

# Natural Forests in the Temperate Zone of Europe – Values and Utilisation



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## Abstracts

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## **Old-growth forests as a knowledge source for silviculture: reality or myth?**

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In central Europe, the few remaining old-growth remnants have often been preserved and studied based on the following plausible line of argument: They increase our understanding of forest dynamics under a natural disturbance regime, which helps to develop silvicultural systems that use natural processes as much as possible. We will review the history of this idea, examine its conceptual foundation and the past use of research results gained in old-growth forests to improve forest management, and explore the potential for future use of such results.

Studying old-growth forests has increased our understanding of spatial and temporal patch dynamics, inter-specific competition between trees, the overlap between tree generations, tree regeneration in gaps, and the potential for producing timber with low-intensity or without silvicultural treatments. Past research in European old-growth forests has contributed to close-to-nature silviculture. However, there were also major difficulties in applying knowledge gained in old-growth remnants to managed forests. First, the assumption of similar site conditions is often questionable. Second, the small area of many remnants makes their representativity doubtful. Third, some of the research methods used to study old-growth forests are questionable, or the inference made went too far.

There is still a considerable potential to increasingly use natural processes to achieve forest management goals at lower cost. The challenge is, however, to find an appropriate degree of naturalness since naturalness is not a management goal in itself. While studying old-growth forests as 'fully' natural forests can still improve some aspects of close-to-nature silviculture, studying managed forests is often a valid alternative, and offers the opportunity of manipulative approaches. We therefore advocate considering carefully and without prejudice whether the results needed are more likely to be gained by studying old-growth forests, managed forests or a combination of both. If studying old-growth forests seems more promising, representativity aspects of research methods should receive particular attention.

**Keywords:** close-to-nature silviculture, old-growth forest, forest dynamics, natural regeneration, research methods, naturalness

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## **Carpathian Biosphere Reserve: conservation and sustainable utilisation**

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The unique forest and meadow ecosystem found in different natural-climatic zones of the Carpathians (ranging from the foothill lowlands through the subalpine zones to the alpine zones) are protected in the territory of the Carpathian biosphere reserve (53,600 ha in area). This is managed according to the Seville strategy for the UNESCO biosphere reserves and utilised in accordance with the principles of sustainable development.

The total area of the biosphere reserve's forests is 44,100 ha. Virgin and natural forests make up 33,300 ha (75.5%), including the largest sites of virgin beech forests in Europe in Uholsko-Shyrokoluzhanskyi massif.

The biosphere reserve has been divided into four territorial functional zones: a reserve zone/core zone (33.7%), a buffer zone (31.9%), a zone of anthropogenic landscapes under traditional management (29.7%) and a regulated protected regime zone (4.8%). The zoning allows fulfilling the need to conserve the natural ecosystem to be combined with serving the interests of the local population.

Attaining these objectives requires: protection, research, monitoring and environmental-training activities. The forest ecosystems are being actively used to develop sustainable forest management models and for international co-operation.

**Keywords:** virgin forests, functional zones, conservation, sustainable utilisation, Carpathian Biosphere Reserve, Ukraine

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44,100 , , 33,300 (75,5 %)  
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## **Forest influence on runoff generation**

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Forest influence on runoff generation has been a topic of research at WSL since 100 years. On the 8<sup>th</sup> of April 1903 the continuous measurements of runoff and precipitation started in the Sperbelgraben and Rappengraben catchments, located in the Bernese Emmental. For the first time Engler presented comprehensive results in 1919, showing that the Sperbelgraben, which was almost completely forested, produced much less runoff during short and intensive thunderstorms than the Rappengraben, covered only to 35% with forest. He also explained that no influence of the forest could be detected as soon as the soils have been saturated during long lasting events. His successors described the influence of forests on the water balance in detail.

Towards the end of the 20<sup>th</sup> century it turned out that no influence of forests on flood runoff could be detected in the Alptal valley, a new test site of WSL. This was due to the fact that in this region the soils have only a very limited capacity to store rain water. Therefore they are very quickly saturated with or without forest and thus with every rain capable to produce a flood event, the effect of forests becomes too small to be detected. The limitations and variations of forest influence on flood generation require a more differentiated approach when assessing the flood protection effect of forests than it was used up to now.

Keywords: runoff generation, forest influence, floods, water balance

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## **Virgin and natural forests in the Ukraine: problems and strategies for protection**

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The area of forests in the Ukraine is 9.4 million ha, of which 67.7% (6.3 million ha) is natural. The older stands cover nearly 236,000 ha (0.25% of Ukraine's forest vegetation). There are four main forest-forming coniferous species: pine - 33.1 %, spruce - 7.6%, fir - 1.3% and larch - 0.1%, covering an area of 3.9 million ha, of which 52.7% is natural. The coniferous virgin forests are found mainly in the Carpathians. The older stands cover about 15,300 ha. The area covered by hard-wood species is about 4.1 million ha, with oak dominating (24.2% of the total forest area in the Ukraine), and beech covering 7.3%, ash 2.6%, horn beam 2%, maple 1.1%, elm 0.6%, acacia 5.1% and honey-locust 0.4 %. Natural forests cover 74.5 % of the total forest area. Mature and over-mature stands cover an area of 174,300 ha, with 50,000 ha beech and 45,700 ha oak communities. The beech virgin forests are found mainly in the Carpathians and the Crimea; and the oak mainly in the plain regions of Ukraine. Soft-wooded species grow in 1.3 million ha of Ukrainian forests of which 5.6% is birch, and 5.7% alder. Such species as aspen (0.7%), linden (0.4%), poplar (0.9%), woody willow (0.4%) are rarely found. The soft-wooded forests are mainly natural (91.1%) and found in Polissya. There are nearly 20 tree species in the forest communities (51,100 ha) and 19 dominant species in the shrubby coenoses (36,900 ha). The natural and virgin forests in the Ukraine are protected and nature conservation areas. Such forests serve as models for sustainable management in the forest ecosystems in the Ukraine.

Keywords: natural forests, virgin forests, tree species, Ukraine

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## **Virgin and natural forests in the temperate zone of Europe**

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Original forests are rare in European temperate zone due to the continuous use of forests historically and due to the high population density. "Virgin forests" are original in their structure and dynamics and are developed untouched by human under natural conditions. "Natural forests" are developed and regenerated with natural succession, but can show anthropogenic influences from the past. The "naturalness" of forests means the degree of human impacts on forests.

Scattered relics of original forest cover still exist in remote areas, in mountainous areas and wetlands especially in the Balkan, Alpine and Carpathian biogeographic regions. The newest estimates show that there are about 0.3 mill. ha virgin natural forests (0.4% of the total forest area) left in strict forest reserves and other categories of protection in temperate zone of Europe. The majority of these forests are mixed fir-beech, or fir-spruce-beech forests. There are over 2500 strict forest reserves, typically the size varies between 40-100 ha.

Difficulties in the interpretation of the protected forest statistics include an array of different definitions and the composition and location of protected forest areas. The common nominator for a strict reserve is that there is no silvicultural management. Countries with the highest proportion of strictly protected areas with no active intervention are the Slovak Republic, Bulgaria, Albania, Slovenia and the Czech Republic.

Complementing the available networks of protected forests is one of the goals of the current forest policy discussion. Both protected forests networks and close to nature silviculture are needed for maintaining forest biodiversity. Rare and vulnerable forests, especially remnants of virgin forests can only be protected by medium or large reserves.

Keywords: virgin forest, natural forest, strict protection, protection networks, biodiversity









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UDC: 630\*907.1:349.6(498)

## **Legal and practical aspects regarding the protection of natural forests in Romania**

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The paper presents the evolution of the legal framework and the associated practical challenges for the protection of natural forests in Romania during the last decade. The main legislation regulating the protection of natural forests and its real impact on the ground is discussed. The main weaknesses involved in implementing legislation are due to poor institutional capacity and lack of available resources. These are analysed, and the recent process of forest restitution, which will lead to more than 30% of the country's forests being in private hands, discussed. Special attention is given to the management of the eighteen large protected areas (national and natural parks), which include the largest area of pristine forests in Romania. The paper concludes with some recommendations regarding the improvement of the legislative framework and the law enforcement capacity of the forest sector institutions in order to achieve a real protection of the natural forests with the new pattern of forest ownership.

Keywords: natural forest, law, protection, institutional setup, Romania

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## **Pattern of phytodiversity in natural and managed mountain forests**

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The National Park "Bavarian Forest" in SE-Germany presents the unique chance of direct comparison of forest stands rather close to natural situation, and managed forest stands next to the national park. Because of low differences in site conditions and historical management of the compared stands the natural forest truly can serve as a reference system.

Two major disturbances recently are affecting the forest stand development: (1) large scale bark beetle (*Ips typographus*) attack, creating several thousand hectares of dead spruce trees and (2) along the boundaries of the national park, intensive clearing of the affected stands to prevent surrounding managed forests from bark beetle invasion. Thus, in the mountain mixed forest of the Bavarian Forest we are able to analyse and compare 4 main disturbance regimes: (1) close-to-nature forest, (2) the same, but dominating spruce trees killed by bark beetle, (3) selection cutting and (4) intensive clearing to prevent bark beetle spreading in the surrounding forests. We analyse the plant species richness in different spatial scales of even aged stands. Richness of vascular plant species is lowest in close-to-nature forest stands and highest after clear-cut. This result is consistent with several other studies carried out in Germany recently. A very important finding of our study is, that phytodiversity of stands under nature-orientated management (selection cutting) is not significantly different from unmanaged stands. Species number per area increases after disturbance, both "natural disturbance" (large-scale bark beetle attack) as well as "man-made disturbance" (intensive clearing); the increase is highest after clearing.

Thus, with the focus on phytodiversity we can conclude, that under a selection cutting system, however, phytodiversity does not leave the natural level of phytodiversity. This opens up a new perspective for sustainable forest management.

Keywords: national park, phytodiversity, species richness, natural forest, reference system

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## **Conversion of pure spruce stands in the National Park Berchtesgaden**

Bauer, M.

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Forest management through centuries has replaced the natural forests (predominantly mountain mixed stands) by plantations mainly with Norway spruce. Presently, the share of Norway spruce in the range of tree species is about double (almost 70%) compared with natural conditions, whereas the share of fir (<1%) and beech (4%) as crucial components of the mountain mixed stands is very low. These spruce-dominated stands are in the near future subject to severe damages by storms, avalanches and bark beetle.

Since the main objective of a national park aims at the maximum protection of nature without accepting much human impact, the question has to be discussed whether or not a forest conversion programme should be implemented. The paper tries to elaborate a decision scheme for forest conversion measures, reviews the possible silvicultural approach and develops a scenario of what would happen if no measures were taken.

The consideration is based on the results of a survey done on a windthrow and an avalanche area respectively. Although on these plots - which have not been treated at all - spruce is presently the minority (being the huge majority in the surrounding stands) one can expect that due to the different behaviour of the different tree species the stands will turn into pure spruce stands in the long run. This justifies the planned silvicultural measures.

Keywords: forest rehabilitation, natural regeneration, mixed stands, alpine forest, nature conservation



## **PAN Parks' Sustainable Tourism Development Strategy: could it work for Europe's forests?**

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PAN Parks is a project that aims to give socio-economic value to nature through sustainable tourism. This approach is also useful for the conservation of natural areas and could be of great value for some relatively unknown treasures in Europe, namely (primary) forests. Eco-tourism only brings benefits for nature and local communities if it is properly planned, organised and marketed.

Europe's forests are facing several threats for a sustainable future since they are not effectively protected by national and international legislation. They suffer from a lack of public awareness about them and there are huge economic pressures on them that directly jeopardize some ecological values.

Some forms of tourism may offer solutions to these problems. PAN Parks is a quality label for a form of tourism that fosters conservation and sustainable development. To receive the PAN Parks' label, 5 comprehensive criteria and indicators must be fulfilled concerning: ecology, management, visitor management, sustainable tourism and regional partnerships. In brief, the PAN Parks' Sustainable Tourism Development Strategy involves:

1. carrying capacity, giving economic value to nature, community involvement, planning and development as a tool for conservation and development tourism
2. a partnership with the region: mutual dependency, controlled development of tourism, stakeholder value
3. sustainability criteria: ecological, socio-economic and cultural sustainability

PAN Parks has a manual for formulating the STDS at the protected area level in co-operation with the region's stakeholders. The steps in this method will be discussed as will the question: Could a sustainable development of tourism be a solution for the threatened forests in Eastern Europe?

Keywords: PAN Parks, sustainable tourism, forests, Eastern Europe

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## **Long-term dynamics of a natural stand's composition and structure: a case study in the Bialowieza National Park, north-eastern Poland**

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Long-term studies of natural forest dynamics are relatively rare. This study covers a period of 65 years and uses data from one of a total of five permanent research plots, established in 1936 in natural, multi-species and uneven-aged stands of the Bialowieza National Park, north-eastern Poland. The area of the plot (transect) is 1.2 ha (200 x 60 m). The stand's characteristics were measured on 7 occasions in 1936, 1949, 1959, 1969, 1981, 1991, and in 2001. For the purpose of this paper, the transect was divided into 5 subplots, 40 x 60 m each. Two subplots contained communities of *Pino-Quercetum serratuletosum*, two communities of *Tilio-Carpinetum*, and the last covered the transitional zone between the two associations. A comprehensive analysis of stand composition and structure was done using the BWINPro program (Nagel 1999). Besides calculating some standard variables, like tree density, basal area and volume, the program made it possible to visualize stand structure as well as to calculate a number of quantitative structural indices. In general, the latter appeared to be more stable than the variables describing tree species' composition. Using the results obtained as an example, the value of natural forest stands as a reference for managed forests is discussed. Special emphasis was given to the problem of how to translate knowledge of the development, growth and structure of natural forest stands into principles of close-to-nature silviculture.

Keywords: BWINPro program, close-to-nature silviculture, index of stand structure, natural stand composition, natural stand structure, permanent plot, potential natural vegetation, Poland

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## **General stability of a natural forest (Slatioara) in the northern part of the oriental Carpathians in Romania**

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The main objective of the paper is to explore the intimate mechanisms of a natural forest ecosystem's stability, taking into account the following premises: (i) the development stages that are specific for such natural ecosystems have a static stability due to the structural-functional mosaic, as well as a dynamic stability given by their functions; (ii) values for the resistance (direct connection) and resilience (feedback) against the most likely disturbing factors, are inside a certain range (from stable to unstable); (iii) global stability can be predicted because the spatial dynamics of development phases can also be forecast. Research was conducted on 26 hectares in the Slatioara old growth forest in Romania and development phases, along with their specific structures were identified. For each phase the stability indices were calculated, taking into consideration the main disturbance elements: wind, snow, fungi, insects, game, grazing and pollution. On this basis, the spatial distribution of the stability and instability centres was plotted, as well as the prognosis of the evolution of the developmental phases and stability. The presented data show the changes in the structure and forest stability, indicating a direct relationship between them. The tree species involved and the site index appear to set the rhythm of the system's evolution. The temporal and spatial dynamics of the development phases within the development cycle determine the spatial and temporal dynamics of stability. Certain conditions and high disturbance intensity may threaten the system's stability in the short-term, but not its long-term existence.

Keywords: natural forests, stability, developmental phases, Carpathians, Romania

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Slatioara

## **Close-to-natural forests as reference systems for nature conservation evaluation of different types of silvicultural management in the Upper Dnister Region (Ukraine)**

Chernyavsky, M.W.<sup>2</sup>; Genyk, J.<sup>2</sup>; Glaser, T.<sup>1</sup>; Schmidt, P.A.<sup>1</sup>; Yashchenko, P.T.<sup>2</sup>

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Within the scope of a research project, supported by BMBF and UNESCO, investigations of close-to-natural forests and managed forests were carried out in the Lviv Region of Ukraine. The following questions shall be answered:

- Which effects do the individual forest uses and different managers have on the forest vegetation structures?
- How have the effects concerning nature conservation criteria such as naturalness and phytodiversity to be evaluated?
- Which conclusions are important for sustainable forestry?

Management of the forest enterprises as well as other forest uses led to complex changes in structures, functions and biodiversity of forest ecosystems. According to the way and intensity of the interventions the forest stands deviate differently and often substantially from the state of the natural forests. The sample plots include among others different silvicultural systems. In order to evaluate them eco-diagrams were constructed, which relate site conditions and natural forest types to each other. Plant species diversity can be increased or decreased by forest management. Species, which are indicators of disturbances and human interference may distribute and compete with characteristic species of the ecosystem types. For instance, the dominance of *Carex brizoides* in mixed oak forests affects diversity in the ground vegetation and natural regeneration of trees. The basis for the evaluation is not the absolute but the representative biodiversity of the respective type of ecosystem. Natural forests as reference systems reflect the natural potential of the sites and the biodiversity of the climax stages of the relevant forest vegetation type.

Keywords: nature conservation criteria, degree of naturalness, biodiversity, forest management, Lviv Region

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*Carex brizoides*

## **Dynamics of the Carpathian virgin beech forests in the Ukraine**

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The main objectives of this study were to analyse the formation and development processes in virgin beech forests in Uholka, Ukraine.

The investigation was conducted on 14 permanent plots, 0.5-1 ha in area. Trees were mapped and the development phases determined according to H. LEIBUNDGUT (1959, 1982).

Beech virgin forests seem to appear and develop under the influence of factors that differ in scale and duration: including gradual to quick decay, catastrophes and natural regeneration.

They are the beginning and final phase of three different types of virgin forest dynamics identified as slow, rapid or slow to rapid. There appear to be seven development phases in virgin beech forests. Tree ages in different phases vary from 10 to 320 years, and stem volumes from 350 m<sup>3</sup>/ha (decay phase) to 696 m<sup>3</sup>/ha (optimum phase). Virgin forest seems to consist of separate isolated biogroups, differing from each other in age patterns.

In general, virgin beech forests in Uholka are older than comparable managed forests. The duration of the development cycle is more than 250 years and may even be 300 years. The stages do not always follow strictly periodically. The names of stages and virgin forest development phases can be compared and synonyms identified through an evaluation criteria study.

**Keywords:** *Fagus sylvatica*, virgin forest, forest dynamics, development phases, Carpathians, Ukraine

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## **Arthropod biodiversity in virgin and managed forest ecosystems**

Chumak V.<sup>1</sup>, Duelli P.<sup>2</sup>, Rizun V.<sup>3</sup>, Obrist M.K.<sup>2</sup>, Wirz P.<sup>2</sup>

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Species richness, diversity and structural organization of invertebrate communities are used here as biodiversity indicators in forest ecosystems.

The arthropod fauna of beech and fir-beech virgin forests of the Ukrainian Carpathians and managed Swiss forests with the same tree species composition were studied from 1999-2001. The investigations were conducted on permanent plots by means of Barber traps and combined window-interception and yellow-pan traps.

In general, arthropod species richness was significantly higher in the managed Swiss forest plots. This was mainly due to spiders, but also the predatory beetle families Carabidae and Staphylinidae were more specious in managed than in virgin forests. The results for Myriapoda and other beetle families were inconsistent with respect to their preference. However, the saproxylobiont beetles were clearly less diverse in the managed beech forest, and the number of diplopod species, which are typical saprophages, was significantly higher in fir-beech forests of the Chornohirskyi massif of the Carpathian Biosphere Reserve compared to a similar Swiss selection forest (Plenterwald). Species numbers of Diplopoda and saproxylobiont beetles seem to be useful biodiversity indicators for the evaluation of undisturbed forests.

Keywords: arthropods, biodiversity, virgin forests, managed forests

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[museum@lviv.net](mailto:museum@lviv.net)

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Carabidae Staphylinidae, Myriapoda

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## **Structures of virgin and managed beech forests: First results of a case study in Uholka (Ukraine) and Sihlwald (Switzerland)**

Commarmot, B.<sup>1</sup>; Bachofen, H.<sup>1</sup>; Bürgi, A.<sup>1</sup>; Ramp, B.<sup>1</sup>; Shparyk, Y.S.<sup>2</sup>; Sukhariuk, D.D.<sup>3</sup>; Viter, R.M.<sup>2</sup>

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The knowledge of the development of untouched forests is important for a close-to-nature forest management. Unfortunately, many of the research plots in virgin forests are too small to analyse the variation and horizontal patterns of stand characteristics.

In order to work out the main structural differences between an untouched and a managed beech forest on a larger area, two research plots of 10 ha each were established in a virgin forest in the Uholka-Massiv in Transcarpathia, Ukraine, and in the Sihlwald near Zurich, Switzerland, a forest that was intensively managed till 1990. The following basic parameters were measured and analysed: distribution of living and dead trees, diameter distributions, variation of tree number, basal area and standing volume. Regeneration was surveyed on 160 sample plots of one and 20 m<sup>2</sup>.

Differences can be seen in the diameter distributions and, to a lesser degree, also in the spatial distribution of trees. The Sihlwald shows the typical structures of a two-storied forest. The diameters of the upper storey trees are normally distributed with a peak around 55 cm. In contrast, the diameters in Uholka are evenly distributed over a wide range of 25 to 85 cm and more, even in areas of 0.25 ha. The basal area and standing volume per ha are higher in Uholka, due to the larger diameters of the old trees. The volume of standing and lying dead wood in Uholka is about 110 m<sup>3</sup>/ha (12% of the total volume), in the Sihlwald about 7 m<sup>3</sup>/ha (1.6%). The number and distribution of regeneration with a height  $\geq 30$  cm is similar in both forests. However, there are much more 10-30 cm high saplings in the Sihlwald.

The results are discussed with regards to a multifunctional, close-to-nature management of beech forests, and to the future development of the Sihlwald which is now left to natural development.

