis*) thickets.

Ass. *Castanetum sativae macedonicum* (Rudski 1938)

Nikolovski 1951 G1.7D (EUNIS)

Forest of sweet chestnut (*Castanea sativa*) takes up very little area. It develops in the vicinity of the village Skudrinje at the socket of Deshat Mountain, so you can say that there is anthropogenic nature of creation. Rock is a silicate, in which develop deep luvisol. In this forest are included many elements of pubescent oak-eastern hornbeam forest community. From physiognomic aspect is clearly visible the impact of man, so the trees have very wide branches and sparse structure. In these areas chestnut is a natural and has relict character. Therefore, this chestnut forest should be placed under protection.

Thickets of *Juniperus communis* and *J. intermedia* F3.164 (EUNIS)

Observed is phenomenon of spreading this type of degraded stage, especially in the zone of alpine pastures. Syndynamically, these thickets tend to be pioneering species to create conditions for development of forest vegetation, mainly depending on altitude, climate conditions and antropo-zoogenic factor. Around the settlements, on abandoned fields and meadows they represent a progressive process of development of forest vegetation. What type of wood will develop depends on the surrounding forest vegetation. Thickets have a protective (erosive control) role in preventing the erosion processes, so in the future should be given greater influence, as one of the important links in the development and expansion of forest vegetation.

Thickets of *Juniperus oxycedrus*

Unlike previous thickets, these thickets spread on thermophilic and expressed drought resistant sites in zones of influence of the Mediterranean climate, or on southern and carbonate sites. These thickets are part of natural succession in the progressive development of thermophilic oak forest.

Thickets of *Cytisus leucanthus*

These types of thickets commonly are observed on greater elevations in the zone of beech and subalpine beech region (1400 to 1900 m). It represents a pioneering stage, which usually develops at grazing floral communities, especially in areas with reduced intensive cattle breeding.

Thickets of *Corylus avellana*

Found on sites where in the past had been some fertile agricultural lands, which now occupy area on abandoned farmland (progressive succession) in the zone of *Quercus petraea* forest areas in the village Tresonche to the village Lazaropole, particularly in Lokvishte. Besides the common hazel (*Corylus avellana*), which builds very dense populations are found elements of the oak and beech forest elements. Depending on site humidity conditions, these thickets can evolve into oak or submontane beech forest. It clearly indicates that this area in the past was under forest, but man rearranged it for own needs.

Heaths of *Juniperus sabina*

The creeping juniper (*Juniperus sabina*) is a mountainous species which is widespread within the Park. It has wide ecological amplitude within the Park, from lower altitude up to 2000 m a.s.l. The creeping juniper is

present almost in all forest and pasture communities, but particularly on wide-open areas, covering rocky slopes.

Heaths of *Vaccinium* spp. and *Juniperus nana* G3.6 (EUNIS)

As a result of intensive livestock reduction, the conditions for the “wilderness” on alpine pastures emerge. One of these areas is more intensive development of the blueberry heaths (*Vaccinium myrtillus* and *V. uliginosum*) and mountain juniper (*Juniperus nana*). In the initial part of the river basin of Adzhina Reka within this heaths, in initial phase of development is found forest of the Macedonian pine (*Myrtillo-Pinetum peuces* Em 1962 = *Gentiano luteae-Pinetum peuces* Em /1960/ 1962), which indicates that heaths in the future, unless they are managed (pastures, burned, cut), can gradually switch (transform) in acidophilic coniferous forests.

Artificial forest stands

Although a national park, on the territory of the PINP Mavrovo there are artificially-planted areas in the immediate vicinity of the settlements, intended to protect against erosion processes. These areas/stands are raised in order for a short period to provide protection from erosion to the settlements. Newly planted forest stands now are in the form of forest plantations, age 30-40 years, which completely fulfilled the function for which they are raised, reducing the erosive processes. These stands are raised with native species, such as: black pine (*Pinus nigra*), Scots pine (*Pinus sylvestris*), spruce (*Picea abies*), and Macedonian pine (*Pinus peuce*).

4. Conclusions and recommendations

Arctotercier endemic and relict community of horse chestnut and hop-hornbeam

Although a small area covered by this community, because the horse chestnut is a tertiary relic and Balkan endemic species, and even more because of the uniqueness of this forest community in Macedonia, it is a phenomenon of great importance as for a natural and scientific value.

Progressive development of the fir and fir-beech forests

Based on the current state of the fir forests, we can conclude that in the past they have been prevalent in many large areas, so today, when favorable conditions again returned to the horizons, as one of the most productive, but also as permanent stages of syndynamics in these sites. Besides the economic importance fir forests have high ambient value, because they give the landscape alpine characteristics.

Black pine grove

This „forest” although in a small area, is a scientific phenomenon. With detailed research there could be an answer to its origin and development.

Spruce-fir forest

The spruce-fir forest is a relic from the last period of glaciations, recorded in these areas. The forest has great scientific significance which derives from its location in the overall distribution of spruce forests. Today are observed processes of extinction, especially withering large number of spruce individuals. To discover all the reasons that contribute to the

drying/withering, it is necessary to set up detailed monitoring of all environmental / ecological factors and based on it will adopt appropriate and sustainable measures for further management.