**Keywords:** *Fagus silvatica*, virgin forest, managed forest, forest structures, regeneration, Ukraine, Switzerland

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## **Restoration of a natural structure in a beech forest in Belgium after 20 years of non-intervention: consequences for biodiversity**

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During the past few years, a network of strict forest reserves has been established in Flanders (Belgium). Their main objectives are nature conservation and scientific research. Belgium is densely populated and has a long history of intensive forest management, so no natural forests are left. Even the forest reserves are composed of man-made, semi-natural forest stands. In the strict reserves, an intensive monitoring programme is performed in order to study the spontaneous development of the woody and herbal layer when man-made forests are left for free development. The methodology involves measurements in a grid of nested circular sample plots, combined with an intensive full inventory in a core zone. The results for typical dendrometric and structural variables (total woody biomass, necromass, gap size and distribution) from the forest reserve of Kersselaerspleyn (230-year-old, man-made beech forest, 20 years of non-intervention) are compared to other beech forest reserves in Europe, both natural and man-made. It is striking to see how quickly the stands from Kersselaerspleyn develop towards a dynamic equilibrium in the total living and dead biomass, comparable to that in natural beech stands. The consequences of this development for species richness and the composition of mosses, vascular plants, saproxylic invertebrates and fungi are also illustrated and discussed. The analysis shows that the spontaneous development of a man-made forest to a more natural state can be quite fast, provided that the original stand is old enough, reaching an age where natural decay normally starts to occur. For beech stands, this can be the case with stands that are 200 years old or older.

Keywords: beech, total biomass, necromass, stem number, natural dynamics, strict forest reserve, biodiversity, fungi, mosses, vascular plants, invertebrates, Belgium



## **History of forest exploitation in Transcarpathia**

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The analysis of archive data and literature sources shows the link between forest exploitation in the Transcarpathian region and the progress of civilisation, with changes in socio-economic conditions, in totalitarian regimes, and in administrative-territorial divisions. The greatest impacts on the intensity of forest exploitation have been: new settlements, targeted use of forests, forms of property ownership, development level of agricultural and industrial production, trade and transport routes. In the second half of the 13<sup>th</sup> century, the best forests were given to monasteries, the clergy and the aristocracy. Serfs uprooted forests in mountainous areas to build houses, that had been left unsettled until the late 17<sup>th</sup> century. From the 16<sup>th</sup> to 19<sup>th</sup> century, forests were cut down for pasture. At first, owners cut down stands only on the lower parts of valleys, but later slopes near the upper timber line were exploited. In the 17<sup>th</sup>, the 18<sup>th</sup> and 19<sup>th</sup> centuries timber was mainly utilised for floating transportation, ship wood, construction timber, barrel staves, charcoal, potash, saltpetre (Uzhanska and Prytysianska valleys), and fuel for the smelting of iron (Kobyletska Polyana, Turya-Remeta). With the introduction of timber sawing in the 17<sup>th</sup> century, timber utilisation increased, particularly in the second half of the 19<sup>th</sup> century, after the construction of the railway network. From the late 19<sup>th</sup> century on, large quantities of timber were harvested for the chemical industry. Between 1880 and 1910, the best and most accessible forests were felled on a large scale. However, data comparison shows that the most intensive forest exploitation was between 1948 and 1960, when the volumes of harvested timber increased 20-50 times. In such conditions, only few stands were left uncut: those in areas difficult to access and those in reserves, for example, beech since 1912 on the slopes of Stuzhytsa Mt., fir since 1912 to 1914 in the Uzh river-head, spruce on the Pip Ivan Maramoroshskyi slopes, and later Uholsko-Shyrokoluzhanskyi. The first attempts to organise a network of natural reserves in Transcarpathia were made by A.Zlatnik in the thirties.

Keywords: forest history, forest conservation, Transcarpathia, Ukraine

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## **Interactions of light, soil properties and regeneration in the Slovenian Dinaric Alps: Patterns in virgin and managed forests**

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The regeneration of virgin Dinaric silver-fir beech forests is driven by small-scale disturbances. For a century forests in this area were managed with the selection system. For complex reasons the silver-fir was declining in both managed and virgin forests. Because of the more associative character of beech, we tested the influence of an alternative approach – the irregular shelterwood management system - on the regeneration process and sapling morphology. The three largest existing gaps (~0.20 ha) with three small adjacent gaps (~0.02 ha) were selected in the virgin forest Rajhenav. An equivalent number of comparable large and small gaps were selected in a managed forest on the same site. In 2000 and 2001, a 5 x 5 m systematic grid was installed within the gaps and the light climate (hemispherical photographs), regeneration characteristics (abundance, growth, morphology, damage), ground vegetation and humus properties, soil moisture and CWD coverage were investigated. The results showed significantly lower light levels in the large gaps of the virgin forest remnant with higher regeneration density, lower ground vegetation coverage and species diversity. In general, the analysed factors suggested differences in climate between the gaps in the virgin and managed forest, although they were comparable in size. This can be attributed to the presence of higher trees, of unthinned stands at the gap borders, and of advanced regeneration in the virgin forest. In both forest types an influence of gap-light asymmetry on silver-fir regeneration was detected, while there were no significant patterns for beech. No differences in the beech sapling morphology were observed in the managed and natural gaps. The results indicate that close-to-nature silviculture should focus more on mimicking a natural gap climate and less on gap patterns.

**Keywords:** *Fagus sylvatica*, *Abies alba*, regeneration ecology, solar radiation, ground vegetation, virgin forest, small-scale managed forest, Dinaric Alps, Slovenia

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## **Role of *Acer platanoides* in changes in forest associations structure according to the gap-model**

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Changes in ecotopes and anthropogenic factors lead to essential changes in a forest's associations structure. The vector of evolution can be determined from the power potential, with the aim to improve energy accumulation mechanisms and decrease entropy through species adaptations (DIDUKH 2002). Forest association appears as an ecological channel, where hereditary information acts as a selection factor according to the structure and function of ecosystem. The investigations, which we conducted in different regions, showed that in broadleaf forest succession is directed towards associations with higher nutritional requirements than the previous ones. The understorey formation of *Acer* genus is intensive, and the maximum density decreases from 53,000 to 100,000 trees per 100 m<sup>2</sup> after one year to 200-380 trees after 5-10 years to just two trees per 100 m<sup>2</sup> after 40 years and longer. *Carpinus betulus* and *Quercus robur* are practically absent.

The understorey vegetation of *Acer platanoides* occurs before the appearance of leaves in the tree layer crowns. Up until 4 May, 2002 it increased by 0.62 to 1.63 ( $\pm 0.06$ ) with respect to the whole vegetation period of 2001. This increment was 1.5 to 2 times higher than for *Carpinus betulus* and *Tilia cordata*. In this period, the leaf surface area of *Acer platanoides* was seven times greater than that for *Tilia cordata* and 10 times greater than that for *Carpinus betulus*. The maple at a height of 3-8 m is in a pregenerative state for a indefinitely long time and could take the place of the dominant. This can be explained by the idea of a gap mosaic. The replacement of one species by another happens with the occurrence of gaps larger than 200 m<sup>2</sup> in area. This requires artificial disturbance and does not take place in our forests naturally. It could be seen as an adaptation of *Acer platanoides*, directed to the seizure of econiches of the dominant species. In long-term evolution such changes in ecosystems are possible, whereby *Acer platanoides*, for example becomes dominant.

Keywords: forest, phytocenosis, succession, gap mosaic, power potential, *Acer platanoides*

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*Acer platanoides*

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## **Values and indicators for assessing the biodiversity of natural forests**

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Biodiversity evaluation depends on the value systems of the stakeholders involved. Different entities and aspects of biodiversity require different indicators for evaluation. Indicators for species conservation value, ecosystem functions, wilderness, or species richness may not correlate, or even correlate negatively.

Based on arthropod data from a comparative study in natural forests in core areas of the Ukrainian Carpathian Biosphere Reserve and managed forests in Switzerland with matching tree species composition, several biodiversity indicators and their underlying value systems are presented and discussed. While species richness (alpha-diversity) in most arthropod groups is higher in managed forests, saproxylic beetles turned out as valuable indicator group for naturalness and conservation value.

Keywords: biodiversity, natural forest, arthropods, indicators, evaluation

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## **On the management of buffer zones in protected territories in beech forests in Bulgaria**

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Both natural and social factors have to be considered, when making decisions about whether to log or not in buffer zones. Some aspects involved in selecting target structures in common beech stands should also be considered when restricted harvesting is approved. Data was collected in field studies, from local yield tables and other sources to characterise the biological specificity and growth dynamics of *Fagus sylvatica* L., the site conditions in beech ecosystems and other relevant factors.

Data analyses were based on the view that the stands in the buffer zone should satisfy the following strategic requirements: 1. The stands structure should be such that it permanently prevents, holds back or mitigates the horizontal transportation of significant anthropogenic and extreme natural impacts from the area outside the buffer zone to the protected territory itself. 2. The structures of the stands have to be maintained so as to be similar as possible to that of an old natural beech forest in good condition. If these criteria are not fulfilled, the stands in the buffer zone could have undesirably significant influences on the central protected territory.

Target structures suitable for beech stands in buffer zones could be designed with sufficient precision to be applied in practice if the integrated approach suggested is applied.

Keywords: beech, buffer zone, ecosystem management, silviculture, Bulgaria

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## **Analysis of Protected Forest Areas in Europe - Provisional results of COST Action E27 PROFOR**

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Protected Forest Areas (PFA) have become a major issue in the international forest policy forum. To analyse the large number of PFA categories and classification systems at both the national and international level, the EU-COST action E27 "Protected Forest Areas - analysis and harmonisation" was launched in 2002 for a period of 4 years. The main objective of the action is to describe, analyse and harmonise the wide-range of PFA categories used in European countries within the context of existing international systems of protected forest areas. The scientific programme covers definitions of PFAs, national classifications and their historical and legal background, analysis of options for the integration of data collected in national forest inventory programmes, and harmonisation of definitions and identification of problem areas when using international classification systems and reporting to international organisations. Clarification of the concept of naturalness and key terms is needed. An overview of provisional results of the action will be given.

Keywords: protected forest areas, biodiversity conservation, reserve selection, categorisation of nature reserves, representativity

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## **Management methods in temperate forests: the Hyrcanian Forest in Iran**

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Forests in temperate zones have their own distinctive characteristics. On the one hand, such forests tend to be located in densely populated areas because they have good conditions for human settlements. This means they are under great pressure from human beings. On the other hand, their natural condition is very sensitive to disturbance. Hence, they need special management so that both people's needs are fulfilled and the forest can be successfully promoted and protected.

In this study logging was compared with ecotourism from an economic point of view using a survey method. Questionnaires were distributed among visitors to a park forest called "Sisangan", located in the Hyrcanian Forest, and a close inventory made. The Hyrcanian Forest is in a temperate zone like the natural forest in the Ukraine, with species such as: *Fagus orientalis*, *Carpinus betulus*. Data regarding park income was also obtained. The data was analysed, and the income in the park compared with the average income from logging in the forest as a whole. It seems there was more income from the Forest Park from ecotourism than there could have been if it had been used for logging.

We then reviewed management methods in the forest. We found that there is no right method for the whole forest. Rather, we should choose by considering conditions such as: topography, species, society and microclimate, for each area.

Otherwise the "close to nature" method appears to be the best for the Hyrcanian Forest we are able to offer at the moment.

Keywords: *Fagus orientalis*, *Carpinus betulus*, temperate forest, forest park, Hyrcanian Forest, Iran

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*Fagus orientalis, Carpinus betulus.*

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## **Protection and conservation of old-growth forests in the French Nature Reserve Network**

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Two thirds of the more than 150 French nature reserves (NR) have forests and over 60 of them contain old-growth forests (OGF). Altogether, OGF represent 35% (>15,000 ha) of the forests protected as NR. Most of them are publicly-owned forests and half of them are located below 250 m. They are mainly alluvial and are mountain beech or coniferous forests. 200,000 ha of OGF have also been identified in overseas NR. Half of the OGF have areas larger than 50 ha. In more than 80% of the forested NR, the surroundings are also forested. The dominant tree species are *Pinus uncinata*, *Fagus sylvatica* and *Quercus ilex* and all but a few of the French forest vegetation types are represented in the network.

The French NR network currently holds 11 times more OGF (in size) than the strict biological reserves network of the French national forestry board (which has a different legal status). Between the two networks, France holds 20% of the European strict forest reserves. Without the NR network, France would only hold 8% of these reserves, and less than 5% of reserves larger than 50 ha. The French NR network plays a major role for the conservation of OGF in France and Europe.

The main aims of the conservation strategies developed in this network are (1) to ensure the long-term conservation of the OGF already protected, (2) to include the remaining unprotected OGF in the network, (3) to define indicators of a naturalness gradient by the statistical comparison of OGF and the structural components of managed forests and finally, (4) to use these indicators to monitor the naturalness of protected forests and to improve the management policies in managed forests.

Keywords: nature reserves, old-growth forests, strict forest reserves, naturalness, networks

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## **Use of non-timber forest resources in the Carpathians**

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The Carpathian forests have been and still are, widely used as a source of timber and various non-timber productions such as: honey, different medicinal raw materials, fruits and berries. These non-timber forest products greatly contribute to the economy of the Carpathian region. During the last decade, their use has decreased, resulting in problems for the region. Financial constraints in the forest sector aid the severe climate conditions of the Carpathians, have led to unemployment and to mountain-dwellers migrating in search of earnings elsewhere. Thus additional sources of income are needed. The value of the forest non-timber resources of the region has made them in great demand. Economic expediency and a crisis in forestry have led to renewed use of non-timber forest products and a revival of this economically important branch of the forestry sector in the region.

Non-timber forest non-timber resources in the Carpathians were investigated in the regional state forests of the Ivano-Frankivsk, Chernivtsi and Transcarpathian RFM (Regional Forest Management). The focus was on discovering the melliferous, medicinal, fruit and berries resources of the forest areas in the Carpathian region. The valuable forest lands, used for non-timber purposes were investigated and the plant species compositions of the sites, and the marketable products determined. There appear to be a tendency non-timber forest resources to be developed locally.

The regional state forestry agencies at present underestimate the potential commercial use of the non-timber forest products. These resources are today mainly used erratically by single consumers.

The potential economic value of these non-timber forest products, based on current prices, still needs to be evaluated.

**Keywords:** forest resources, medical products, fungi, fruit and berries, nuts, melliferous plants, bee-keeping, hunting, sheep breeding, Carpathians, Ukraine



## **The role of old growth forests within forest ecosystem modeling**

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Forest ecosystem models are an important diagnostic tool to enhance our understanding in the complex interactions between plants and the surrounding environment. Key processes such as carbon uptake, respiration losses, transpiration, evaporation and the radiation balance, etc. are essential to study the flux of energy water carbon and nitrogen within different ecosystems. Most of our current forests have been influenced by humans resulting in a reduction of forest covered land area, changes in the forest species distribution and soil conditions. These impacts may have resulted in degradation effects and consequently may have changed the sustainability of our forests. One option to assess and study such fundamental changes is the use of mechanistic ecosystem models. In combination with old growth forests, which can be considered as the “potential” or “ideal” sustainable forest ecosystem, such models can be used (1) to understand the succession dynamics of old-growth forests and (2) to assess potential changes in the system due to different management strategies. One typical criterion is the self-initialization procedure commonly used to define initial values of state variables within these models. Within the self-initialization process or spin up run the development of soil and plant carbon as well as the soil and plant nitrogen pools are modeled until the annual production, respiration, decomposition, etc. are at a steady state. This procedure usually takes about 3000 to 5000 years. In this paper we will demonstrate (1) the reliability of such self initialization procedures by applying our species specific model adaptations within the biogeochemical model BIOME-BGC to different old growth forest stands, and (2) use the model to assess degradation effects within heavily managed secondary Norway spruce stands in Lower Austria.

Keywords: old growth forest, degradation, forest ecosystem, BGC-modeling

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## **Virgin ecosystems of the Uzhanskyi National Natural Park**

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The Carpathian virgin ecosystems constitute a unique natural relic in Middle Europe. On the territory of the Uzhanskyi National Natural Park (NNP) the total area of virgin forests preserved is 3000 ha. Here, mainly beech-fir (Fageto-Abietum) and fir-beech (Abieto-Fagetum) forests prevail. On the rocky slopes where the vitality of beech is decreased, sycamore-beech (Acereto-Fagetum) forests are formed. A number of forest reserves (“Ravka”, “Cheremkha”, “Holanya”, “Beskyd Volosyanskyi”, “Stinka”, etc.) have been established in the Park’s territory for the protection of the unique virgin forest ecosystems. The virgin forest ecosystems play an important role in the conservation of the diversity of biological species, ecologically linked with the forest environment. 311 species of lichen belonging to 126 genera were found in the areas investigated, 20 of them for the first time in the Ukraine. 11 species of plants, entered into the Red Data Book of Ukraine, and 15 Red Data Book species of vertebrates are described in the virgin forest phytocenoses in the Uzhanskyi NNP.

In 1934-36, the Czech geobotanist-forester, Prof. Zlatnik, set up permanent plots in the virgin forests of the “Stuzhytsa” reserve to conduct dendrometric and phytocenological investigations. Scientists from the NNP and the Agricultural and Forest University of Mendel (Brno, the Czech Republic) are jointly continuing this research. Many aspects of the investigated characteristics of the forest ecosystems will allow us to learn about and understand the processes of change taking place there under the influence of biotic and anthropogenic factors. The temporal duration of these impacts and the inadequate environmental conditions of the investigated periods should be taken into account.

Keywords: Uzhanskyi National Natural Park, virgin forest, biodiversity, lichens, Carpathians, Ukraine

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## **Natural development of forests in the lowland of northern Germany and consequences for nature conservation**

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In 1961, a network of forest reserves without any utilisation, so called "Naturwaldzellen", was established in Eastern Germany. Western Germany followed in the seventies. With the National Programme of the GDR in 1990 we now have more than 25.000 ha of forests under strict protection. The protected forests comprise nearly the whole spectrum of relevant forest sites and forest communities, different types of *Fagus* forests, *Quercus-Carpinus* forests, *Quercus-Pinus* forests, *Quercus-Betula* and also *Pinus* and *Betula* forests. However, all these forest communities were more or less changed and disturbed by long-term utilisation in the past. After protection, the forests started a process of secondary succession. This development was described as regradation and the development stages as pioneer, intermediate and climax (or climax-near) stages. In old *Pinus* forests which correspond to the pioneer stage we found that *Quercus* invaded. In the intermediate stages of *Pinus-Quercus* forests, *Fagus* spreads out, as well in *Carpinus-Quercus* forests. Only the *Fagus* dominated forests are stable ecosystems. These results show that there exists no nutrient determined limit for *Fagus sylvatica* in the lowlands of northern Germany, and also no climatic limit. Consequently, the conservation of pioneer forests as *Betula* and *Pinus* forests and also intermediate forests as most types of *Quercus* forests needs a management not unlike the formerly utilisation. But this is nature protection against nature.

Keywords: *Fagus sylvatica*, succession, pioneer forests, forest reserves, nature conservation, northern Germany

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*Betula* *Pinus,* , *Quercus*

: *Fagus sylvatica,* , , ,

## **From forest utilisation to forest conservation: historical development of natural forest reserves in the Southern Limestone Alps of Austria**

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Recent studies have confirmed that more than 20% of the Austrian's forests can be classified as seminatural or natural. Such natural forest areas are mostly located in the Inner Alps as well as in the Northern and Southern Limestone Alps. "Natural" means that, even if historical impacts were present, these are no longer detectable today. However, historical records give evidence of former utilisation also in those forests which now are considered "natural". The objective of this study is to answer the question what factors in the course of history have determined the development of former intensively exploited forests towards seminatural or even natural forests. In evaluating the history of human impacts on forest ecosystems the study relies on the following sources: land surveys, tax valuations, local inventories and management plans stored in provincial and private archives.

In this study the forest history of some natural forest reserves in the Southern Limestone Alps, which are located in former strongly industrialized areas, where mining (lead and iron) was an important branch of economics from the 16th to the middle of the 19th century, was examined. The paper deals with the measures taken by the local people in order to secure the natural resources on a long-term basis in responsibility for subsequent generations. The main driving forces economy, ecology, politics and management have been analysed and taken into account. By the comparison of different case studies also the question will be answered whether ownership structures have influenced the development.

Keywords: natural forest reserves, forest utilisation, forest management practises

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## **The global position of the Caspian forests**

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The Caspian (Hyrcanian) Forests in the Alburz and Talysh mountains (Iran, Azerbaijan) as well as the Colchic forests (Georgia) are the most important refuge and relic forests in West Eurasia, and an important biodiversity “hot spot”. They are like a “cradle” of the younger and less diverse European deciduous forests.

Deciduous broadleaf forests are the natural vegetation of temperate oceanic-suboceanic regions in Eastern North America, in West Eurasia, and East Asia. The “arcto-tertiary” vegetation is their common origin. The natural area of temperate deciduous forests is considerably reduced, the remaining stock has been modified to artificial plantations and secondary woodland. Relics of primary undisturbed temperate broadleaf forests are extraordinary rare all over the world.

Those parts of the Caspian forests, that are still in a virgin state, represent world-wide the last relics of primary temperate broadleaf forests. The age and the continuation of forests cover are of irreplaceable value. A primary forest, once cut, is irreversibly lost, it can be never reconstructed. The protection of primary forests and the sustainable use of secondary woods is a challenge of international importance.

The paper shall 1) analyse the plant-geographical position of the Caspian forests within the temperate broadleaf forests of the Northern hemisphere, 2) identify threats, and 3) recommend opportunities of conservation, sustainable use and integrated management.

Keywords: Caspian forests, deciduous broadleaf forests, temperate virgin forests, forests relics

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## **Computer simulations of natural beech forest dynamics in the Boberka river basin in the Ukrainian Beskids**

Kozak, I.<sup>1</sup>; Menshutkin, V.<sup>2</sup>; Parpan, V.<sup>3</sup>; Shparyk, Y.<sup>3</sup>; Parpan, T.<sup>3</sup>; Viter, R.<sup>3</sup>; Kozak, O.<sup>1</sup>; Senko, Z.<sup>1</sup>

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The main aim of our study was to investigate natural beech forest dynamics in the Boberka river basin in the Ukrainian Beskids using the FORKOME model.

In constructing the model we have taken into consideration major environmental factors such as: light, temperature, water, amount of nitrogen in the soil, as well as such forest processes as: natural regeneration, and the growth and death of trees.

The model was verified in field trials in 2001-2002 in uneven-aged spruce-fir-beech forest with beech (*Fagus sylvatica* L.) dominating.