Initial stage of development of the Macedonian pine forest

Further monitoring of the successive development of this initial stage of formation of the Macedonian pine forest provides excellent opportunities for scientific monitoring of dynamics and creation of new forest, as well as to take timely measures for its protection (impact of antropo-zoogenic factor). This forest community in the future will greatly contribute to forest biodiversity in the Park because it will increase the number of relict communities.

Forests with virgin forest's characteristics

Within some communities are found forests with virgin forest's character, and as builders or participants occur (very old): *Aesculus hippocastanum*, *Ostrya carpinifolia*, *Juniperus foetidissima*, *Acer pseudoplatanus*, *Fagus sylvatica* ssp. *moesiaca*, *Abies borisii regis*.

Increasing the area under thickets and heaths as part of a progressive stage of development of forests

The increase in area under these degraded stages is important for landslide care. Some of them are important for stimulating rural development in the local population. Some of them, however, are very important in preparing the ground for the emergence and development of economically important species and establishing a stable forest ecosystem.

Impact of antropo-zoogenic factor to the spread and increase of forest communities' area

With reduced human influence on, mostly, pastures, besides abiotic factors, there is inevitably increase or gradual expansion of forests. Parts of new areas under forest are, in essence, areas that previously were under the forest, so now again invaded the area. However, the activities of employees in the Park, guided by special plans for forest management, moderate and appropriate rejuvenate and refresh the existing forest areas, not letting it lead to a natural climax, which are increasing their productivity and quality, and thus create and improve conditions for development of forests as the most stable terrestrial ecosystems.

References

- Acevski, J., Simovski, B., 2010. Forest communities of the NP Mavrovo (report). Environmental protection, economical development and promotion of sustainable ecotourism in National Park Mavrovo. UCODEP. Skopje, p.57.
- Džekov, S., 1961/62. Dendroflora und Waldvegetation im Einzugsgebiet des Mavrovo-Sees. Jahrbuch der Land- und Forstwirtschaftliche Fakultät der Universität in Skopje. 15:5-33.
- Em, H., Džekov, S., Rizovski, R., 1985. Refugiale Waldvegetation in der SR Mazedonien. Contributions, Maced. Acad. Sci. & Arts, Sec. of Biol. & Med. Sci., 6(1-2): 5-20.
- Em, H., 1973/74. Tannenwald in Mazedonien- *Fago-Abietetum meridionale* ass. n. Jahrbuch der Land- und Forstwirtschaftliche Fakultät der Universität in Skopje. 26:41-58.
- Em, H., 1967. Subalpine Waldvegetation in der Gebirgen Mazedoniens. Mitteilungen der Ostalpindinarischen pflanzensoziologischen Arbeitsgemeinschaft. 7:77-80.
- Em, H., 1967, Overview of the Macedonian dendroflora – spontaneous & sub-spontaneous species. Skopje, p.125.
- Em, H., 1962. Šumske zajednice četinaru u NR Makedoniji. Biološki glasnik 15:1-33.
- Em, H., 1961. Die Verbreitung der Weisstanne (*Abies alba* Mill.) in der VR Mazedonien. Forestry proceedings. 6:3-8.
- Em, H., 1958/59. Über die Rosskastanie in der VR Mazedonien. Jahrbuch der Land- und Forstwirtschaftliche Fakultät der Universität in Skopje. 12:49-58.
- Filipovski, G., Rizovski, R., Ristevski, P., 1996, The characteristics of the climate-vegetation-soil zones (regions) in the Republic of Macedonia. Maced. Acad. Sci. and Arts. Skopje, p.177.
- Micevski, K., 1985 / 1993 / 1995 / 1998 / 2001 / 2005, Flora of (S) Republic of Macedonia. Maced. Acad. Sci. & Arts, Sec. of Biol. & Med. Sci., Skopje, 1(1-6).
- Naučno veće vegetacijske karte Jugoslavije, 1986, Prodromus phytocoenosum Jugoslaviae – ad mappam vegetationis m 1:200000. Bribir-Ilok, p.46.
- Nikolovski, T., 1991, Vegetation of forests and alpine pastures of the NP Mavrovo. NP Mavrovo. Skopje, p.31.
- Rizovski, R., 1999/1978, Phytocoenology with principles of typology of forests and pastures (Author's lectures). UKIM. Skopje, p.310.
- Simovski, B., 2011. Dendrofloristic characteristics of the National Park Mavrovo. MSc (thesis), Univ. Ss. Cyril and Methodius, Faculty of Forestry, Skopje, Republic of Macedonia.

How to cite this paper:

Acevski, J., Simovski, B., 2012: Forest associations of the National Park Mavrovo in the Republic of Macedonia. In: Horodnic, S.-A., Duduman, M.-L., Palaghianu, C. (eds.): Proceedings of the International Conference Integrated Management of Environmental Resources - Suceava, November 4-6th, 2011. Editura Universităţii „Ştefan cel Mare” Suceava, Romania, 17 – 27.