Changes in the number and biomass of trees were predicted in a single simulation run and in Monte Carlo statistics. Forest dynamics in response to possible climate change were modelled. The simulation demonstrated beech domination when mean annual temperatures increase by 2<sup>0</sup> C. That trend is also characteristic of scenarios with parameters set as warmer and drier than those in the control. However, if temperature decreases by 2<sup>0</sup> C, fir and spruce will dominate in the research plot.

The results presented indicate the usefulness of the FORKOME model for investigating various topics, especially those concerning climate change, which may be of both theoretical and practical importance.

Keywords: natural beech forest dynamics, FORKOME model, simulations, climate change, Ukrainian Beskidy Mountains

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## **Permanent sample plots in a case study in “Bukowa Gora” Forest Reserve in the Roztoczanski National Park, Poland**

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The objectives of this study are to present the application of permanent sample plots to research the development of a natural forest and forecast its future structure. The study was executed in the beech-fir forest reserve “Bukowa Gora” (Roztoczanski National Park, South-East Poland). The area of 128 ha was covered by a grid of 65 systematic permanent sample plots. Each sample plot consisted of four concentric sub-plots with the following rules for measurement: 5 m<sup>2</sup> (all trees except seedlings in their first year of growth were measured), 20 m<sup>2</sup> (trees of  $h \geq 0.3$  m), 50 m<sup>2</sup> (trees of  $dbh \geq 2.0$  cm), 500 m<sup>2</sup> (trees of  $dbh \geq 7.0$  cm). Results from 1974, 1991, 1996, and 2001 were used.

After the structure of the forest had altered following a series of disastrous hurricanes, two hypotheses on the forest stands dynamics were put forward in 1991. The first anticipated the following trends: gradual restoration of standing volume, alteration of stand species composition towards an increasing share of European beech, growing tree volume increment rate, temporary decrease in dying tree numbers and temporary growth of forest regeneration (specifically: beech regeneration). It was also expected that the condition of beech regeneration would gradually worsen, but that of fir would improve, due to the decrease in the light intensity under the tree canopy. Using information about the mortality rate of trees and the trees' diameter increment rate, the critical density of forest regeneration needed to ensure the maintenance of the most important tree species in the area, namely fir and beech, was calculated. The extent of young tree generation ( $dbh < 7$  cm) decreased in almost all size classes (except trees of  $h < 0.3$  m) during the period 1991-2001. In 2001 the density of fir was below the critical level in all size classes of regeneration, yet the density of beech was completely sufficient.

Measurements on permanent sample plots enable non-intrusive research into the development of a natural forest. A survey of the forest regeneration ought to be carried out as one of the most important parts of such research.

Keywords: forest reserve, permanent sample plots, forest development, forest regeneration, European beech, white fir, Poland

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## Genetic diversity of beetle populations in unmanaged and managed forest stands in Southern Germany

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Studies on the genetic diversity in forest ecosystems mainly consider woody plants or mammals, whereas invertebrates are less investigated, particularly in systems affected by natural or anthropogenic disturbances. In unmanaged and managed mountain mixed forest stands of the National Park "Bayerischer Wald" (Germany) the genetic diversity of two prevalent coleopteran species was studied. Populations of the click beetle *Athous subfuscus* (Elateridae) and the ground beetle *Pterostichus oblongopunctatus* (Carabidae) were sampled at mature forest sites of different disturbance types: (1) unmanaged (since 20-30 years) as reference, (2) unmanaged (since 20-30 years) with spruce destroyed by bark beetle infestation, (3) single-tree selection management and (4) clear-cut as forest protection measure in the border zone of the park. Genetic diversity of these populations was studied by use of allozyme analysis at 11 (A.s.) and 7 (P.o.) polymorphic loci, respectively. For both species, the mean allelic richness was relatively similar between the populations (A.s.: 2.6 - 3.0; P.o.: 2.3 - 3.0). Genetic diversity, indicated by the mean observed heterozygosity, was highest in the populations of the clear-cut site (A.s. 0.233; P.o. 0.105). Regarding gene diversity (expected heterozygosity) the two species differed obviously (A.s.: 0.244 - 0.298; P.o.: 0.177 - 0.195). This may be explained by their different ecological demands.

The comparison of genetic diversity with species richness of Carabidae and Elateridae indicates, that genetic diversity of one single species reflects the faunistic diversity of the whole family. High genetic or faunistic diversity is not necessarily a character of unmanaged forest ecosystems.

Keywords: *Athous subfuscus*, *Pterostichus oblongopunctatus*, allozyme electrophoresis, genetic diversity, National Park "Bayerischer Wald"

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(A.s. 0.233; P.o. 0.105).  
(A.s.: 0.244 - 0.298; P.o.: 0.177 - 0.195).  
Carabidae      Elateridae  
: *Athous subfuscus*, *Pterostichus oblongopunctatus*,

## **Forest regeneration processes in the virgin fir forests (*Abies alba* Mill.) of the Ukrainian Carpathians**

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The investigation aimed to study the forest formation processes in virgin fir forest ecosystems in the Carpathians.

The study was conducted on 23 plots, 0.5 to 1.2 ha in area. It involved collecting material on virgin fir forests, studying their morphological structure, age structure, and increment, and conducting tree inventories. The plots were set up throughout the whole geobotanical region where spruce-beech-fir forests occur in the Ukrainian Carpathians.

Based on this investigations we determined the development stages from regeneration to old age and decay of the damp spruce-beech-fir forest in virgin forest ecosystems. The whole development cycle of one generation of fir takes 320 years. Two phases of the forest formation cycle (fir and fir-beech) are typical of this period. Each phase is characterised according to the age and morphological structure of the stands and the increment.

This study of the regularities of forest regeneration processes has helped in developing an ecological basis for differentiated forest use, taking into account the targeted use of the forest ecosystems. It also provides support for the claim that it is necessary to introduce a selective management system into forest management practice, in the interests of conservation and of using the forests in a sustainable way.

**Keywords:** *Abies alba*, mountain forest, virgin forest, regeneration, development stages, Carpathians, Ukraine

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## **Coleopterans (Insecta, Coleoptera) as a component of the virgin forest ecosystems of the Ukrainian Carpathians**

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Protection of the virgin forest ecosystems in the Ukrainian Carpathians draws on studies of species composition and of the ecological characteristics of the ecosystems' components. In this study coleopterans were investigated in the foothills, and lower and upper forest zones in nearly 100 sites in both virgin and well-preserved forests (oak, beech, coniferous and mixed) in the Carpathians, using various methods (hand collecting, soil excavations, traps, siftings). Over one thousand species of coleopterans have been found. These species include nearly all families registered in the Ukrainian Carpathians. Most species are widely distributed eurybionts or forest species. Some species are typical of the old unmanaged forests. As a rule, these species are not found outside the forest, as they require specific conditions associated with such forests: the existence of weak, sick and dried out trees, fallen trees in different stages of decay, rich litter, as well as mushrooms and other organisms. A number of species have been newly registered in the Ukrainian Carpathians. The well-preserved forests are often in small, remote and isolated areas. Nevertheless, nearly each harbours newly registered species of other communities. This may also indicate a gradual decline of coleopterans fauna, as old-growth forest areas decrease.

Keywords: Coleoptera, virgin forests, Carpathians, Ukraine



## Natural forests of pedunculate oak (*Quercus robur* L.) in Croatia

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Forests of pedunculate oak make up about 10% (201,739 ha) of the total area of Croatian forests. Today, 95% of this area is managed with oak forests of the first, second and third generation, starting from the first cuttings in virgin forests of Slavonian pedunculate oak. Stands were formed with regeneration under the crowns of old trees according to the shelterwood system. Stands over 120 years old cover one fifth of the area. Forests of pedunculate oak excluded from forest management for protective purposes cover about 10,468 ha (5%). They include the forest reserve of Prasnik, extending over 58 ha. The paper compares the results from research in the reserves and in commercial stands on pedunculate oak in Croatia. The research aimed to a) compare the structure, method of regeneration and floral composition of virgin and commercial stands; and b) identify the effects of past management on the natural character of commercial forests of pedunculate oak. The results show that the character of the commercial pedunculate oak forests is very similar to that of the natural reserves due to their origin, tending, regeneration, floral composition, structural properties and preservation of the site. These natural commercial forests are the product of the application of the principles of the Zagreb School of Silviculture.

Keywords: *Quercus robur* L., natural regeneration, shelterwood system, natural forests, oak virgin forests, Croatia

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## Plain forests of the Ukraine: unique habitats for rare species

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The study is based on the field data on the rare and vanishing flora species of the plain forests of Ukraine collected between 1973 and 2003.

The flora of the plain forests of Ukraine includes 102 rare and vanishing plant species (nearly 10 % of the flora), consisting of 39 European, 25 Holarctic, 16 Submediterranean, 10 Boreal, 3 Cosmopolitan, 9 endemic species, as well as 9 tertiary, 12 glacial and 10 interglacial relics. The flora diversity was compared to that in Europe by analysing plant associations. 42 of the species found in the plain forests of Ukraine are rare in Europe, 19 in central and south-east Europe, 5 in Ukraine and 9 in Ukrainian plain areas. Some rare species (of, e.g., such genera as *Botrychium*, *Cypripedium calceolus* and *Epipogium aphyllum*) are found in coniferous and broadleaf forests. Other species (e.g., *Arnica montana*, *Goodyera repens*, *Hypersia selago*, *Linnaea borealis*) are associated with coniferous forests. Rare and vanishing species, coenotically connected with broadleaf forests, are higher in number. Four of them, *Euonimus nana*, *Malaxis monophyllos*, *Galanthus nivalis*, *Leucojum vernum*, live in broadleaf and small-leaved forests. The habitats of *Atropa bella-donna*, *Carex umbrosa*, *Crocus heuffelianus*, *Erythronium dens-canis*, etc., are found in shady broadleaf oak, beech, hornbeam and hornbeam-oak forests. Such species as *Carex brevicollis*, *Delphinium sergii*, *Dictamnus albus*, *Fritillaria montana*, and *Iris graminea*, on the other hand, are found in the light-demanding broadleaf forests. The small-leaved forests with common alder harbour *Spiranthes amoena* and ash-alder forests *Aconitum odonthandrum*. Such rare Ukrainian species as *Daphne sophii*, *Staphylea pinnata*, and *Equisetum telmateia* grow in the ecotone between the forest and the steppe, meadow and marsh ecosystems. Thus, the plain forests of Ukraine provide unique habitats for many rare and vanishing plant species.

The geographical distribution of the populations divides the rare species into three types: a) species locally distributed within the region and widely spread outside; b) species distributed inside and outside the region; and c) species locally distributed with a low number of individuals. Some species have between 1 and 10 (*Botrychium multifidum*, *B. virginianum*, *Coeloglossum viride*, *Fritillaria montana*, *Linnaea borealis*, *Viola alba*, *Woodsia ilwensis*) local habitats. The spatial structure of their populations has been disturbed, and they are under threat of disappearing. Some rare species (*Arnica montana*, *Botrychium matricarifolium*, *Gladiolus palustris*) have already vanished from the flora of the plain forests of Ukraine. Considering the importance of the Ukrainian forests for the conservation of the flora diversity in Europe, the unique habitats of rare species in such forests should be included to the European Conservation Network. Based on our conclusions, 6 national conservation areas and 24 local conservation areas were established.

Keywords: plain forests, rare and endangered species, Carpathians, Ukraine



## **Network of Strict Forest Reserves as reference system for near to nature forestry in Lower Saxony/Germany**

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Since 1970 continuous research in strict forest reserves is conducted in Lower Saxony. A network of reserves covering all major soil and forest types has been established meanwhile. Monitoring of forest structure comprises more than 30 years. Main principles and problems of research in strict forest reserves are stated. State of the art and development of the monitoring program are described and discussed. Monitoring methodology has undergone specific changes with respect to size, number and distribution of plots as well as attributes to be measured. It is concluded that the maintenance of target-orientation is a central and specific problem of long term research in these reserves.

The existing database serves as information pool with increasing relevance for near to nature silviculture. Exemplary monitoring results are presented. They refer to the following topics: competition between beech (*Fagus sylvatica* L.) and light demanding tree species, gap dynamics, natural regeneration, development of structural diversity and dynamics of coarse woody debris. Conclusions for forest planning and management are drawn.

The results show that a causal understanding of processes in strict forest reserves is a prerequisite for proper comparison to managed forests and the translation into management practice. Disturbance regime, forest history and site conditions are identified as major determinants for structural dynamics. The initial situation apparently determines forest dynamics over a long period of time. Thus, dynamics of strict forest reserves are in most cases considerable different from those in virgin forests.

Keywords: monitoring, forest structure, competition, structural diversity, coarse woody debris, gap dynamics, regeneration

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(*Fagus sylvatica* L.)

## **Management concept for natural forests in Poland**

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The objective of this study is to present a new concept for the preparation a protection plan for forest ecosystems in a national park. Some of the solutions connected with the concept differ from the rules in the Polish guidelines of 1994.

It is assumed that during the preparation of the plan, the following principles should be considered:

- 1) identification and respect of social expectations
- 2) assurance of forest sustainability
- 3) elaboration of the desired future state of the forest
- 4) description of how to reach the defined protection aim
- 5) recording of the forest state and monitoring its development
- 6) co-operation on the related protection plans.

The interpretation of these principles and the interrelationship between them is discussed. Some examples from Polish national parks are given: (1) sociological investigation of the public opinion about the transformation of stands with exotic tree species; (2) balance between processes of forest mortality and development; (3) steps in the transition from the 'post-managed' stands to 'natural' ones; (4) forest management in five different types of protection unit; (5) real and theoretical number of trees in regeneration; and (6) conservation of marshy forest – a strict reserve or a technical reconstruction of the water condition?

The preparation of the protection plan for forest ecosystems requires a non-stereotyped approach and the application of new, but tested, methodologies and engineering solutions.

Keywords: protection plan, national park, forest management, forest sustainability, Poland

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## **Approaches and methods for the spatial interpolation of field data on plant abundance**

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In order to effectively organize conservation activities, it is important to delineate as accurately as possible the actual and potential habitats of rare and endangered plant and animal species. As the primary data is mostly collected in the field on spots, it should be interpolated spatially. This research considers two approaches and methods for such interpolations.

The research is based on data on the abundance of some plant species collected in the nemoral forest near L'viv (Western Ukraine). Two methods of interpolation were tested. The first was based on geostatistical interpolation and the second on a multiple regression model using land morphology attributes as indicators. Measures of error for each method were verified by check samples. A relative error-weighting technique was then used to combine the outputs of both methods, which allowed a more accurate final output.

As a rule, there is no single general method for data interpolation. Different methods could be valid and more or less effective depending on the available data and the spatial variation of species abundance. As plant abundance is strongly influenced by ecological factors, often reflected in land surface morphology, data on such attributes stored in detailed digital databases is valuable. When different interpolation methods produce results of comparable accuracy, the relative error weighting technique can combine their results to significantly increase the final accuracy.

**Keywords:** species abundance, habitat, data integration, geostatistical interpolation, multiple regression, ecological factors, spot data, error weighting

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## **Forest vegetation in Nerussa-Desna, Russia: assessment of its nature conservation value**

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In contrast to rare and threatened species, the criteria for rarity of forest communities are absent. These are, however, important for effective nature conservation. The objective of this work is to show the variability of the forest communities in Nerussa-Desna with regard to their floristic composition and structure, ecology and risk assessment. The study region is situated in central Russia and represents a typical Polessie landscape (pine and mixed forests and swamps on sandy soils). In this region 11 associations of three forest classes were described according to the Braun-Blanquet system. The criteria "rarity" and "risk assessment" for forest associations are proposed. Pine (ass. *Molinio-Pinetum*, *Peucedano-Pinetum*, *Querco-Pinetum*) and deciduous forests (ass. *Trollio-Quercetum*) represent the most widespread forest type and are especially susceptible to fire. Floodplain and black alder forests (ass. *Ficario-Ulmetum*, *Ribo nigri-Alnetum*) are stable, and contain hardly any rare species. They are typical of the Polessie landscapes. The mean number of species of association does not correlate with the number of rare species. Rare communities, which are located at the limit of their range, contain the greatest number of rare species. These include termophilous deciduous forests (ass. *Potentillo albae-Quercetum*), rich birch forests (ass. *Serratulo-Pinetum*), lichen-pine forests (ass. *Cladonio-Pinetum*) and swampy *Populus tremula-Climacium dendroides* communities. Many forest stands of these associations are very small and located far away from other stands of the same type. This means there is a high risk of species becoming locally extinct due to their impoverished populations, isolation and small chance of re-establishment.

Keywords: forests, classification, rare species, rare communities, Polessie landscape, Russia

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Molinio-Pinetum, Peucedano-Pinetum, Querco-Pinetum)  
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( . Cladonio-Pinetum)  
(Populus tremula-Climacium dendroides).

## **Why native woodlands of Scotland are important: some implications for sustainable forestry**

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Over recent decades the role of forests in sustainable rural development has changed. The multiple forest functions are at the centre of moves towards woodland expansion across Europe. Focusing on forests in Scotland, this study shows how the values of different woodlands are very different depending on the location, the forest function and the sustainability dimension under consideration.

The economic dimension of sustainability concerns the ability to maintain an economically viable forestry and sustain levels of productivity sufficient to meet current and future demands for forest products and services, whilst using resources efficiently. The social dimension concerns institutions that are to turn forestry towards sustainability and need to deliver a socially acceptable distribution of incomes and multiple benefits from forests. The environmental dimension concerns the maintenance of biodiversity, health and vitality of forest ecosystems and their ability to provide a continuous stream of environmental, ecological, cultural and amenity functions.

Although the contribution of forestry to the Scottish economy is moderate, it is the second largest form of land use and its influence on the environment is significant. The expansion of forest cover, nature conservation and restoration of native woodland are major priorities of rural policy in Scotland.

Contrasting native woodlands with the non-native forests that dominate, this paper presents an analysis of the different functions performed by forests. Within a sustainability framework and from a European perspective, considering the current economic, social and environmental incentives for, and constraints on woodland expansion, this paper outlines the possible futures of Scotland's native forests.

Keywords: native woodland, sustainability, Scotland



## **Social and cultural values of forests and trees in Northwest and Southeast England**

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The key issue of 21st century forestry is sustainable forest management (SFM) which incorporates economic, environmental and social considerations. The social element of sustainability has not been given the same prominence in forestry as economic and environmental issues such as timber production and biodiversity. Differences concerning what people value often underlie the conflicts that can arise between publics and organisations over forest management. Therefore values are an important element to be consider in SFM. The objective of this research was to examine public values for forests in Northwest and Southeast England. Qualitative data were collected, in both urban and rural areas, using a series of in-depth discussion groups that explored in detail the values people associate with forests. The main findings of the study draw attention to the importance of a number of issues and include the importance of using forests as children. Early memories of using forests were overwhelmingly positive encompassing feelings of excitement even when these bordered on the scary. People also emphasised feelings of well-being and described the physical benefits of using forests as secondary to how being in a forest actually made them feel. People's perspectives also linked to wider issues of concern over increases in development, the loss of natural space and ownership of land. The implications of the research for future policy development include the need to build long-term relationships between organisations and publics. Also to provide accessible public land particularly in urban areas where people have little opportunity for contact with nature.

Keywords: sustainable forest management, values, in-depth discussion groups, perspectives

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## **Large-scale patterns of genetic variation among indigenous populations of *Picea abies* Karst., *Abies alba* Mill. and *Fagus sylvatica* L. in the Carpathians and adjacent regions**

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This contribution summarizes research employing isozyme gene markers on the genetic differentiation and diversity of populations of three forest tree species which are the principal constituents of montane and subalpine forest belts in Europe, namely: Norway spruce (*Picea abies* Karst.), silver fir (*Abies alba* Mill.), and common beech (*Fagus sylvatica* L.). Additionally, the genetic footprints of the postglacial recolonization process are briefly discussed.

In beech, a relatively homogeneous distribution of alleles was found. Accordingly, the genetic differentiation among regional groups of populations was weak, but there was, however, a considerable within-region differentiation among populations. There was no correlation between allelic richness and gene diversity in this species.

In silver fir, a strong differentiation among regions and a much clearer geographic distribution pattern was found. There was a clinal variation in allelic frequencies and gene diversity along the Carpathian ridge. Western Carpathians exhibited the lowest levels of genetic diversity. Genetic diversity within populations subsequently increased both towards the west (Herzynic and Pre-Alpine region) and south-east (Eastern and Southern Carpathians, Balkans). In contrast to diversity, allelic richness was quite regularly distributed.

In Norway spruce, different patterns of genetic variation were detected in the Herzynian and in the Carpathian populations. Virgin forests and stands originating from natural regeneration exhibited smaller genetic differentiation and higher levels of intrapopulation genetic variation than artificially established stands.

**Keywords:** *Picea abies*, *Abies alba*, *Fagus sylvatica*, genetic diversity, allelic richness, Carpathians



## **Utilisation of natural forests for ecotourism: matching expectations and goals**

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Primeval forests should only be used for ecotourism purposes with the utmost caution and their integrity must not be compromised in any way. The paper discusses whether primeval forests should be opened up for ecotourism on a larger scale at all and if so, under what conditions.

A thorough study was conducted to investigate public awareness of the primeval forests' value prior and after the visit of the Prince of Wales to the Badin primeval forests in Slovakia. Evaluation forms were obtained from groups with different background and interests. The overall impact of these excursions was assessed in terms of nature protection and ecological awareness. One conclusion is that a clear line should be drawn between ecotourism in a broader sense and scientific tourism. Different goals must be set for each group, at least two groups different expectations should be distinguished: ecotourists, opinion-leaders and decision-makers, on the one hand and scientists, conservationists, and land managers on the other.

Both factors, i. e. the expectations of the various groups and the goals to be achieved, were analysed in various localities in the light of the optimal, near-natural utilisation of primeval forests for scientific, educational and recreational purposes. Alternative approaches and best practices according to the particular expectations and goals are proposed based on this analysis, and initiatives such as Green diplomacy and educational trails in natural forests.

Keywords: natural forests, ecotourism, scientific tourism, forest pedagogy, Slovakia

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## Optimising the conservation of natural forests in Moldova

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The area covered by forests in the Republic of Moldova is 392,600 ha (11.65% of the country's territory). There are 120 forest-protected areas covering a total area of 59,495 ha (17% of the area covered by forest). All forest-protected areas were grouped according to their structure and composition into five forest ecosystems.

1. Pedunculate oak (*Quercus robur*) with cherry trees: occurs in the north of Moldova and covers 11,602 ha. 10 protected areas have been established with a total surface area of 2,146 ha (18.5%).
2. Sessile oak (*Quercus petraea*), pedunculate oak (*Quercus robur*) and beech (*Fagus sylvatica*): are spread in the central part of Moldova. The total surface of this type of forests is 150,309 ha. 44 protected areas covering 33,815 ha (21.1%) have been selected.
3. Pubescent oak (*Quercus pubescens*): occurs in southern Moldova with a total surface area of 7,000 ha. 25 protected areas have been selected covering 5,374 ha, (76%).
4. Willow (*Salix alba*), poplar (*Populus alba*, *P. nigra*) and pedunculate oak from water meadows: cover a surface area of 15,000 ha. 14 protected areas with a total surface area of 4,609 ha and 10 forest genetic resources have been selected.
5. Sessile oak (*Quercus petraea*), and pedunculate oak (*Quercus robur*) on a limestone substratum: 27 protected areas with a surface area of 8656 ha (36%) have been selected.

Keywords: forest ecosystem, forest type, forest genetic resources, conservation, Moldova

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4.	( <i>Salix alba</i> ),	( <i>Populus alba</i> , <i>P.nigra</i> )		
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(36%).				

## **The largest surviving remnants of the great European fluvial forests: a case study in Transcarpathia**

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The Transcarpathian fluvial forests represent the unique and largest surviving refugium of the ancient riverine forests (oak/small leaved ash stands) of Central Europe, described in the CORINE Biotopes manual as the: "Most diverse, structurally, floristically and faunistically, of all European ecosystems..., the great fluvial forests of Europe are reduced to a few highly vulnerable examples". Their importance was not appreciated till recently and no effective conservation exists at the present moment. The current Ukrainian economic stagnation adds to the pressure upon these forests. The country risks losing these unique ancient monuments of nature.

The study purpose was to provide ecological research data in order to develop conservation and restoration models, for transboundary threatened biota and their natural habitats, which address considerations of biodiversity, eco-hydrology, sustainable development and a changing environment.

Despite recent pressures, the riverine forests of Transcarpathia remain one of the most important, but largely overlooked, biodiversity hot-spots. The high number of nationally and internationally threatened plant and animal species (>150 species) and communities (>20 types) known to be present in these forests, together with the imminent threat of their large-scale destruction, provide an urgent need to work towards the establishment (or in some cases substantial enlargement) of national and international transboundary protected areas. These outcomes could also form additional economic and cultural bridges between the EU and Ukraine.

**Keywords:** biodiversity hot-spots, human impact, conservation areas, internationally important

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## **A comparison of the carabid communities of virgin and exploited beech forests in the Ukraine**

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Communities of carabid beetles in virgin and exploited beech forests in the Ukrainian Carpathian mountains were compared.

Samples were collected between 1994 and 2002 using pitfall traps (Barber's traps). Five traps were placed on each plot investigated and kept functioning in most cases from April to October. The fixing liquid was 4% solution of formalin. In total 3 sites in a virgin forest of the Carpathian Biosphere Reserve and 5 sites in exploited forests with a prevalence of a beech were investigated. Another about 12,700 specimens were collected and 76 species of Carabidae identified.

The species structure of carabid communities in virgin and exploited forests are quite similar, but the structure of dominance differs.

The body size structure of communities in virgin forests tends to be complete. In exploited forests the loss of species with maximum and minimum body sizes is observed.

Carabid communities in beech forests in the western region of Ukraine can be divided into 3 types: 1) lowland beech forest; 2) low mountain beech forest (up to 700-800 m a.s.l.); 3) mountains beech forest (from 700-800 m a.s.l. up to the top border of a beech forest belt).

The characteristics of carabid communities in different beech forest types are most pronounced at a generic level. The genera *Carabus*, *Cychrus*, *Trechus*, *Pterostichus*, *Abax*, *Molops*, *Trichotichnus*, *Licinus* are typical of beech forests. It seems that there is a connection between areas where these genera of Carabidae occur and the history of origin and the formation of nemoral vegetation in the Palearctic.

Keywords: Carabidae, virgin forests, Carpathians, Ukraine

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*Pterostichus, Abax, Molops, Trichotichnus, Licinus.* *Carabus, Cychrus, Trechus,*

: Carabidae, , ,

## **Description of the decay stage in natural oriental beech (*Fagus orientalis* Lipsky) forests in Iran**

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In order to study the development stages in natural oriental beech (*Fagus orientalis* Lipsky) forests of northern Iran, 8 sample plots, each with an area of 1 ha, were selected in two beech forest reserves. All trees with a dbh of  $>7.5$  cm were recorded within the sample plots. This paper presents only the results of one sample plot in the so-called decay stage.

Results showed that the structure of the studied stand was uneven-aged. The number of stems per ha was 371, which was distributed in diameter classes from 10 to 120 cm. The total volume of the stand was  $470 \text{ m}^3 \text{ ha}^{-1}$ , in which 61% of the volume was classed as large timber ( $>55$  cm dbh). The height of the recorded trees varied between 10 and 50 meters.

The number of standing and fallen deadwood per ha was 21 stems with a volume of  $53 \text{ m}^3 \text{ ha}^{-1}$ . 87% of the deadwood volume was classed as large timber. Felling old trees produces gaps and openings, which leads to vertical structuring, establishing new generations in medium-sized gaps. The mean number of seedlings and saplings was counted (approx. 5000 per ha).

Keywords: Caspian region, oriental beech, development stage, structure

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## **Diversity of forests in strict nature reserves in Lithuania**

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In order to have an overall picture of the diversity of forest ecosystems it is important that the whole range of such diversity is represented in the Strict Nature Reserve Network. Research to identify representative plots of varying forest types in the Strict Nature Reserve Network in Lithuania is currently being carried out and the findings to date will be presented.

Forests of Strict Nature Reserves are the main objects of this study. The status of Strict Nature Reserve ensures that the territory is developing in a natural way without any direct human intervention. The ideal case occurs when such territory is established in naturally formed and untouched forest areas.

This type of protection provides a unique opportunity to observe and investigate natural and naturally developing ecosystems. However, some analysis shows that the network of Strict Nature Reserves was created without considering the principle of representativity, but rather by assessing different values of certain proposed territories.

This paper presents an analysis of forest inventory data on typological diversity and age structures emphasising protection gaps, the disproportion of protected forest types and the unequal distribution of age classes among strictly protected forests. The level of naturalness and factors affecting the naturalness of these forests is also analysed.

**Keywords:** strict nature reserve, representativity, forest type, diversity, naturalness, Lithuania



## **Close-to-natural beech forests as reference systems for evaluation of effects of forest reconstruction on vegetation in coniferous stands of Saxony (Germany)**

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Currently, forest reconstruction takes place in Saxony aiming to transform planted, unstratified and even-aged stands of *Picea abies* and *Pinus sylvestris* to ecological, stable mixed woods. Ground vegetation and seed banks of pure coniferous stands, beech forests and reconstruction stands (planted beeches of an age-chronosequence under pine or spruce) on potential sites of Luzulo-Fagetum were focussed on. Near-natural beech forests served as reference ecosystems for nature conservation evaluation.

The following questions were raised:

- Which effects do silvicultural operations have on naturalness and biodiversity of phytocoenoses?
- Which structures, species groups or parameters can be indicators of evaluating forest reconstruction?

Characteristic distinctions exist in species diversity, mean dominance and above-ground biomass of herbaceous and moss layers between the sample plots. Pine stands, pine stands with a layer of planted 5- to 15-year-old beeches (partly oaks) and managed beech forests are relatively abundant (averaging 35-36 species). The reference beech forests (20.6) and pine stands with 31- to 45-year-old beech layers (12.7) have a lower diversity. Species number, dominance and biomass of ground vegetation correlate with light and anthropogenic factors. The seed banks show high numerical abundance of few species (cf. Juncaceae, Cyperaceae) and absence of numerous species typical of natural acidophytic beech forests.

Decisive here is not absolute biodiversity but reference to the respective stage of natural forest ecosystem. Beech forests devoid of management for some decades but not yet with mosaic structures may be species-poorer, being however more natural than species-richer pure coniferous stands.

Keywords: biodiversity, phytocoenotical indicators, nature conservation evaluation, Luzulo-Fagetum, forest management

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(cf. Juncaceae, Cyperaceae)

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## **Herb layer species as indicators of biodiversity of forest ecosystems - Examples from forest nature reserves and managed forests**

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Unmanaged forest nature reserves can be used as standards for forestry and nature conservation in order to derive modern forest practices including the main goals of sustainability and biodiversity. Examples of floristic and vegetational studies from forest nature reserves in Lower Saxony and Hessen showed that the number of vascular plant species in forests managed close-to-nature is higher than in unmanaged forests. Looking at species richness in a ten year interval of unmanagement forest reserves showed a significant decline of number of species, too. In both cases, species richness is mainly caused by the number of non-forest species dependent on higher light intensity and soil disturbances. Beech (*Fagus sylvatica*) becomes dominant in unmanaged forests according to its high shade tolerance and shade effects towards other species. These are the main reasons for decreasing number of plant species in unmanaged forests. Only after large-scale disturbances like windthrow with open mineral soil plant species richness increased.

Keywords: biodiversity, herb layer, forest nature reserve, managed forests, indicators

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(*Fagus sylvatica*)

## **Forest management in a national park: objectives, realisation and first results from National Park Kalkalpen, Austria**

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The Kalkalpen national park, established in 1997, is the largest forested reserve in Austria. It is designated as NATURA 2000 site and category II site according to IUCN management categories. Situated in the south of the province of Upper Austria it is part of the northern limestone alps.

Forests cover about 80% of the area. Since the 15<sup>th</sup> century, these forests have been heavily used as energy source for a flourishing regional iron industry for more than 400 years. As a consequence parts of virgin forest actually are less than 1% of the total forest area and tree composition in many parts has been changed to spruce (*Picea abies*) dominated forests instead of mixed forest stands dominated by beech (*Fagus sylvatica*).

The main objective of national park forest management starting in 1998 is to accelerate a natural development of pure artificial spruce stands into mixed stands by removal of spruce (*Picea abies*). Parts of the cut trees remain in the place, parts are harvested and sold.

From 1999 to the end of 2002 a LIFE project funded by the European Union was running at an area of about 6.000 hectares aiming at a concentration of forest management activities to a restricted area in order to be able to finish it earlier.

Keywords: National park, forest management, spruce, bark beetle, LIFE project

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## **The role of ungulates in the vegetation dynamics of natural temperate forests: a review**

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Forest ecosystems are made both of plants and animals. Each organism group evolved under the influence of the other. Plant-consuming animals may affect plant population dynamics as well as competitive interactions among plant species. Thus, herbivores can govern development and structure of forests. In the present review we will focus on the potential effects of ungulate herbivory on dynamics and composition of natural temperate forest. These forests originally sustained several ungulate species ranging in size from roe deer (*Capreolus capreolus*) to aurochs (*Bos primigenius*). Feeding strategies and hence impacts on forest plants vary among ungulate species, these being either browsers or grazers or a combination of the two types. Until the recent past relatively large forests remained in the temperate zone that were little altered by man. Wild ungulates, however, were much sought after by men since millennia. As a consequence ungulate populations were either significantly reduced or extirpated, leaving most natural/primeval forest without their primeval ungulate fauna. Thus, influences of ungulates at natural densities on primeval forest ecosystems remain largely speculative. Only relatively recently conservation programmes and management for recreational use led to high population densities in some ungulate species. In such altered ecosystems impacts of ungulates on vegetation became obvious. In general, tree seedling and sapling dynamics were affected, but observation periods were short. Thus, resulting projections towards future forest development may have been misleading. Primeval/natural forests having their ungulate fauna and their predators efficiently conserved or, if previously extirpated, reconstructed, may provide prime settings to study type and scale of impacts of wild ungulates on forest plant communities.

Keywords: ungulates, herbivory, browsing, forest regeneration, stand dynamics

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*(Capreolus capreolus)*

*(Bos primigenius)*.

## **Optimisation and monitoring of the recreational value of natural forests**

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The optimisation and the monitoring of the recreational value of natural forests are a component of sustainable regional development. The monetary recreational value of natural forests can be quantitatively increased with different methods. For natural forests there are also monetary recreational value forms, which are based on idealistic and ethical social principles. The monetary recreational value of natural forests depends on different factors: on the megatrends and on the demand of ecotourism, on the socio-economic type of the natural forest region as well as on the quality of the management in the natural forest region. Concerning the management strategies and management instruments specific success and failure criteria are determined. The quality management of natural forest regions can be evaluated and improved.

Keywords: natural forests, recreational value, management, ecotourism, sustainable regional development

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## On protection of unique forest objects of nature from fires

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Unique forest objects of nature, unlike reserves and nature parks, are comparatively small in size. Therefore the spread of wildfire (including fires started by lightning) over their territory should be prevented at all costs. Traditional prevention schemes (creation of fire prevention barriers, forest-fire roads) and the use of heavy digging equipment in the process of extinguishing a fire can turn a unique object of nature into a conventional forest. Therefore the main element of a fire prevention scheme should be the creation of an information database to ensure prompt and effective fire fighting containing information on existing roads, paths, the hydrological network, and plots not liable to burning.

A large-scale vegetation fuel map (VF map) provides the basis for the information database. The methodology for creating such maps using forest inventory information is elaborated in the Institute of Forest SB RAS. Each forest inventory plot on a VF map receives a brief pyrological description for spring, summer, and autumn. Details are given in the pyrological description of the plots enclosed with the map.

The protection of unique objects of nature from wildfire invasion from adjacent forest is of great importance. Therefore a VF map should be created for the adjacent territory as well, and roads should be built directly along the border of unique objects of nature to allow approaching fires to be fought, using backfires.

Another important element is the improvement (especially in mountain areas) of the daily fire danger ratings on the basis of local scales for timely fire detection. Improved estimations of forest fire drought levels should help to determine the likelihood of vegetation plots (shown in the VF maps), catching fire and to make it easier to predict the spread, development and impact of a fire.

Keywords: unique forest objects of nature , protection from fires, vegetation fuel map, fire danger rating

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## **Socio-economy, socio-ecology and tourism in natural forests**

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The article is based on the paradigm that socio-economics encompass the conflicts and synergies between values and utilities, postulating that a deontic concept sets the context within which utilitarian orientations (the economy) are operative (ETZIONI 2003). Many ethical, but also aesthetical and mythological values, emotions and attitudes attached to natural forests by human society define the deontic framework of socio-economic interactions in this type of landscape.

Furthermore socio-ecological interactions between society and forests (an element of the landscape) are overwhelming. Human society hammers the environment but vice versa landscape shapes human society and culture.

Contemplative nature tourism in natural forests reveals the persistence of those strong values which are relevant in a socio-economic approach. Socio-economic commercial tourism activities are quite beneficial and profitable. There is a socio-ecological impact on the tourists exposed to "true" nature e.g. in pristine forests. However beneficial socio-ecological interactions through tourism are most sensitive to disturbances.

Beside this example of tourism many other economic opportunities are waiting for a new socio-economic forestry approach.

**Keywords:** socio-economics, socio-ecology, forest landscapes, deontology, values, contemplative nature tourism

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## **Natural disturbances in Central European forests: approaches and preliminary results from Rothwald, Austria**

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There is a continuum of disturbances in forests ranging from fine-scale (breakage of branches or death of single trees) to coarse-scale (stand-replacing) events. Despite the fact that disturbances are considered to be driving forces in forest development, very little is known about the disturbance history of natural forests in Central Europe. As part of a larger study on the long-term dynamics of a spruce-fir-beech forest in Austria, the role of disturbances for the development of tree population and species coexistence was investigated. The applied approaches included age structure analysis, development of a disturbance chronology based on dendroecological analysis, analysis of gap (size) distribution (terrestrial analysis, and analysis of a time series of aerial photographs), and a species replacement matrix. The majority of the gaps were smaller than 400 m<sup>2</sup>, however, most gaps were the result of more than one disturbance event. Age class distribution of beech indicated stand-initiating disturbance events of intermediate scales (> 1 ha) or possibly synchronised fine-scale disturbances. These preliminary results suggest that disturbance events of intermediate severity are important for the stand dynamics and may be one mechanism maintaining coexistence of tree species at Rothwald. True primeval forests provide an excellent opportunity to characterise disturbance regimes. However, the disturbance regime can only be described relative to a given scale. Much too often extent and grain of a study are limited by the small size of old-growth remnants. Therefore, large protected areas of old-growth forests are immensely valuable for maintaining and (subsequently) studying forest dynamics.

Keywords: primeval forest, long-term dynamics, disturbance, gap, dendroecology

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## **Characteristics of virgin forests in the Ukrainian Carpathians and their significance for the close-to-natural forest management**

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10 ecological criteria were determined to evaluate the natural state of forest plant associations: species composition of plant associations in natural habitats, uneven aged communities, multi-layered vertical structure, natural state of pedosphere, natural species composition of fauna, natural mortality and decay of trees, existence of phases, typical of the phylocoenogenesis: regeneration phase, phase of formation of species composition and vertical structure, phase of middle-aged trees and disintegration phase. Based on these criteria, nearly 60,000 ha of natural forests were located. Their degree of naturalness varied from virgin, quasi-virgin to near-natural ecosystems. The species structure indicates monodominant (climax) and polydominant (paraclimax) virgin forests. The postglacial period of vegetation development resulted in relict climax virgin ecosystems of the early Holocene (*Pinetum sylvestris*, *Pinetum cembrae*, *Laricetum polonici*, and *Piceetum abietis*), relict ecosystems of the mid Holocene (*Quercetum petraeae*) and late Holocene ecosystems (*Fagetum sylvaticae*). Natural ecosystems are valuable in many ways: logistically, phytohistorically, phytogeographically, from a co-evolutionary perspective, genetically, ecodidactically, from the point of view of landscape diversity and plant associations conservation and for landscape-aesthetics. The Carpathians currently harbor 174 500 ha of secondary ecologically unstable spruce monocultures, where different ecological catastrophes have been observed. The virgin forests are our “phytoceenotic gold mine”, with significance as ecomodels for the formation of close-to-natural, ecologically stable, homeostatic plant associations, that are able to self-regenerate, are self-protective and self-regulating.

Keywords: virgin forest ecosystem, ecomodel, phylocoenogenesis, Holocene, Carpathians, Ukraine

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(Pinetum sylvestris, Pinetum cembrae, Laricetum polonici, Piceetum abietis),  
(Fagetum sylvatici),  
(Quercetum petraeae),

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## **Herb layer dynamics of primeval fir-beech forests in central Slovakia**

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Badínsky prales and Dobro ský prales primeval forests are the oldest nature reserves in Slovakia, established in 1913. Both reserves have been the object of intensive research, focusing on the tree layer, whereby the dynamics of the herb layer have been largely ignored. Our current research in these primeval forests is aimed at the study of herb species dynamics in association with the tree-layer development within the cyclic changes in primeval forests. We established 28 rectangular 400 m<sup>2</sup> plots in both reserves placed in sites with different developmental stages. Frequencies of herb species were calculated based on two hundred 0.25 m<sup>2</sup> square subplots systematically distributed within each plot. Within the plots, we measured the tree parameters of seven vertical tree layers.

The frequencies of most of the herb species were closely correlated with the total herb cover, the number of trees in the lowest layer (0–130 cm) and their estimated cover. Generally, frequencies of herb species decrease with increasing sum of tree heights, basal area and volume, as well as with the number of trees and the cover of the tree layer. However, in several herb species, relationships deviating from this general rule were found.

Differences in herb species dynamics are related to different community types, reflecting differences between habitats. Indirect gradient analysis (DCA) showed three separated clusters corresponding to different syntaxonomical units. Ordering of plots according to development dynamics can be recognised only within particular clusters.

While there seem to be some common features among the herb layer changes recorded during natural fir-beech stand development, they are very specific for each community type.

**Keywords:** primeval forest, fir-beech, nature reserve, herb layer dynamics, development stages, Western Carpathians, Slovakia

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K., E., M., E., M.

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“Badínsky prales” “Dobro ský prales”  
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## **Native vegetation cover regeneration between the forest and subalpine belts in the Ukrainian Carpathians (Chornohirskyi massif)**

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Long-term anthropogenic impact has resulted in a lowering of the natural upper timber-line (by 100 to 200 m). This has caused a decrease in the forest area, the formation of numerous meadows on the former forest areas and negative changes in the subalpine zone. Various data indicate that the upper timber-line has lengthened by 5 to 40%. Dozens of hectares of rocky waste-ground and new avalanche sites have been formed. Plants have also spread: e.g. *Vaccinieta myrtilli* by 15%, *Nardeta strictae* by 10%, and *Deschampsia caespitosa* by 5%. In this study the current timber-line zone of spruce forests was investigated. Plots and transects were set up in various biotopes to investigate the degradation stages of the vegetation cover, the dynamics of the succession processes in the forest and meadow plant associations, the natural forest regeneration in the meadows on the former forest lands, and the distribution and number of the rare plants and plant communities. Generally recognised methods were used for phytocoenotical and forestry investigations. Traditionally managed areas were investigated and, as a control, some of the reserve's unmanaged areas. The valuable data obtained records the level of disturbance and succession directions in the transformed ecosystems, natural forest regeneration and biodiversity conservation under different ecological conditions. Practical recommendations for using such upland areas sustainably are given.

Keywords: *Picea abies*, anthropogenic impact, timber line, succession, biodiversity, conservation, Carpathians, Ukraine

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: *Vaccinieta myrtilli* 15%, *Nardeta strictae*-10%, *Deschampsia caespitosae*-5%

: *Picea abies*,

## **Stand structure and gap dynamic in the Slovakian virgin beech forest reserve Havešová based on an extensive inventory**

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The paper is based on extensive field studies in the Havešová virgin beech forest reserve in eastern Slovakia. They are carried out on the whole area in close connection with the Slovakian Institute of Silviculture in Zvolen (Prof. Dr. Milan Saniga), and add information to the intensive and repeated measurements on relatively small permanent sample areas established by Korpel. The objective is to gain a clearer picture on gap dynamics and thus the disturbance regime on the whole area in order to draw conclusions for a close to nature management of artificial beech forests in Central Europe. The applied method is an extensive inventory with 24 samples distributed regularly over the total area. Gaps are measured according to the method of RUNKLE (1992). The rate of decomposition of dead wood is assessed along a newly developed grading scheme.

Preliminary results show that the mean gap size equals the growing space of 4 old trees, the maximum is 56 trees. Gaps, defined as interruption of the dominant crown layer, are at most 40 years old before the canopy is fully closed again. These gaps occupy ca. 18 % of the total area. The gap filling tree species is almost ever beech, other species like *Acer pseudoplatanus* are very rare. Regarding the management of artificial beech forests it is important that gap sizes well surpass the number of just a few old trees. Quite large gaps are possible under a pure natural disturbance regime, what can be best emulated by group selection or even patch cutting in managed forests. This will facilitate the establishment of light demanding tree species in mixed beech forests, an important objective of close to nature silviculture in Central Europe.

Keywords: *Fagus sylvatica*, virgin forest, stand structure, gap dynamic, dead wood, disturbance regime

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## **Research on natural forests in the Czech Republic: examples from three fir-beech reserves in the Moravian Carpathians**

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A complex research program on the virgin forest reserves in the Czech Republic was initiated by E. Průša in the 1970s. Between 1994 and 2000 investigations were repeated in 18 of these reserves. Three of the re-surveyed reserves (Mionší, Salajka, Razula) comprised montane fir-beech stands located in the Moravian Carpathians.

In this study the tree layer was geodetically mapped across all the reserves. The pattern of natural regeneration, forest types and developmental stages was then overlaid and described. A series of permanent typological plots and cross-sectional stand profile transects were established, such that changes in soil conditions, the ground layer, and stand structure could be assessed.

It was found that the oldest generation of silver fir had declined and appears to be entering its final stage of disintegration. A younger fir trees remain sporadic, the population is critically endangered. Grazing by sheep in the 15-19<sup>th</sup> centuries favoured fir over beech, but the successive exclusion of sheep has allowed beech to regenerate strongly. There was a severe reduction in the herb layer cover across all the reserves, mainly due to increased regeneration of beech, but species composition changed only slightly. The average volume of living wood and dead wood in the developmental cycle of these forests was calculated to be 560 and 190 m<sup>3</sup> ha<sup>-1</sup>, respectively.

Recent changes in the composition and structure of these natural fir-beech forests in the Czech Carpathians indicate that: (i) silver fir might be eliminated in the future; (ii) sheep grazing has impacted strongly on tree regeneration, affecting both the past and potential future stand composition; (iii) increased tree regeneration has impacted on the cover of the herb layer; and (iv) levels of living and dead wood change during stand development, but form overall an average of 75% and of 25%, respectively, of the total.

Keywords: fir, beech, natural forests, dynamics, disturbance, Carpathians, Czech Republic

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## **Local people's perception of protected areas: an example from the Carpathian Biosphere Reserve in Transcarpathia**

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The establishment of protected areas has become one of the most important instruments in international nature protection policy. Integrative protection concepts such as for example the UNESCO Biosphere Reserve Concept shall not only help to protect nature, at the same time they intend to contribute to the local population's livelihood. But does the local population actually perceive the establishment of a protected area as a benefit? The study deals with the mental models people living in the surroundings of a biosphere reserve develop regarding the changes that follow the establishment of a protected area. This case study was carried out in the Carpathian Biosphere Reserve in Transcarpathia and its results were compared with the results of a case study from the Biosphere Reserve Entlebuch in Switzerland.

Keywords: biosphere reserves, acceptance, perception, social sciences

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## **The importance of natural stand structures in managing beech forests for conservation purposes**

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Since 1999, a research project, funded by the Federal Agency for Nature Conservation, is carried out in Brandenburg (Germany) to define nature conservation standards for the management of lowland beech forests. The avifauna, xylobiontic beetle fauna, ground beetles, vegetation and the stand structures are investigated in 12 differently managed and six since 12 to more than 150 years unimpaired, near-natural beech forests to identify bioindicators for forest management methods which do not deteriorate the typical biocoenosis of beech forests. Results show, for instance, (i) wide differences in stand structures between near-natural beech stands and managed forests, (ii) close dependence of xylobiontic bird species on stand structures, (iii) influence of moss layer, coarse woody debris and forest developmental phases on the typical ground beetles of beech forests, (iv) changes in vegetation through forest management.

Some bioindicators for near natural, managed beech forest are presented:

- (i) naturally ageing trees, dead wood and, in focus, special tree structures which are typical attributes of ancient forests are suitable structural indicators,
- (ii) the Middle-spotted Woodpecker *Dendrocopos medius*, was identified as a valid indicator for mature beech forests with trees more than 160 years old up to the natural mortality. The occurrence of *Dendrocopos medius* depends on two typical stand structures: a) rough bark structures (typical for very old beech trees) and b) parts of dead wood of stems or branches of standing trees.
- (iii) *Osmoderma eremita* is described as a possible bioindicator, too.

Finally, a detailed proposal for managing beech forests for conservation purposes is presented.

Keywords: natural beech forest, nature conservation standards, close to nature forest management

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  - a) *Dendrocopos medius* ( ) ) :
- (iii) *Osmoderma eremita* , .

## **State, conservation and regeneration of forest genetic resources in the Carpathians and adjacent territories**

Yatsyk, R.; Stupar, V.; Haida, Y.; Fenysh, V.; Kaplunovskyi, P.; Porada, T.; Ravliuk I.

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The paper considers the current state, conservation, regeneration and use of the genetic resources of the main forest associations and of the valuable, rarer forest species in the five administrative regions of the Western Ukraine. The focus of the paper is closely connected to the concepts of sustainable development and biodiversity conservation. Forests with a rich genetic diversity could help to fulfil the ecological, social and economic needs of society. A detailed analysis of the 20-year-period dynamics of the state of genetic resources in the Carpathian region and adjacent territories allows integrated methods for their conservation at both population and species levels to be substantiated. The methods depend on biological, ecological and phenological characteristics of the forest species in question.

The conservation of forest genetic resources is most important in those areas where vegetation cover has suffered the most appreciable anthropogenic changes, that is on plains and foothills. To conserve and rationally use the genetic resources in the selection seed programs, 210 gene reserves of 18 types, totalling 13,400 ha in area, were formed. Roughly 1300 plus trees and nearly 500 ha of the plus stands were selected, and over 320 ha of clone seed orchards were set up.

The study determined the general principles that ensure the continued existence of the genetic resources, such as: gene pool protection, natural forest regeneration and measures favouring it; use of environmentally sound technologies for forest management and forest regeneration; optimal methods of stand shaping), use of the selected natural seeding) and locally collected seeds for artificial forest regeneration; inclusion of valuable vegetative and seed material of the protected territories where anthropogenic impact is reduced to a minimum in the selection seed programs; and the formation of small habitats from the seed and stool collections of ecotypes using the ex situ method.

Keywords: genetic resources, biodiversity, sustainable development, conservation, Ukraine

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## **Gap disturbance patterns of a beech virgin forest remnant in the mountain vegetation belt of Slovenia**

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This study investigated disturbance patterns of a beech virgin forest remnant based on inventory of the horizontal canopy structure.

Stand data were collected from the beech-dominated southern part of the Krokavice reserve in the Slovenian Dinaric Alps. The canopy layer was classified into gap and non-gap areas based on terrestrial inventory, and combined with aerial photograph interpretation.

The study shows that 49 identified canopy gaps covered 5.6 % of the reserve area. Gap size varied from 6 to 833 m<sup>2</sup> with mean value of 137 m<sup>2</sup> and gaps larger than 300 m<sup>2</sup> rarely occurred. Gap size frequency distribution at 50 m<sup>2</sup>-class interval followed the log-normal distribution. The gap size mode was represented by the 100 m<sup>2</sup>-class. Single-tree gaps were predominant and canopy gap orientation did not show a significant uniform distribution. Taking the canopy in a dichotomous view proved to be a suitable procedure to analyse gap dynamics in one-layered, beech-dominated virgin forests.

The study area was characterised by high vitality and competition of beech, low intensity of disturbances and low proportion of other tree species. Gap formation was influenced by combination of both endogenous and exogenous environmental factors. Thus, gaps were relatively small and they occupied a small land area. The mentioned features may be attributed to interactions between climate, landform, rich soils, disturbance regime and the ability of beech to close the gap by lateral branch growth.

**Keywords:** canopy gap, disturbance patterns, beech, virgin forest, gap size distribution, gap formation

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## **Characteristics of a natural reserve of cypress ( *Cupressus sempervirens* var. *horizontalis* ) in the Caspian forest region of Iran**

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This study was carried out in the Hassan Abad forest, which is located in the Mazandaran province in the Caspian forest of northern Iran. Features of this natural reserve of cypress were investigated. First, maps, aerial photos and other necessary data were collected and field-work performed. Aerial photos were used to measure the percentage of natural forest, of plantation and of crown coverage. This region has a Mediterranean climate so it has special geographical and topographical conditions. There are some areas of pure *Cupressus sempervirens* var. *horizontalis* forest. This region has been considered a protected area since 1992. Some erosion has occurred on south-facing slopes and non-developed soils with an AC or A (B) C profile type and little leaching. The area of the cypress Protected site is about 5463 ha, natural forest 1592 ha, and plantation forest 664.36 ha. The crown coverage is classified into three levels: sparse (337.6 ha), semi-dense (954 ha) and dense (300,4 ha). The structure of the stand is uneven-aged. There are 186 stems per hectare. The basal area of the stand is 11.76 m<sup>2</sup>/ha and 60% of trees belong to a high-forest system (of seedling origin).

**Keywords:** Cypress, *Cupressus sempervirens* var. *horizontalis*, natural reserve, aerial photos, crown coverage, Caspian forest, Iran

**(*Cuppressus sempervirens* var. *horizontalis*)**

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*Cuppressus sempervirens* var. *horizontalis*. 1992  
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## **Comparison of the structures of the protection beech forest Tisovac and the primary beech forest Kakanj**

Ballian, D.<sup>1</sup>; Cengic, I.; Visnjic, C.; Vojnikovic, S; Balic, B.; Kunovac, S.; Ibrahimspahic, A.; Treštic. T.

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This study was carried out on two standing inspection sites 1ha in area located in the protection beech forest Tisovac and the primary beech forest Kakanj. The objective of the study was to compare structures of these forests and to determine the regulating measures for managing beech forests based on the data obtained.

In this study we presented the structure of diameters ( $d_{1.3}$ ), heights, basal area, volume and tree number per hectare. The results proved that the beech forest of Tisovac is in the optimal stage, and the Kakanj forest is in a decomposition stage as well as in a regeneration phase.

Phytosociological data proved that both forests, Tisovac and Kakanj, are a part of the forest association Luzulo-Fagetum (MEUSEL 1937). This type of forest is mainly present in the area of the Dinaric Alps.

Pedological research revealed the presence of silicate geological substrates in both research areas. The most common types are the riolits and quark porfirs. The most common soil type is a distinct cambisol with different subtypes.

In our measurements on the sample plots, we noticed a selection structure in Tisovac and Kakanj forest. However, this structure is different from the Liocourt's structure, which is a consequence of a permanent development and changes in the stands, as well as the impact of the microhabitat. The structure of these forests presents a very important example and shows us how to manage beech forests.

Keywords: primary forest, structure, protection, soil, phytosociology

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Luzulo-Fagetum (Meusel 1937).

## Use of a GIS to display functioning regularities in beech virgin forests

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The results of the complete inventory of a 10 ha plot in the virgin beech forest in the Uholsko-Shyrokoluzhanskyi massif of the Carpathian Biosphere Reserve showed a lack of close correlation between the main characteristics of the virgin beech forest. This indicated there must be other limiting factors in the formation of virgin beech forest. It would be logical to assume that a certain site's soil and climatic conditions determine the forest structure. A GIS "Beech virgin forest" was set up to establish a link between soil characteristics, vegetation cover, undergrowth and stand structure.

Use of geographical information systems (GIS) allows us to see the spatial information obtained from the field investigations and to make conclusions about its spatial distribution. Special format files (\*.dbf) are used to store all the information obtained about a certain forest ecosystem layer. A database for all layers was set up using "ArcView" software, and the geographical co-ordinates for the separate layer elements were given. The next step was to analyse the information obtained (maps) using "ArcInfo" software.

The investigation concluded that the GIS "Beech virgin forest" contains the following maps: relief (3 characteristics), soil (6 characteristics), hydrographic network (4 characteristics), vegetation cover (7 characteristics), undergrowth (5 characteristics), and stand (14 characteristics). On analysis a correlation between the separate maps was found, as well as between the separate characteristics for one map. Thus tree species composition and vegetation cover seems to depend on the depth and rock debris soil, and the proximity of constant watercourses. Timber volume largely depends on the humus and soil depth. Stand density determines the density of herb layer and the quantity of undergrowth. The study determined the stand characteristics in the virgin beech forest and established a correlation between the stand characteristics and parameters of the other layers.

Keywords: Geographical Information Systems, virgin beech forests, Carpathians, Ukraine

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## **Faunistic aspects of virgin forest development phases**

Bondarenko, V.

Ukrainian State Forest-Technical University, O. Kobylianska Str. 1, UA-79005 Lviv, Ukraine

Virgin forests are forest ecosystems (communities), originating and developing in natural way under the influence of natural factors. They undergo the complete development cycle without any human interference. In determining the naturalness of forest ecosystems, investigators take into account site areas. The minimum area for the maintenance of natural development processes in virgin forests is considered to be 30-50 ha. Little attention is usually paid to the influence of forest fauna, specifically large mammals (deer, wild boars etc.). Large mammals are mostly the objects of hunting, and so constantly migrate to places where human impact is less. Their concentration is possible in sites in virgin forest, but they also periodically move outside these sites. This means human activity has an indirect impact on virgin forest development. The records and my own investigations on permanent animal routes and places where animals concentrate show that number of large mammals in virgin forests could be 2-5 times higher than in adjacent territories.

Thus, when classifying forests as virgin forest and determining the degree of forest naturalness, it is necessary to take into account the activity of large mammals. Their populations have suffered and continue to suffer systematic anthropogenic pressure. Large mammals have most influence on forest development in the concentration sites and during migration. In particular, they may affect the duration of development phases and the rate of change. This study raises several methodological questions that need to be addressed.

Keywords: virgin forest, large mammals, naturalness

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## **Analysis of beech forest distribution in the Kvasnyi Potik Basin of the Ukrainian Marmarosh**

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The upper reaches of the Kvasnyi Potik Basin is a small testing area in the Ukrainian Marmarosh (part of the Carpathian Biosphere Reserve). The area has a complex geological structure (flysch, lava, limestone, slatestone and metamorphic formations) with nival and relict glacial landforms geomorphology and a diverse biocenological cover.

Given the diversity of the landscape and area structure, a GIS data-base was set up to form a landscape register of the area using ESRI and ERDAS software.

In 2000 geoecological field studies were conducted in the Kvasnyi Potik Basin. The point coverage of the field observation sites contains extensive attribute information on the geomorphology, soil morphology and vegetation cover of relatively small areas (approx. 10 x 10 m), closely examined in situ. The vector layer of the "Biogenic / Anthropogenic Units" was obtained from the data collected and satellite images. Analysis of this vector layer resulted in four land-cover classes being distinguished: 1) coniferous forest, 2) deciduous forest, 3) sub-alpine shrubs and growth, and 4) meadows. The beech forest distribution is also shown in relation to aspect, absolute altitude (meters above sea level) and parent rock.

Keywords: beech forests, geoecological studies, landscape register, Kvasnyi Potik Basin, Carpathian Biosphere Reserve, Ukrainian Marmarosh

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## **Selection criteria and representativity of protected forest areas in Europe**

Branquart, E.<sup>1</sup>; Verheyen, K.; Latham, J.; Welzholz, J. C.; Saudyte, S.; Frank, G.

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Information about selection criteria and representativity of protected forest areas in European countries has been gathered through a standardised questionnaire sent to country representatives of the COST action E27: 'Protected forest areas in Europe - Analysis and Harmonisation'.

The results show that networks of protected forest areas developed in individual countries are mainly based on pragmatic selection criteria rather than scientific standardised ones. As a result, current networks may be not fully representative of the range of forest types to be found in Europe or in individual countries.

Guidance rules based on compositional, structural and functional indicators can however be formulated for the selection of future protected areas to fulfil both biodiversity conservation and naturalness objectives.

Keywords: biodiversity, conservation, forest, naturalness, protected area, representativity, selection criteria

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## **Ecological stability of the most southerly spruce forest ecosystems in the western Carpathians**

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The aim of this study was to evaluate the ecological stability of the forest ecosystems in the most southerly spruce forests in the western Carpathians. Biometric measurements were performed in 1999-2000 on 9 circular plots, 1000 m<sup>2</sup> in area, situated in the Biosphere Reserve Polana mountains along the research transect. The results were subjected to biometric analysis focusing on the following topics: tree species and number, tree sociological status according to Prof. Zlatník, tree diameter at dbh (precision 2 cm), tree height (precision 0.5 m), length of living crown (0.5 m), deadwood (length and diameter (precision 0.1 m), and natural regeneration .

The values measured were processed according to methods established by Prof. Voloschuk. The following parameters of ecological stability were assessed: a (approximation) indicates how the present species composition of the stand corresponds to the original composition; CI (crown index) gives the ratio of crown length to the entire tree height, SR (slenderness ratio) is the ratio of tree height to tree diameter; SQ (sanitary index) is the ratio of healthy to damaged trees, LQ (layering index) shows the deviation of the present vertical layering of the forest stand from the land standard model of a three-layered forest.

The outcome of this study was the classification of the forest ecosystems investigated on a five-point scale of ecological stability. 4 of the ecosystems were stable, 1 was fairly stable, 3 plots showed a low ecological stability and 1 ecosystem was unstable. None of the studied plots could be classified as very stable.

**Keywords:** ecological stability, forest ecosystem, approximation, tree species composition, crown index, slenderness ratio, sanitary index, layering index, Carpathians

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## **Estimating the spatial distribution of defoliation in ground sample plots in the Karkonosze Mountains National Park**

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The Karkonosze Mountains National Park (NP) was created to protect alpine spruce tree stands. High levels of industrial pollution have done catastrophic damage to NP forests. A rectangular dense grid of permanent ground sample plots was created to make inventories and to monitor changes in the tree stands. Some indicators of forest health were also measured on the plots. The main objective of the research was to estimate the spatial distribution of damage in the whole area using point data from sample plots, taking into consideration the diversity of the sites and tree stands.

The level of defoliation was assessed on 1859 trees on 294 sample plots. From a wide set of tree stand characteristics only those that correlated with the observed level of defoliation were selected. The influence of these characteristics and the spatial location on the level of damage expressed by the level of defoliation was analyzed, and a model created. This was used in the spatial interpolation of the level of defoliation for the whole area of the NP.

Results showed a strong influence of site (especially elevation) and tree stand characteristics on the observed level of defoliation and a weak influence of spatial location. This suggests that industrial immisions affect the whole park with the same intensity.

Thus more research is needed on the influence of site and tree conditions before any spatial interpolation can be done. Further monitoring will allow any changes in the damaged tree stands to be identified.

Keywords: spruce, pollution damage, spatial interpolation, Karkonosze Mountains, Poland

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## **Computer-aided field mapping and measurement driven by a highly productive and flexible software tool**

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Almost all types of terrestrial inventories of natural resources can significantly benefit from the use of advanced electronic field equipment. GPS, laser rangefinders, electronic callipers and mobile computers increase the accuracy and productivity of fieldwork. However, the level of the efficiency of advanced field technology mostly depends on the software solution driving the entire system. Statistical forest inventories, forest health monitoring, timber cruising, biodiversity research, detail ecosystem studies and many other types of research and inventories can use the same technology but differ substantially in their database structure and field methodology. For this reason it is often necessary to develop and maintain special software applications for a particular inventory programme. This part is usually the most complicated.

In order to avoid the problems of the complicated development and maintenance of field software applications, a new software application has been developed that allows custom applications to be rapidly developed without requiring programming skills. Each custom application is developed and maintained by building a database tree in a simple graphical editor. Thus, the user can concentrate on the methodological solution itself and not have to deal with programming. Functions required, such as communication with external devices, measurement data handling, mapping functionality, etc. are performed automatically. As a result it is possible and even simple to develop and run multiple complex projects with different field methodologies and multilevel hierarchical database structure. The data are stored in standard formats (ESRI Shapefiles, MS Access database) and can consequently be used immediately for further work.

**Keywords:** computer aided field mapping, forest inventory, electronic field equipment, ecosystem research, monitoring



## **Distribution of downy mildew fungi (Peronosporaceae) in the Ukrainian Carpathian forests**

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The aim of the study was to establish the diversity of downy mildew fungi in natural forests, mainly in mountain beech, compare it with their diversity in other ecosystems and elucidate the consortive connections of fungi with their host plants in the Ukrainian Carpathians. The data are based on field collections processed in the laboratory with standardised methods for identification of downy mildew fungi. In the Ukrainian Carpathians 91 species of downy mildew fungi were registered. The territory of the Ukrainian Carpathians includes 3 geobotanical regions: Near-Carpathian forests, Carpathian forests and the Transcarpathian area. 77 species of Peronosporaceae (59 of them belong to the genus *Peronospora*) occur in Carpathian forests, 32 (25) in Near-Carpathian forests and 14 (10) in the Transcarpathian area. The main type of forest, where downy mildew fungi were collected was beech. The downy mildew fungi of the Ukrainian Carpathians are parasitic on 125 vascular plant species from 82 genera of 29 families. The dominant families according to the number of host plant species were Asteraceae (26), Fabaceae (15), Brassicaceae (12), Scrophulariaceae (11), Caryophyllaceae (9), Ranunculaceae (8). According to the species number of downy mildew fungi, Fabaceae (15), Brassicaceae (10), Asteraceae (9), Caryophyllaceae (8), Scrophulariaceae (7), Ranunculaceae (6) dominate. An analysis of the downy mildew fungi distribution in the biotopes of host plants showed that in natural biotopes the highest species diversity of these fungi is associated with the forest vegetation of the Ukrainian Carpathians: in various types of forest plant formations 45 species of Peronosporaceae were identified. More than half of these species (24) were found in beech forests. The species composition of downy mildew fungi in the other natural plant formation of the Ukrainian Carpathians was significantly lower in comparison with the forest ones. 18 species of Peronosporaceae were collected in meadow and only 5 in swamp phytocenoses. At the same time the species diversity of downy mildew fungi in the anthropogenic biotopes of the region (segetal and ruderal habitats) is almost as high as their species composition in forests. 42 species of Peronosporaceae are observed in these locations. Their distribution seems to be connected with synantropic species migration processes.

Keywords: natural forests, peronospora fungi, Ukrainian Carpathians

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Brassicaceae (12), Scrophulariaceae (11), Caryophyllaceae (9), Ranunculaceae (8).  
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Fabaceae (15), Brassicaceae (10), Asteraceae (9), Caryophyllaceae (8),  
Scrophulariaceae (7), Ranunculaceae (6).

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## **Construction of a natural forest cell system in Saxony: tools for an ecological orientated silviculture and the integration of conservation aims to the forest land use**

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Natural wood units according to forest law are in the first place working instruments of an ecologically directed silviculture. From this they must be submitted to scientific work. In the interest of such an approach a self-restriction is imposed with regard to the size of the area, the selection of plots and the basic programme of working issues, the implementation of which must be secured by the State Forest Research Centre.

The combination of total preserve and reference area under management within one and the same natural wood unit means a transition to nature protection which is integrated with its whole area into forest-area management. The given device aims mainly at the optimisation of silvicultural procedures by direct comparison with spontaneously running ecosystemary processes. The criterion of optimisation is the ecological sustainability of the analysed geobiocoenoses. This approach includes minimisation of energy inputs.

The investigations will be carried out mainly in existing nature preserves. Therefore, overlapping interests with the State Office for Environment and Geology (LfUG) must be expected particularly in total preserves of medium size, so that the need of co-ordination is foreseeable.

Since the year 2000, 8 natural forest cells have been set up in Saxony according to this concept.

Keywords: forest-area management, total preserve, natural wood units, forest cell system, Saxony

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## **Contrasting effects of fire vs. gap dynamics on patch suitability for a resident Three-toed Woodpecker**

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In this study, the breeding density and success of Three-toed Woodpeckers *Picoides tridactylus* were examined during a 7-year period (1993-1999) after fire in a 143 ha Scots-pine (*Pinus sylvestris*) dominated burnt patch in eastern Finland. Burned trees remained in the area to allow for natural development of the vegetation. From 1996 to 1999, abundance levels of the woodpecker insect preys were studied to test for the hypothesis that variation in the woodpecker abundance and demography is related to change in prey abundance. Available evidence suggests temporary changes in woodpecker numbers after fire, with a dramatic increase in breeding density the following year followed by a rapid decline. Inversely, the reproductive output of individuals increased progressively. Contrarily to spruce bark beetles (the woodpecker autumn-early spring food supply), whose abundance declined through the years in parallel to the number of breeding woodpeckers, the abundance of longhorn beetles (the nestling food supply) increased significantly. Thus, this study highlights a progressive deterioration of feeding conditions for a wintering Three-toed Woodpecker during the years after fire, with implications for the breeding density, but an actual improvement of food supply for a reproducing bird and its offspring. Contrasting patterns of annual changes in prey abundance between the burnt and neighbouring old-growth forest patches (where the woodpecker is also present) emphasise the importance of a patch disturbance history on its suitability for a resident woodpecker.

Keywords: *Picoides tridactylus*, breeding density, forest fire, food availability, bark beetles, longhorn beetles

: 598.726:630\*182(480)

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*Picoides tridactylus*  
(*Pinus sylvestris*),

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: *Picoides tridactylus*,

UDC: 630\*907.32:630\*907.1(436)

### **The Austrian Forest Reserves Research Network**

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The Austrian Forest Reserves Programme, as a specific approach of voluntary contribution to conservation of forest biodiversity, is presented. This programme is based on the concept of nature conservation by contracts under private law, signed by forest owners and the Republic of Austria. The forest owners commit themselves to omit any utilisation which may have negative effects on the reserves, with the exception of necessary hunting activities. The network of reserves is managed by the Federal Office and Research Centre for Forests. Experiences gained during the establishment and the maintenance of the network are discussed. Specific emphasis is laid on the problem areas selection process, use of the network for monitoring purposes, and long term-management of the network.

Keywords: biodiversity conservation, protected forest areas, Austria

: 630\*907.32:630\*907.1(436)

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## **Structural characteristics of a virgin beech forest in south-western Romania**

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The “Izvoarele Nerei” Nature Reserve in Caras Severin County is situated on the upper basin of the Nera River, covering 5028 ha of the southern slope of the Semenik Massif, at an altitude of 700-1450 m a.s.l. It was part of the “Semenic–Cheile Carasului” National Park until the year 2002.

The research area covers several multi-aged beech stands from this natural reserve and the poster presents the results of research on the dimensional and spatial structure of the stands at different altitudinal levels. The research shows that *Fagus sylvatica* ssp. *sylvatica* is preponderant, with 150- to 350-year-old trees, but the presence of *Fagus sylvatica* ssp. *Moesiaca* is also significant. Up to 1250 m in altitude, there are exceptionally large trees, up to 48 m in height and 1.20 m in diameter. The spatial structure, shown by the height curves, is characteristic of a multi-aged forest. Above that altitude, up to the treeless zone, the dimension of the trees steadily decreases. Their spatial distribution tends to be in tree biogroups, indicating an adaptation of the spatial structure to the climatic stress. In these beech stands, the frequency of the trees of particular heights and diameters, estimated with a beta theoretical distribution, presents a left asymmetry as in an even-aged forest.

Keywords: beech stands, natural reserve, dimensional and spatial structure, Romania

: 630\*182: (582.632.2+630\*228.81):630\*907.11(498)

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700-1450 "Izvoarele Nerei" 5028  
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*Fagus sylvatica* ssp. *sylvatica*, 150  
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## **Main characteristics of the development stages of the virgin forests, Janj and Lom, in the Republic of Srpska**

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The virgin forests, Janj (295.00 ha) and Lom (297.00 ha), are situated in the south-west of the Republic of Srpska, on the mountainous massifs Stolovaš (1535 m) and Klekova a (1962 m). The bedrock in Janj is Triassic dolomite, and in Lom, Triassic limestone. The soils in Janj are rendzinas and brown soils, and in Lom calcomelanosol, calcocambisol and luvisol. The prevailing climate is perhumid, and during the vegetation growth period temperate-humid. The largest areas in the virgin forests are occupied by the communities Piceo-Abieti-Fagetum. The main taxation data in the forests were measured and the health condition of the trees assessed. The applied sampling method was that of concentric circles distributed at distances of 100 m. The data were processed using standard dendrometric and statistic methods. Both Jan and Lom contain all the three development stages (initial, optimal and terminal). The dominant species in terms of overall number is beech (*Fagus silvatica*), but in terms of volume fir (*Abies alba*). Janj has a higher productivity than Lom, due to the more favourable site conditions.

Defining the development stages requires knowledge not only of the structural parameters and volume, but especially of the state of health condition of the trees and the degree of regeneration, particularly in the initial and terminal stages of development.

Keywords: virgin forests, development stage, Republic of Srpska

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## **Fungi in Bavarian Nature Reserve Forests with an emphasise to beech dominated stands**

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Studies of fungi in the Bavarian Nature Reserve Forests were initiated by the Bavarian State Institute of Forestry (LWF) in 1989. Investigations have led to detailed species lists of higher fungi being drawn up. However, a conclusive interpretation of these data is lacking. Altogether 1548 species of Macrofungi have been found in the 31 plots. The data set was analysed using cluster and correspondence analysis (DCA). The beech-dominated plots can be divided into two major groups: beech stands on acid soils (mainly Luzulo-Fagetum) and stands on base-rich sites (Hordelymo-Fagetum, Carici-Fagetum). The oak-dominated plots were grouped with the base-rich beech forests. Since the Galio-odorati-Fagetum prefers only moderately acid to weakly basic soils, concentration of higher fungi is surprisingly high. These stands in the ecological “centre” of the Bavarian beech forests fall into one of the two major groups. Thus, the higher fungi seem to be very good indicators of small differences inside the Galio-odorati-Fagetum. The wood-inhabiting fungi also seem to react to differences in the soil, especially in the pH. The fungal species composition of both soil- and wood inhabiting fungi differ clearly in the pine-dominated forests and also swamp- and fen-forests with *Alnus*.

Keywords: macro fungi, beech, nature reserve forests, correspondence analysis, Bavaria

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## ***Cerasus avium* (L.) Moench in natural forests of the Ukrainian Carpathians**

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*Cerasus avium* (L.) Moench is a component of the broadleaf forests (oak groves, beech forests and mixed stands). It is one of the tree species with a very high range of altitudinal distribution. There are, however, no data on their characteristics and distribution patterns in the Ukrainian Carpathians yet. Regional route observations of the natural plant associations and forestry survey analyses were performed and *Cerasus avium* (L.) Moench was found to be as a concomitant species of the natural forests forming between 5 and 30 % of the tree population. In the Ukrainian Carpathians this species can be found in the ecological niche at altitudes from 150 to 1100 m a.s.l. The upper borderline of *C. avium* distribution is intermediate between the Crimea mountains and the Alps, where *C. avium* grows at altitudes of 1000 and 1800 m. In the Ukrainian Carpathians *C. avium* mainly concentrates in the middle mountain forest belt between 350 and 600 m a.s.l. The distributional analysis discussed here, shows that, in the Ukrainian Carpathians *C. avium* occurs in the natural forest stands, 27,343.6 ha in area, that covers only 2.2 % of the state forest resource in the Carpathian region. The Ukrainian Carpathians appear to harbour the largest areas of *C. avium* on the south-west mountain slopes (one third of all stands).

Thus, the natural-climatic conditions of the Ukrainian Carpathians influence *C. avium*'s distribution. The ecological niche of the species is at altitudes from 150 to 1100 m a.s.l. The best conditions for *C. avium* growth in the Ukrainian Carpathians are in the temperate-warm and temperate climatic zones at altitudes of 350 to 600 m a. s. l.

Keywords: *Cerasus avium*, distribution, Ukrainian Carpathians

: 582.734.6:630\*228.8(477-924.52)

## ***Cerasus avium* (L.) Moench**

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### *Cerasus avium* (L.) Moench

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: *Cerasus avium*, ,

## **Qualitative and quantitative characteristics of oriental beech in the Caspian forest**

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In order to study some qualitative and quantitative characteristics of oriental beech (*Fagus orientalis* Lipsky), research was carried out in the Caspian region of northern Iran. The natural stand studied was located in the Sangdeh District with a surface area of 3 hectares, at an altitude of 1900-1950 m a. s. l. The statistical design included 3 treatments (low thinning, intermediate thinning and control), with two replications. Moreover, 6 sample plots each with an area of 0.49 ha, were systematically selected and all trees within the plots were recorded. Results derived from all plots showed that the distribution of stem number per diameter class was more or less homogenous, and they appeared to have an even-aged structure. The highest frequency of stems was recorded in the diameter class of 25 to 40 cm. The mean dbh, stem number, basal area and volume were 35 cm, 574, 53.59 m<sup>2</sup>ha<sup>-1</sup> and 677.9 m<sup>3</sup>ha<sup>-1</sup>, respectively. The mean height of the stand was 27.1 m and the dominant height was 31.3 m. Using an increment borer, the mean age of the stand was calculated to be 137 years. More than 50% of stems had disease and were in decline. There were 66 dried stems per ha and 4 fallen dead trees per ha.

Keywords: oriental beech, forest structure, even-aged, basal area, height, dead tree, Caspian forest, Iran

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(*Fagus orientalis* Lipsky).

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## **Anthropogenic changes in the Carpathians and their consequences**

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The Ukrainian Carpathians are a unique complex with a high diversity of landscape and a rich plant and animal world. From the ancient times forest was the main richness of the Carpathian land. Forests played an important role in the life of people and for conservation of the natural environment in the region. In the first millennium A.D. the Carpathian mountains were continuously covered with forest. In different altitudes one could find such valuable tree species as beech, oak, spruce and fir. The average forest cover percentage exceeded 60%. The excessive utilization of the Carpathian forests during the feudal and capitalist periods caused the decrease of forest resources, reducing the protective and water-regulative functions of the forest. The first and the second world war caused irretrievable damage to the forests. The Carpathian forests suffered the heavy destruction during the post-war years (1945-1975), when the real sale of timber exceeded by two or even more times the calculation rates. The violation of the principal regulations of forest management in the Carpathians led to the exhaustion of the forest resources, with increased erosion processes, decreased power resources in the rivers, the forming of rocky taluses and unproductive areas (487,000 ha). That was one of the main reason for the catastrophic windbreaks and floods, tending to increased damages.

To prevent harmful hazards (wind throws, floods, erosion processes, etc.) the forest cover percent of the region should be increased up to 60%. It is necessary to improve forest management, forbid clear cuttings, to aim at an optimal age structure of the forests and systematically carry out flood preventive measures, such as creating special storage reservoirs.

Keywords: forest management, natural hazards, forest policy, Ukrainian Carpathians

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## **Bird communities in virgin beech forests in the Carpathian Biosphere Reserve**

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This reports on a study of the spatial structure of the fauna and bird communities in the Carpathian virgin beech forests. From 1992 to 2002 bird records were kept in the virgin beech forests of the Uholko-Shyrokoluzhanskyi massif in the Carpathian Biosphere Reserve, using Kuzyakin's route method. Recording routes 1 km in length were set up at various altitudes. The results indicate that the higher the altitude, the lower the density of the bird communities. At all altitudes chaffinch (*Fringilla coelebs*) prevailed with 9 pairs per 10 ha or 90 per 1 km<sup>2</sup>. The total density of the breeding community was approx. 38.8 pairs per 10 ha or 388 pairs per 1 km<sup>2</sup>. The distribution of species among the habitats varied. For example, blue pigeons (*Columba oenas*) were found along the ranges and wrens (*Troglodytes troglodytes*) along the ravines and streams. Some interesting features of the bird distribution in the massif, in particular in the taiga fauna were the occurrence of e.g.: black woodpeckers (*Dryocopus martius*), Ural owls (*Strix uralensis*), and Tengmalm's owls (*Aegolius funereus*). The density of the latter two was higher than in coniferous forests. Unlike in the disturbed stands (managed forests), the fauna and bird communities were more diverse in the virgin forest. High abundance of Ural owls, white-backed woodpeckers (*Dendrocopos leucotos*), wild pigeons, white-collared flycatchers (*Muscicapa albicollis*), etc., were only registered in virgin forests.

Between 1992 and 2002, 135 bird species were registered: 67 non-passerine and 68 passerine species. In the Uholka virgin beech forests of the reserve 9 of the bird species found were entered into the Ukraine's Red Data Book. The breeding community in virgin beech forests contains more than 50 bird species. The investigations showed the significance of virgin beech forests for the conservation of many bird species both rare and typical.

Keywords: birds, virgin beech forests, fauna, community, Carpathians, Ukraine

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1992–2002 .

1 2. 388 1 2. (Columba oenas) troglodytes (Dryocopus martius), (Fringilla coelebs) – 9 10 90 38,8 10 (Troglodytes (Strix uralensis), (Aegolius funereus) (Muscicapa albicollis) 135 ,67 9 68 50

## **Structure and potential production of a virgin forest of little-leaf linden (*Tilia cordata* Mill.) in the Obro yska Reserve (southern Poland)**

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A unique stand of the little-leaf linden, considered to be a relict of the Atlantic period, is growing in the Obro yska Reserve situated near Muszyna in the Beskid S decki mountains. The area of the Reserve is 98.25 ha, including 26,68 ha of stands of a primeval character which are under strict protection. The Tilio-Carpinetum is the main forest community found there.

Trees were measured in 1990 and 2000 in three experimental plots (Obro yska 1: 0.25 ha, Obro yska 2 and 3: 0.5 ha each) where the species composition and development stages were comparable with those prevailing in a primeval forest in the strictly protected part of the Reserve. This made it possible to determine the production potential of these stands.

The stands growing in the sample plots had the following development stages: Obro yska 1 – transition to the optimum stage, Obro yska 2 – the optimum stage, Obro yska 3 – the growing up stage, selection phase. The volume per hectare, and the annual volume increment (2000 data) were: 745 m<sup>3</sup>ha<sup>-1</sup>, and 7,9 m<sup>3</sup>ha<sup>-1</sup> a year at Obrozyska 1; 889 m<sup>3</sup>ha<sup>-1</sup>, and 10,4 m<sup>3</sup>ha<sup>-1</sup> a year at Obro yska 2; and 811 m<sup>3</sup>ha<sup>-1</sup> and 9,3 m<sup>3</sup>ha<sup>-1</sup> a year at Obro yska 3.

These stands belong to broadleaved forests of primeval character with the highest volume per hectare in the Polish part of the Carpathians.

**Keywords:** *Tilia cordata* Mill., development stages and phases, volume per hectare, volume increment, Carpathians, Poland

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<sup>3</sup> -1 2; 811 <sup>3</sup> -1, 9,3  
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: *Tilia cordata* Mill.,

**Investigations of genetic variation of silver fir (*Abies alba* Mill.) within and among a virgin forest stand (Derborence, Switzerland) and different managed forest stands in Switzerland**

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This paper describes the investigation of genetic variation of silver fir (*Abies alba* Mill.) within and among a virgin forest stand (Derborence, Switzerland) and different managed forest stands in Switzerland. Genetic investigations were carried out by means of isoenzyme gene-markers at 14 polymorphic gene loci.

To evaluate the dynamics of genetic variation, the genetic structures between adult trees, their natural regeneration and various developmental stages were investigated (total 800 individuals). The developmental stages differed only little in genetic variation. This observation can be explained with a continuous passing on of genetic information from one generation to the next, which may due to the small-scaled regeneration under the specific ecological conditions in the virgin forest of Derborence. This manner of regeneration secures a distinct continuity of population size in time and space. Another hypothesis to explain this observation is the uniform adaptive processes under comparatively homogenous environmental conditions caused by almost continuous shading effects in time and space. To estimate the value of natural forests (in particular the virgin forest "Derborence") for in situ preservation of genetic resources of silver fir in Switzerland the dataset was compared with datasets of 18 autochtonal silver fir stands (HUSSENDOERFER 1997). The results showed that the likelihood of preserving rare alleles is distinct higher in Derborence than in the other stands. Possible reasons for this finding are the potentially high age of single trees, the constant high number of individuals per square unit and the (possible) lower selective discrimination against mutants.

Keywords: *Abies alba*, genetic variation, virgin forest, isoenzyme, in situ preservation

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## **Potential natural vegetation (PNV) - a useful concept for decision support in sustainable forest management.**

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The concept of potential natural vegetation (PNV) was introduced by TÜXEN 1956. In the last 50 years the concept found its way into many different scientific studies. The knowledge about the potential natural forest-vegetation of a specific forest stand can help forest-managers to find sustainable solutions in silviculture for distinct stands. E.g. it can help to find out which is the natural tree-species combination or stand structure.

To increase the knowledge about PNV and to encourage its application in the work of forest-managers, a web-based expert system will be developed for the southern part of Carinthia, Austria. The expert system should help the forest owner or forest manager to find out the PNV for a specific stand by a set of site classification indicators like altitude, geology, soil-type, water supply etc. The development and evaluation of this expert system depends on data from natural or seminatural forests. Therefore the expert system will be based on an extensive analysis of vegetation- and stand-data of natural and seminatural forest stands within the study area. The project emphasises the value of natural forest stands and the importance of their conservation. It will be financed by the Carinthian Government, the Austrian ministry of agriculture, forestry, water and environment and the Austrian ministry of science, education and culture.

Keywords: potential natural vegetation, expert system, site classification, decision support



## Dynamics of today's vertical vegetation zones in the Ukrainian Carpathians

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The following vertical vegetation zones are distinguished in the Ukrainian Carpathians: 1) oak forest zone with *Quercus petraea* (Mattuschka) Liebl. in the foothills (200-550 m a.s.l.); 2) lower mountain forest zone with *Fagus sylvatica* L. (500-1300 m a.s.l.); 3) upper mountain forest zone with *Picea abies* (L.) Karst. and *Abies alba* Mill. (1300-1500 m a.s.l.); 4) subalpine zone with *Alnus viridis* (Chaix) DC., *Juniperus sibirica* Burgsd. and subalpine meadows (1500-1800 m a.s.l.); 5) alpine zone with the prevailing arctic-alpine flora: *Festuca supina* Schur, *Juncus trifidus* L. etc.

In the botanical literature various opinions about the dynamics between different vegetation zones are expressed. P.D. Yaroshenko (1953) considers that the soil formation process is causing a lowering of the present upper timber line and of the beech and coniferous zones. In contrast, investigations conducted within the last decades showed that global warming, caused by the greenhouse effect, leads to a raising of the upper timber-line. The sub-atlantic flora species *Fagus sylvatica* is spreading on the higher altitudes, displacing *Picea abies* and *Abies alba*. The anthropogenic factor decisively influences the dynamics of today's vegetation zones.

Keywords: vegetation zones, timber-line, dynamics, anthropogenic influence, Ukrainian Carpathians

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*Quercus petraea* (Mattuschka) Liebl. (200-550 . . .); 2)  
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*Picea abies* (L.) Karst. *Abies alba* Mill. (1300-1500 . . .); 4)  
*Alnus viridis* (Chaix) DC., *Juniperus sibirica* Burgsd.  
(1500-1800 . . .); 5)  
: *Festuca supina* Schur, *Juncus trifidus* L.

(1953)

*Fagus sylvatica*  
*Picea abies* *Abies alba*.

## **Geospatial database of the primary natural territorial units of the Upper Dnister Basin**

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This study was carried out within the "Dnister" research project ([www.dnister.de](http://www.dnister.de)), which focuses on an area of 21 469 km<sup>2</sup> that includes the Carpathian Mountains, the Precarpathians and the Podolian Plains. These areas used to be covered by continuous forests. Existing topographic, geomorphological, geological and soil maps, publications and field observations were used to map habitat patterns with the spatial accuracy of a 1:250 000 scale. The basic characteristics of the natural plant associations and soils identified in the field studies were extrapolated to the areas with similar geomorphological conditions where greater changes in the soil-vegetation cover had taken place. The information obtained was automatically recorded in a GIS system as a single polygon overlay, containing data on the morphography, morphogenesis, parent-rock material, prevailing soil type, amount of nutrients and moisture in the likely primary habitats, and primary natural vegetation sub-formation. The geospatial database also contains a point overlay of the field observation sites with rather detailed inventories of current geomorphological and soil conditions, technogenic elements, phytocenotic composition, and photographs.

The survey covered nearly 40% of the area and will be completed in 2004. The database will supplement a raster data-set of the current land-cover structure derived from satellite images and will be particularly helpful in loading prospective afforestation areas.

**Keywords:** integrated terrain mapping, primary natural vegetation, GIS, Upper Dnister Basin, Ukraine

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## Wood-inhabiting fungi in temperate beech forests along a gradient of different management intensity

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Natural beech forests in Transcarpathia, Ukraine, show significantly more fruit bodies of wood-inhabiting basidiomycetes, than a managed deciduous forest in central Switzerland. Corticioid and poroid basidiomycetes are among the most essential decomposers and important mycorrhizal species in European beech forests. In order to address the question of diversity, abundance, host age, decomposing processes, regional factors and the influence of modern forestry, 16 plots have been selected eight each in Ukraine and Switzerland. Preliminary results suggest that species richness is higher in natural beech forests in Transcarpathia than in Switzerland. The Ukrainian plots even harbour some species indicating old-growth forest conditions like *Hericium coralloides*. However, species richness is not exclusively determined by the availability of substrate. Tree species richness normally increases fungal diversity. In this study the higher tree species diversity in the Swiss plots, does not seem to have this strong influence, as the Ukrainian plots consist typically of only one single host tree, *Fagus sylvatica*. Forest management practices probably have the strongest impact on fungal diversity in temperate beech forest ecosystems.

Keywords: wood-inhabiting fungi, basidiomycetes, species richness, beech forest, forest management

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*Hericium coralloides.*  
– *Fagus sylvatica.*

## **The run-off regulative function of forests on mountain river watershed**

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The run-off regulative function of the forest is one of the natural factors to be considered in managing nature conservation areas around watersheds. A forest's absolute and relative influence on the re-distribution of run-off should be distinguished. The absolute influence of a forest with a certain structure depends mainly on the meteorological conditions. The relative influence depends, additionally, on the geomorphological characteristics of the watershed. During arid periods these influences are strong, but weak when water is plentiful.

In this study the periods of maximum run-off from the watersheds of the north macroslope of the Ukrainian Carpathians were analysed. The site areas were analysed over 40 to 50 years, ranging in size from several hundreds of square kilometres. Periods, when the mean daily outlays of the flood and inundation exceed the annual outlay by 25% of the water supply or more were counted. A correlation analysis indicated no connection between the forest area and the average number of the annual cases (display coefficients). A weak connection between the forest area and the extreme modules of the watershed flow was found.

Each watershed has a historically formed, specific relationship with forests with particular structures and non-forest areas. The absolute and relative hydrological influence of the forest and its dynamics should be modelled for each watershed with different scenarios for land and forest use and different meteorological conditions. Observation data showing the hydrological impact on stands outside the watersheds studied, and from plots set up by the hydrological posts should be analysed. The depths of the stream and river beds, and the time needed for water to flow up to the gauge line should be taken into account, using data on the actual flow to verify calculations.

Keywords: run-off, forest functions, watershed management, Carpathian, Ukraine

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## **Phenological characteristics of *Fagus sylvatica* L. development in beech virgin forest of the Carpathian Biosphere reserve (1993-2002)**

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In the Carpathian biosphere reserve special attention is currently being paid to beech virgin forests, and complex scientific investigations are underway. In the study of natural processes in virgin forests, phenological-meteorological observations, conducted over 24 years (1978-2002) on the reserve's permanent phenoposts and meteoposts, have an important role to play. The main purpose of establishing phenoposts is to study the development dynamics of seasonal phenomena in regard to altitude.

In the Uholka massif, three phenological posts have been set up at altitudes of 650 m, 910 m, 1120 m a.s.l. The following phenological phases are registered: budding, leaves sprouting, mass pollination, leaf colour change and leaf-fall. These determine the duration of the vegetation period. The periodicity of pheno-observations in spring-summer is every 3-4 days, and in summer-autumn every 5-6 days.

Hydrometeorological indices are recorded at the meteoposts and hydroposts, at 430 m a.s.l. The development of the phenological phase was monitored from 1993 to 2002 using recordings from phenoposts located at 650 and 1120 m a.s.l. in beech virgin forest (with a mean daily temperature of  $7.4^{\circ}$ ). The vegetation period for beech was found to last 198 days at the lower altitude. In virgin forest near the upper timber line (1120 m a.s.l.) it lasts 22 days less. The mean date for bud swelling at the altitude 650 m was April 10, and April 25 at the altitude 1120 m.

These long-term investigations indicate that the important factors influencing the process of beech development are the site conditions: local climate, altitude and slope exposition. The phenogradient of beech phenopases is three days per every 100 m, increase in altitude.

Analogous pheno-observations of beech have also been conducted in the mixed and pure spruce forests in the Chornohirskyi massif. Altogether, there are 14 operating phenoposts and 40 phenoroutes in the reserve's territory. Separate indicator species (herbal plants, trees, bushes and inorganic natural phenomena) are also recorded.

**Keywords:** *Fagus sylvatica* L., virgin forest, phenology, vegetation period, altitude, meteopost, Ukraine

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***Fagus sylvatica* L.**  
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## **Forest cover structure and dynamics in the National Park “Ugra”, Russia**

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Our research is aimed at determining the impact of forestry on the present forest structure in the National Park “Ugra” in the central part of the Russian Plain. This territory is situated at the boundary between the broadleaf and coniferous-broadleaf forest zones.

We used methods of ordination based on Detrended Correspondence Analysis to reveal groups of communities with similar structures. The eco-coenotic structure and biodiversity of the associations were also investigated.

The broadleaf forests in the National Park have been less transformed than the mixed forests because various forest protection regimes have been applied in the former since the 16<sup>th</sup> century. That is why in some forest communities the structure is close to the potential "natural" structure. Such communities are exemplified by the multispecies broadleaf forests with a mosaic of different development stages. Forestlands, that have been damaged by felling and the creation of plantations tend to have simplified structure and lower biodiversity. The coniferous-broadleaf forests have been exposed to considerable human impact over a long period of time, including: felling and ploughing on the watersheds, fires in the river basins and coniferous plantations everywhere. Old-growth forest communities can now be found only in small fragments separated from each other by secondary forests and coniferous plantations. Current forest dynamics is aimed at coniferous-broadleaf forest restoration, but the wide-spread distribution of coniferous plantations has resulted in a general intensification of the influence of boreal species.

This research has shown that the structure of old-growth communities reflects the state of the landscape. In communities transformed by forestry practices, the current forest structure and its dynamics are determined mainly by the type of human impact.

**Keywords:** forest structure, forest dynamics, broadleaf forests, coniferous-broadleaf forests, biodiversity, old-growth forest, Russia

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## **Value of the Carpathian forests for the conservation of beetle mite species diversity (Acari: Oribatida)**

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Anthropogenic impact has resulted in the formation of numerous landscapes without many animal taxons. This has caused decreases and even breakdowns of many communities, as well as having other deteriorating effects on these phytocoenoses. Therefore, it is important to find those habitats where the conditions for particular organisms are most favourable, in order to preserve specific species and genetic diversity.

Long-term investigations (since 1975) of numerous (high number and species diversity) beetle mites species, living mainly in the surface soil and forest litter of the Carpathian region, showed there are different number of species in different forest types. The soil and litter samples, each 200 cm<sup>3</sup> in volume, were taken in the forest types: oak (23 forests investigated), beech (22) and spruce (21). Five to 25 samples were taken in each forest. Beetle mites were then removed from the samples, fixed, identified and counted.

The highest species diversity (91 species) was registered in one of the beech forests, 27 to 72 were recorded in the other forests of this type. In oak forests, the maximum of species found on a certain site was 61, 27 to 51 species were recorded in the other oak forests investigated. The lowest species diversity (maximum 49 species per site) was registered in spruce forests (17 to 38 species in the other spruce forests investigated). The natural fir-beech and dark-coniferous-beech forests have the richest species composition (63 to 91 species), especially in the Shyrokoluzhanskyi massif. The total number of the beetle mites species found in the Carpathian forests of Ukraine is 296 in beech forests, 241 in oak, and 233 in spruce. Hence, the best and most diverse habitat for the vitality of beetle mites in different forest types in the Ukrainian Carpathians is in the beech forest associations and in some other natural forests, as well.

Keywords: forests, beetle mites, species diversity, Carpathians, Ukraine

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## **Assessing the energy, water, carbon and nitrogen flux within old-growth forest ecosystems**

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Old-growth or virgin forests play an important role in understanding the natural dynamic equilibrium of forest ecosystem that is characterised by the long-term balance in the fluxes of energy, water, carbon, nitrogen and other nutrients within the ecosystem. One option to study the development of these undisturbed forest ecosystems is the use of mechanistic biogeochemical models (BGC models). These models describe biomass accumulation driven by physiological background processes such as respiration, transpiration, evaporation, radiation balance, photosynthesis, littering, decomposition, nitrogen fixation and denitrification etc., and hence resemble a valuable tool in old-growth forest research. In this work we used the species-specific adaptation of BIOME-BGC model for the simulation of the dynamic of two virgin forests in Central Europe. The results showed that the original model highly overestimates both stand volume and soil parameters, i.e. carbon and nitrogen in soil, and severely underestimates the amount of coarse woody debris. As a reason for the unrealistic performance we identified the shortcoming of the model to account for the rotation of development stages, i.e. stage of regeneration, optimum and breakdown, because the model does not consider the changes in mortality over time. With the implementation of a simple succession cycle defined by its length, minimum and maximum mortality within one cycle we improved the results considerably.

Keywords: old growth forest, forest ecosystems, modelling

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BIOME-BGC

## **Why live so many endangered beetle species just in coppice-with-standards oak forests?**

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Coppice-with-standards oak forests are famous for a high diversity of xylobiont beetle species. To find out the reasons for this phenomena, we collected beetles in recent coppiced forests, formerly coppiced forests, high-stand oak forests, and in two nature reserve forests (formerly coppiced forests without any logging since 25-50 years) in Northern Bavaria. To analyse relations between tree structures and beetle communities – using correspondence analyses – we sampled beetles by canopy fogging, flight interception trapping in crowns, and by hand collecting in one hectare plots. We tried to find out the main differences between these types of oak forests.

Coppice forestry creates two-layered forests. When left growing, the formerly coppiced forests developed a complex, three-layered structure with many tree and shrub species. In average 0.5 to 1.0 m<sup>3</sup> dead wood was found in the crown of living residual oaks. In certain logged and coppiced forests most of this dead wood was sunlight. In the closed, dense nature reserve forest most dead wood in the crowns was shaded. These ecological conditions reflect the communities of xylobiont beetles pretty well. Sunlight dead deciduous wood today is a limited habitat variable in our intensive logged, even-aged forests lacking old residual trees. The main result is the direct relation between tree or forest structures and high diversity of xylobiont beetles. The type of forest management shows only a secondary influence. Xylobiont beetles didn't read books concerning forest management, but actually need structures to live in, as crown dead knots, different types of dead wood and, most important, a intensive change of sunny and shady patches. Big, closed, even-aged, younger oak-stands lead to horizontal isolation for many species.

Keywords: Red-List, xylobiont beetles, coppiced forests, dead wood

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## **Impacts of silviculture on the carbon balance of European beech forests**

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Forests and woodlands cover about 40% of European land area. Except for some protected or inaccessible areas all of these forests are used by human beings. The influence of different silvicultural activities on timber production and quality is well documented for all European merchantable tree species. But data on the carbon balance of different silvicultural systems in comparison to natural, unmanaged forests are rare, particularly in regards to soil organic carbon pools. To enhance our knowledge about the impacts of silviculture on carbon pools and to provide a consistent database for the ongoing discussion on Article 3.4 of the Kyoto Protocol a project was initiated to compare carbon pools of even-aged shelterwood systems (chronosequence approach), uneven-aged selection systems and unmanaged beech stands. Differences in soil organic carbon pools between the managed and unmanaged beech forests as well as effects of litter fall, edaphic factors (soil bulk density and soil texture) and land use history on soil organic carbon pools are presented.

Keywords: silviculture, carbon balance, unmanaged forest, near natural beech forest, shelterwood system, selection cutting system, soil organic carbon pools, soil texture, land use history

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## **Present state of natural forests in the Subcarpathian Ukraine**

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For centuries the Carpathians and the Subcarpathian lowlands have been covered with natural forests. These forests provided local people with food, heat and a refuge from the severe environmental conditions and from enemies. The forest and mountains have ensured a wide biological diversity of plants, animals and preserved the ethnic ecology of indigenous people, cherishing the development of their unique culture.

Fundamental changes began with the first forest regulations, issued by the Empress Maria Theresa in 1754-1756, intended to improve forest management, particularly in the area of the present Zakarpatska oblast. The Empress's decrees introduced monocultural timber production areas into the natural forests. During the Soviet regime, several laws and directives were issued intended to increase the economic profitability of the forests. The Ukrainian state today pays even less attention to the conservation and sound utilisation of forests than in former Soviet times. A "colonial policy" has been and is still being applied to forests, and the areas of natural forest have decreased.

The heavy impact of the human activity has resulted in a low stability of the natural forest ecosystems.

The natural composition of stands has changed so that are now just a few production timber species that also negatively influence natural stands.

The state of health of most tree species has worsened. Stands suffer from disease and insect pests. The "living capacity" of natural stands has been further reduced by acid rain, soil erosion, mycorrhizal death, animal species misbalance, decrease in the groundwater level and climatic changes.

Keywords: natural forests, present state, forest history, Subcarpathia, Ukraine

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Ma Te e 1754-1756

## **Problems of forest management in the Carpathian region and basic trends towards ecological forestry**

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The paper analyses the present condition of forests and the forest management in the Carpathians and proposes some rational methods for ecological forestry.

The study involved selecting and analysing the basic characteristics of the forest resources in the Carpathian region over a fifty-year period, and the volumes and structures involved in forest utilization. It also involved identifying the legal, forest management, economic and ecological problems in forestry in the region and surveying trends in ecological methods of forestry.

For the last 60 years, the forest area in the Carpathian region has been increasing, with improved species structure and reduced felling volumes. There have been increases in the forest stock grown, in the average increment, in the number of protected forest areas and in the nature conservation fund. With the economic recession of the last decade, forestry has been affected by numerous economic, organisational, legal and forest management problems. Possible solutions may be based on adopting economically viable and nationally profitable, nature conservation principles. Forest management can be improved by learning from past mistakes. The paper indicates the necessity of overcoming the agricultural stereotype of “sowing” and “harvesting” in mountain forestry, and of changing to using selective felling in the multi-layered mixed forests.

From the information it can be concluded that: 1) recent problems in forestry in the region reflect the system crisis; 2) the forest inventory should distinguish virgin forests, natural forests and anthropogenic forests; 3) forestry regulations should encourage selective felling, founding and protecting of biotopes, new approaches to vegetation stability indices, and natural forest regeneration; 4) reforms in forest management should try to balance ecological, economic and social interests.

**Keywords:** mountain forestry, forest utilisation, forest inventory, forest management, main biotopes, close-to-nature forestry, Carpathians, Ukraine

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## **The Biological Valuation Map as reference system for the distribution and valuation of different woodland types in Flanders**

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The Biological Valuation Map of Flanders is a standardized survey and evaluation of the biotic environment of the whole of Flanders and for some Walloon regions. The field survey was carried out using a uniform legend for the whole country. The legend units are based on vegetation types, land use and small landscape elements. It was composed on the basis of existing knowledge on the vegetation types of Belgium. The expert knowledge of project leaders and surveyors was decisive for identifying homogeneous legend units.

There are about 150 units, often with some variants. About 25% of them concern more or less natural woodland and scrub vegetation types, mostly corresponding with an association in the sense of Braun-Blanquet. All these units are considered as having a high biological value regarding to nature conservation. This valuation is based on best professional judgement. The criteria used were rarity, vulnerability, naturalness and replace ability.

The Biological Valuation Map is used for different purposes. In the European context it is one of the most important reference systems for the implementation of the EU habitat directive for Flanders and for the mapping of the Natura 2000 habitats.

Keywords: biological valuation, woodland vegetation maps, EU habitat directive

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Natura 2000.

## **Regeneration of silver fir (*Abies alba* Mill.) in secondary pine stands of Prykarpattia**

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The investigation aimed to study the growth of silver fir under the cover of secondary pine stands, rare communities in the Ukrainian Prykarpattia, which developed naturally on cultivated land. Such pine stands were formed in 1950-1960 on pastures and hay-making areas, bordering on fir forests with an admixture of pine. The secondary succession caused the fir to grow under the pine cover. The present vertical structure of these forests is two-layered: pine building the first layer and fir the second. The fir understorey is concentrated mainly in pine stands of medium density (0.4-0.6), with 3 to 10 thousand fir trees per hectare. Such understorey is sufficient for the formation of highly productive fir stands, provided that the fir are not damaged by the felling of the pine. The accumulation of understorey started in the early stage of the secondary pine stand formation, at the age of 10-20 years, and a stand density of 0.3 to 0.4. Further on, the number of fir in the understorey did not increase, but its growth ceased, after the pine reached an age of 30-40 years and a density of 0.6 to 0.7. On 7 sites, the top shoots of the undergrowth at the age of 12-19 years show a mean annual height increment of 8 to 10 cm. On one site, with a stand density of 0.4-0.5, the annual height increment of the fir is 15-18 cm, due to sufficient light conditions, and on the site with a density of 0.9, the increment is 3-7 cm. The average age of the understorey fir is 14-18 years, ranging from 7 to 29 years, and the height – ranges from 40 to 535 cm. The variation coefficient (22.5-32.3%) indicates that the differences in age are insignificant. It is concluded that the high regeneration potential of silver fir in the pine stands of Prykarpattia shows the high vitality of this species and a possibility to re-establish the natural forest.

Keywords: silver fir, secondary pine stands, regeneration, succession

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**(*Abies alba* Mill.)**

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## Forests of the Donetsk ridge, unique for the conservation of rare flora in the Ukraine

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Strong anthropogenic impact on forest ecosystems has led to a decrease in their phytodiversity. The forests of the Donetsk ridge are not an exception. Using various methods, the forest flora and vegetation of the Donetsk ridge were investigated from 1999 to 2002.

There are three forest types in Donbas: flood-plain, watershed and ravine forests. These forests cover approx. 4% of the whole territory. The first tree layer of the flood-plain forests includes *Populus alba*, *P. tremula*, *Salix alba*, *Alnus glutinosa*, and *Fraxinus excelsior*. Stands harbour such regionally rare species as *Scilla sibirica*, *Corydalis solida*, *C. marschalliana*, and even one species from Ukraine's Red Data Book (*Tulipa quersetorum*). The first tree layer of the watershed and ravine forests includes *Acer campestre*, *A. tataricum*, *Quercus robur*, *Fraxinus excelsior*, *Ulmus laevis*, *U. glabra*, and *Tilia cordata*. *Carpinus betulus* is found rarely (only at two sites). In the second growth *Euonymus europea*, *E. verrucosa*, and *Sambucus nigra* predominate. *Corylus avellana* is quite rare here. The grass layer includes *Stellaria holostea*, *Galium aparine*, *Urtica dioica*, *Corydalis solid* and *C. marschalliana*. Five species, entered into Ukraine's Red Data Book (*Tulipa quersetorum*, *Fritillaria ruthenica*, *Ornithogalum boucheanum*, *Platanthera bifolia*, *Epipactis helleborine*, and species from the regional lists like *Carpinus betulus*, *Corylus avellana*, *Aconitum rogoviczii*, *Arum elongatum*, *Veronica umbrosa*, *Dryopteris carthusiana*, *Cystopteris fragilis*, *Pedicularis dasystachys*, *Myosotis popovii*, *Asarum europea*), are found in these forests.

Thus, the forests of the Donetsk ridge, are habitats for rare Ukrainian flora and should be protected. Nature conservation areas in the southern districts of the Luhansk region and in the eastern districts of the Donetsk region should be created.

Keywords: flood-plain forest, rare species, Donetsk ridge, Ukraine

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*Populus alba*, *P. tremula*, *Salix alba*, *Alnus glutinosa*, *Fraxinus excelsior*,  
*Scilla sibirica*, *Corydalis solida*, *C.*  
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*tataricum*, *Quercus robur*, *Fraxinus excelsior*, *Ulmus laevis*, *U. glabra*, *Tilia cordata*,  
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*Euonymus europea*, *E. verrucosa*, *Sambucus nigra*, *Corylus*  
*avellana*. *Stellaria holostea*, *Galium aparine*, *Urtica dioica*,  
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(*Tulipa quersetorum*, *Fritillaria ruthenica*, *Ornithogalum*  
*boucheanum*, *Platanthera bifolia*, *Epipactis helleborine*,  
*Carpinus betulus*, *Corylus avellana*, *Aconitum rogoviczii*, *Arum elongatum*, *Veronica*  
*umbrosa*, *Dryopteris carthusiana*, *Cystopteris fragilis*, *Pedicularis dasystachys*, *Myosotis*  
*popovii*, *Asarum europea*

## **Elements of structure and biodiversity in natural Silver fir-European beech forests of the ăga Massif (Southern Carpathians, Romania)**

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Natural forest represents the most complex research laboratory of ecological phenomena and processes. Such forests are quite common in the Romanian Carpathians and a research project was started in 2002 with the main objective to indicate the value of natural forests as reference systems for forest development, regeneration and succession processes, as well as for species diversity.

The theory of "stages of development" (LEIBUNDGUT 1959) was used for the study of natural forest structure, organisation and functionality. For this purpose several sample plots were established in natural mixed Silver fir-European beech forests, located in the ăga Massif, part of the F g ra Mountains, at an elevation of 850-1,350 m.

The main results of the project were as follows:

- the plots contained a high variability of densities (number of trees/ha) of different development stages, diversity of individual tree sizes (Silver fir trees up to 55 m tall and 1.2 m d.b.h.) and ages (1-200 years old),
- there were variable structures depending on each stage of development,
- the values of the slenderness index indicate that individual trees are stable,
- there were clear traces of the phenomenon of "species alternation" (European beech seedlings below mature Silver fir trees and vice-versa),
- there were many dead trees standing or lying on the ground in different stages of decomposition.

Taking into account all these aspects, as well as the scientific and ecological importance of the natural forests, their long-term protection and conservation in both nature reserves and protected areas is compulsory.

**Keywords:** natural forests, mixed Silver fir-European beech forests, structure, biological diversity, stability, Romania, Carpathians

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## **Impacts of silviculture on hemi-edaphic invertebrates in the southern forests of Belgium**

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The major aim of this study is to compare the impacts of different kinds of forest management on the biodiversity in the context of western European silviculture. The bioindicators used are the hemi-edaphic invertebrates (Carabidae, Staphylinidae and Myriapoda) trapped by pitfall. A first trapping period was performed in 1999 in managed forests (uneven-aged and even-aged beech stands; group mixed stands; even-aged oak stands; uneven-aged and even-aged coniferous stands) of the southern part of Belgium (Ardenne). Three stages were sampled for each kind of silvicultural management (regeneration, growing and mature stages). A second trapping period was performed in 2002 in some Ardenne forests characterised by their indigenous tree composition (oak and beech forests), their lower intensity of management, their dead wood abundance and forest continuity (reference forests). The 2002 trapping period in the reference forests gave interesting catches (notably rare and new species for Belgium). Globally, the 2002 trappings gave higher species richness for a less important trapping effort than those involved in the managed forests. The analysis performed allow us to quantify and to specify the silvicultural influences on the hemi-edaphic invertebrates in Ardenne forests. It will then be possible to draw silvicultural rules favourable to forest litter biodiversity.

Keywords: litter-dwelling macroinvertebrates, Carabidae, Staphylinidae, Myriapoda, silviculture

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## **Sustainable utilisation of forest resources in the Balkans: problems and possibilities**

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The degree of biodiversity in the Balkan Peninsula is very high regarding both ecosystems and species, so it represents one of the centres of biodiversity in Europe. The diversity is conditioned by the peninsula's geological-morphological and climatic characteristics, and by its special refugium character. Consequently, this space is inhabited by numerous forest communities. The regions of Serbia, Bulgaria and Macedonia are characterised by a great number of endemic-relic floral elements from different geological periods. In this study the sustainable management of forest resources was analysed based on surveys of forest resources and of economic development in each region.

Forest resources were analysed in terms of the structure of the growing stock, which was distinguished according to the primary function, ownership, tree species, volume and volume increment. The role of forestry in the national economies, the degree of privatisation, regional management, practices and methods of financing, and the use of technical equipment are discussed.

The major problems hindering the sustainable utilisation of forest resources in the regions of Serbia, Macedonia and Bulgaria are the poor technical equipment available for forestry, the ownership structures and the effects of climate change on forest ecosystems.

Keywords: forest resources, sustainable utilisation, Balkan Peninsula



## **Hemiptera-complex of beech forests in Transcarpathia**

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This investigation of the Transcarpathian beech forests' Hemiptera-complex is intended not just to enrich our general faunistic knowledge about the nature of the Eastern Carpathians, but also to understand better the ecological regularities in the formation and functioning of mountain ecosystem components. Hemiptera insects in the beech forests of Transcarpathia were analysed and the species composition of the inhabitants of the trunks, crowns, herbal layer and litter in the beech forests was identified. Under the dry crown, in the bark cracks and rotten parts of the European beech trunk 7 species of flat bugs (Aradidae, typical mycetophagans) were found. Mainly assassin bugs (family Anthocoridae) were found on the surface of both healthy trunks and branches and those damaged by xylophags. Among true bugs inhabiting the crowns, zoophytophagans (family Miridae) prevail. No monophagans of beech were found among the typical phytophagans (only 4 species). The forest litter is poor with respect to species (detritophagans – 4 species, zoophagans – 2 species). Hemipterae, typical of the herbal layer in beech forests, were mainly plant bugs (Miridae). In general, the Hemiptera-complex of the beech forest in Transcarpathia is not very rich in species, but these still number over 60. A typical feature is the numerical domination of zoophagans and zoophytophagans, whereas the number of phytophagan species is small.

Keywords: Hemiptera insects, beech forests, Transcarpathia, Ukraine

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## **Logistics of monitoring forest reserves supported by computer-aided data collection techniques (Example of the Polednik area, Jizerske Hory, Czech Republic)**

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At the present time the Czech government agency, Management of Protected Forest Areas, is establishing a network of Strict Forest Reserves (SFR) in the most significant parts of natural forest ecosystems. No further management is planned in these strict reserves. This network will provide a wide spectrum of information about the most notable natural forest types in the Czech Republic. The undoubted value of such a network is enhanced by using an appropriate methodology for monitoring and successive data evaluations. High quality data can easily be gathered using a computer-based mapping system called Field-Map. Field-Map allows a project's database structure to be designed before-hand, while field technology facilitates data collection. This poster presents the logistics and procedure for measuring SFRs with Field-Map as used during a pilot experiment at the Jizerskohorske Buciny reservation, Polednik area, Jizerky Mts., Czech Republic.

The large area of the planned SFRs required a statistical inventory in the form of a grid of circular plots combined with detailed measurements of a 1 ha core area. As a full-scale ecosystem study, the monitoring system must be able to handle complexity, and be effective and replicable. These requirements were fully met using Field-Map technology.

**Keywords:** strict forest reserve, Field-Map software, inventory, field measurement, Czech Republic



## **Current state of natural genetic resources of forest mushrooms in Subcarpathia**

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Mushroom species as *Amanita caesarea* (Scop.: Fr) Pers. ex Schw., *Anthurus archeri* (Berk.) Fisch., *Choiromyces venosus* Fr., *Grifola frondosa* (Dick.: Fr) S. F. Gray, *Macrolepiota puellaris* (Fr.) Mos., *Sparassis crispa* Fr., *Strobilomyces floccopus* (Fr.) Karst., *Tuber aestivum* Vitt., *Cantharellus cibarius* are rare in the Transcarpathian region of Ukraine. They are in danger of extinction, because of poor forests management.

To preserve the genetic resources of rare fungi we must:

- i) accumulate data about local sites of the fungi
- ii) build up a collection of spore prints of local mushrooms and study the survival of their mycelia during cryopreservation
- iii) use the developed methods of cryopreservation and cultivation of mycelia for all locally isolated strains
- iv) expand the information about local genetic resources and exchange strains with other collections
- v) introduce the cultivation of edible mushrooms to local communities
- vi) apply to local and central state authorities for legislative and financial help to preserve rare species of fungi and forests where they grow, especially, natural forests
- vii) collaborate internationally to study and conserve wild mushroom and toadstool populations in natural European forests of temperate climate
- viii) improve the local awareness of the importance of fungi in forest ecology, human life and in sustainable development of our region.

Keywords: forest mushrooms, Carpathians, Ukraine

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, *Amanita caesarea* (Scop.: Fr) Pers ex Schw. , *Anthurus archeri* (Berk.)  
Fisch., *Choiromyces venosus* Fr. , *Grifola frondosa* (Dick.: Fr) S. F. Gray, *Macrolepiota*  
*puellaris* (Fr.) Mos. , *Sparassis crispa* Fr. , *Strobilomyces floccopus* (Fr.) Karst., *Tuber*  
*aestivum* Vitt., *Cantharellus cibarius* (Fr.)

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## **Beech virgin forests of the Ukrainian Carpathians: model of the long term state of equilibrium**

Shparyk, Yu.S.<sup>1</sup>; Viter, R.M.<sup>1</sup>; Berkela, Yu.Yu.<sup>2</sup>

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The sustainable forest management is an urgent task. Therefore the understanding of the self-regulation processes of virgin forests is very important. The aim of this study was to define quantitative characteristics of different development stages of beech virgin forests and to show correlation between areas with different development stages. The study was conducted on an area of 10 hectares in a beech virgin forest in the Uholsko-Shyrokoluzhanskyi massif in the Ukrainian Carpathians. The trees were measured and assessed according to IUFRO classifications.

In general, the beech virgin forest can be characterised as an uneven-aged multi-layered stand with a decreasing type of diameter distribution. However, the main stand characteristics of 0.25 ha subplots vary considerably (up to 56%), and three subtypes of diameter distributions can be distinguished: decreasing, even and intermediate. The mentioned differences become insignificant between virgin forest areas larger than 5 ha.

Based on the indicators N/ha,  $D_m$ , V/ha, diameter distribution, volume of dead wood and number of regeneration, six main stages in the development of virgin forest were identified: destructive-regenerative, young stand, middle-aged, ripening, mature, and overmature-destructive. The analysis with GIS methods allowed to estimate the percentage of areas per stage. Starting from the thesis of the correspondence of the duration and the percentage of the occupied territory of a development stage, the duration of the different stages was calculated. The age of beech was determined by tree-ring analyses of wind-thrown trees.

The results show that a beech virgin forests is in a state of equilibrium when all development stages are present with 0.1–2.0 ha each, and that an area of 5.0-10.0 ha can be sufficient to maintain a long-term state of equilibrium.

**Keywords:** beech, virgin forest, development stages, area of equilibrium

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## **Analysis of vegetation structure in the Natural Forest Reserve GAISBERG (Austria)**

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The Natural Forest Reserve (NFR) Gaisberg, 28 ha in size, has been investigated concerning vegetation composition and stand structure. The area is situated 30 km southwest of Vienna in the submontane zone and belongs to the Austrian Natural Forest Reserves Programme. To establish a phytosociological classification of the forest communities, 60 sample plots have been surveyed following the BRAUN BLANQUET method. After classification the area was mapped with respect to the defined forest associations. Additionally, stand structure has been ascertained in a systematic grid on circular plots with additional satellite plots. On the latter understorey vegetation data were collected quantitatively using the LONDO-scale. The vegetation of the NFR Gaisberg may be characterized as very rich in plant species diversity and small scaled in site and stand structure. Differences in soil conditions at the meso- and microscale and former human forest management activities might be the cause. Because of the terraced relief we found high variation in soil depths, i.e. with respect to the soil type Terra Fusca. As a consequence, water and nutrient regimes vary to a great extent, too. Human forest management is detected as a driving force of tree species composition. I.e., *Fagus sylvatica* was suppressed in former times to favour *Pinus nigra*, *Quercus petraea* and *Carpinus betulus*. As a consequence, invasion of many plant species adapted to better light conditions and modified humus forms took place. *Fagus sylvatica* now starts self-reestablishment and successive shading. Natural stand development without disturbance will probably lead to a decrease in plant species diversity.

Keywords: diversity, Natural Forest Reserves

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Terra Fusca.

*nigra*, *Quercus petraea* , *Fagus sylvatica*  
*Carpinus betulus*.

*Pinus*

*Fagus sylvatica*

## Quantifying the naturalness of forests

Stoiculescu, C.

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Four aspects were chosen to express the naturalness of forests, in order to highlight differences between natural, virgin and quasi virgin forests. These aspects were quantified with respect to the parameters:

- (1) *Diversity*: number of site and forest types, and forest formations;
- (2) *Abundance (a)*: number ( $N$ ) of site and, forest types, and forest formations reported per 1,000 ha surface area ( $S$ ); [ $a = 1,000 \times N : S$ ];
- (3) *Ecological value*: (a) proportion covered with stands of autochthonous species; (b) proportion covered with stands that have structures resulting from site-specific ecological and human-related factors. Both parameters were divided into five equal percentage classes; (c) age categories of the wood groups. The points obtained analysing the two levels (a) + (b) and (c) are the expression of the ecological value of the surveyed area, which can vary between the extremes: 1 - exceptional and to 9 - negligible.
- (4) *Natural landscape potential*: 5 natural elements (relief, rocks, water, vegetation, visibility degree) and 32 human-related factors, such as (a) tourist facilities, (b) forestry constructions, (c) harvesting of wood products, (d) harvesting of non-wood products, (e) introduction of non-autochthonous species, (f) pollution, and (g) work performed (forestry, fishing-hunting, for land improvement etc.) were assessed in 1-20 steps, with the initial one set at 100%. The methods described, which are based on the forest management plan, ensure an objective assessment of the current ecological value of the forests. Also, the method allows a hierarchy of researched forest areas, to be drawn up according to their degree of naturalness.

Keywords: virgin forest, quasi virgin forest, diversity, abundance, ecological value, natural landscape potential, Romania

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(1) *Різноманіття:*

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## **Assemblages of *Gastropoda terrestria* in forests in the East Carpathians (Poland)**

Sulikowska-Drozd, A.

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In northern temperate regions land molluscs are less regionally diverse than in tropical regions. But a single site, especially in deciduous forest, may harbour a huge percentage of regional fauna. High habitat differentiation was hypothesised to be the major factor determining the high diversity of mollusc communities. A low degree of microhabitat diversity and human impact were identified as the major causes of low diversity fauna.

The aim of the study was to assess the diversity and structure of woodland malacocenoses in a relatively undisturbed part of the Carpathians – the Bieszczady Mountain range in south-eastern Poland. Samples of snails were collected at the 11 plots (of 10 m x 10 m) located along the transect crossing two mountain crests. The sites were chosen to give a range of different forest associations (with beech, sycamore, alder) and elevations from 650 to 1250 m above sea level.

The author collected 7571 specimens of Mollusca on the study sites, belonging to 56 species (mostly terrestrial snails and slugs and 7 freshwater snails and clams), constituting 67% of the regional species. Zonitids, endodontids and ellobiids were the most abundant families. In terms of species richness, Clausiliidae predominated. Alderwoods had the richest fauna, with up to 41 species occurring sympatrically on 100 m<sup>2</sup> of forest floor. Molluscan communities in alderwoods were dominated by forest taxa highly vulnerable to human impact, endangered according to the Polish Red List. It is likely that the study sites are located in the best preserved floodplain forest in the Polish Carpathians and are thus of great conservation value. Beechwoods (most common in the area) and sycamore forests had impoverished faunas, in which less demanding, euryecological snail species dominated.

**Keywords:** snail biodiversity, assemblage structure, montane forests, alderwoods, endangered species, Carpathians, Poland

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***Gastropoda terrestria***

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## **Structure and biodiversity of a 160-year-old natural Scots pine forest in the central Polissia region of Ukraine**

Sviridenko, V.; Zibtsev, S.<sup>1</sup>; Kremenetska, E.

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The prevalence of clear-cuttings is the main reason for the reduction in area of natural forests in the Ukraine. Therefore, old-growth natural forests, without essential anthropogenic disturbance, are of great scientific and social value. This study investigated the structure, productivity and biodiversity of an extremely valuable, 160-year-old Scots pine forest, occupying an area of 375 ha in the Kiev Region of northern Ukraine. It is a natural, even-aged two storey forest. In 1981 two experimental 1 ha plots were established. The d.b.h., height, and crown projections of the trees on the plots were measured. A botanical description was made and the biological cycles of N, P, K, Ca, Mg in the forest ecosystem were studied. The average Scots pine was found to have a diameter of 50 cm and a height of 40 m. The total pine volume is between 600 and 700 m<sup>3</sup>/ha, with an average increment of 7 m<sup>3</sup>/ha/year. The horizontal structure shows that Scots pine constitutes separate groups of trees. Deciduous trees grow on the periphery of these groups. A high level of biodiversity is also found on the plots. There are more than 350 species of vascular plants among the herbaceous species that constitute 1/6 of all Ukraine Polissia flora. It was concluded that under conditions with medium anthropogenic pressure and slow silviculture intervention (only selective sanitary cuttings), a natural Scots pine forest can maintain its structure and be characterised by high productivity, biological stability and good health. But the absence of Scots pine regeneration is a great problem. Therefore a special regeneration technology should be developed and introduced in the near future.

Keywords: Scots pine, natural forest, biodiversity, regeneration of forests, pre-urban forests, Ukraine

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UDC: 630\*300:582.632.2(430.1-43.45)\

## **Utilisation of beech-forests in the state of Hesse**

Tegeler, R.

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The distribution and silvicultural objectives of natural beech forests in the state of Hesse/Germany are described. A 156 year old experimental beech site in central Europe without any cuttings during an observation period for more than 115 years gives a good impression of growth trends and increment of beech. The results of genetic diversity experiments are demonstrated and the influence of thinning on the genetic diversity of beech stands in different altitude levels are discussed.

Benefits and costs of naturally managed forests and natural forests without utilisation are compared. Also the economical consequences of changing tree species i.e. from spruce to beech with their differences in forest rental are shown.

The economical and ecological consequences are compared and the conclusions for a state forest enterprise with an area of about 700.000 ha are drawn.

Keywords: beech, forest-types, genetics

: 630\*300:582.632.2(430.1-43.45)

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## **Ecological and vegetational characteristics of natural and virgin beech-fir forests in Croatia**

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The paper presents and compares structural, ecological and vegetational properties of virgin and natural commercial forests of beech, fir and spruce in Croatia. The focus is on following virgin forests with primary or secondary characteristics: Corkova Uvala, Devcica Tavani, Nadzak Bilo, Velika Pljesivica - Drenovaca, Velika Pljesivica - Javornik - Tisov Vrh, Javorov Kal and Stirovaca. These forests have been affected by changes in the site and environment, particularly in the 20th century, and the principal ecological factors decisive for their development have been investigated. The main aim of the investigation was to establish and compare the stability of virgin and natural forests. The participation of old silver firs, common spruces and beeches and dead trees, as well as changes in the structure and composition of these forests were analysed. The basic vegetational properties are shown and differences in the vegetation picture of these forests analysed. Ecological, structural and vegetational parameters needed for establishing ecological models of virgin forest development were studied and the prospects of survival in changed ecological conditions discussed. The paper also deals with the problem of maintaining and managing forests in protected areas.

**Keywords:** beech, fir, virgin forest, vegetational properties, ecological models, forest development, Croatia

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: Corkova Uvala, Devcica Tavani, Nadzak Bilo, Velika Pljesivica - Drenovaca, Velika Pljesivica - Javornik - Tisov Vrh, Javorov Kal Stirovaca.

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## **Forest fires and some problems of biodiversity conservation**

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Fire as a natural factor cannot play a determinative role in the decrease of the forested area and its biodiversity. But they are a contributing factor in combination with the three major reasons of deforestation: logging, mineral extraction and clearance for agricultural use. In this case the frequency and number of fires of anthropogenic origin rapidly increase.

Similarly fire cannot determine the replacement of forest with non-forest vegetation on marginal positions on an environmental gradient in a landscape - e.g. in dry habitats, or on land with a high groundwater level. The fire destruction of forests in wetlands causes the rise of bogs. On dry sandy and stony sites, heath or dry meadows susceptible to frequent fires may develop in a moderate climate in post-fire periods.

In any case, the frequency of fires ("rotation of fire") but not the fire itself can be considered as a major factor of deforestation, as a determining factor for changes and dynamics of forest vegetation and biodiversity composition. On the one hand the alteration of the intermediate period can affect the pyrogenic succession, but on the other the changed vegetation composition can influence the frequency of fires. It is assumed that during an interval the vegetation reconstitutes and accumulates combustible material for a new fire. In many cases this cycle has catastrophic consequences: an ordinary fire causes an additional amount of fuel and has more serious impact.

**Keywords:** forest fire, frequency of fires, pyrogenic succession, biodiversity conservation, forest vegetation



## **Assessing and modelling the protective function of mountain forest against rock falls**

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Since many decades land use changes in the Alps transform mountain landscapes. The abandoned agricultural lands located on steep gradient areas are quickly overgrown with natural forests mainly made of coppice stands of white oaks (*Quercus pubescens* Willd.). Those forests happen to be a screen between human activities such as villages or roads and rock departure zones. The protection of those habitations is at stake. Forest stands constitute nevertheless specific protective structures as they evolve with time through processes of tree growth, death and regeneration. Stand structure modifications may be sometimes extremely important, especially when over-mature stands collapse and regenerate or when even-aged stands are cut for renewal. The forest capacity to stop rock falls is then constantly evolving. Developing the use of forests as protective structures then requires evaluating the capacity of a forest stand to stop or reduce the risk in the long term. For describing and anticipating the protective function of post-agricultural forests against rock falls we aim at building modelling tools from a survey led on an experimental site. The methodology of this study is based on two complementary approaches. Firstly a diagnosis of the protection capacity of the forest is realised given detailed stand structure attributes (stand density, size distribution, species composition, spatial organization), topography and the age of the land abandonment. Then the time history of the forest protective efficiency is analysed by modelling spatial and structural dynamics of the stands from field data, historical data and aerial maps. The model consists of a cellular automata simulation. The main results are maps of the protective function of the post-agricultural stands and a simulation of its evolution.

Keywords: mountain forest, natural hazard, rock falls, vegetation dynamics, modelling

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(*Quercus pubescens* Willd.).

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## **Genetic characterisation of natural beech regeneration from differently composed populations**

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With the ecological reorientation of silviculture from clear cutting system with predominant coniferous monocultures towards forest ecosystems of high stability, productivity and species diversity since the beginning of the 1990<sup>th</sup>, Common beech (*Fagus sylvatica* L.) has become the most important deciduous species in the lower mountain range of Saxony.

The relicts of large beech populations in the Ore mountains play an important role as seed sources for the extension of beech in this area as well as objects of silvicultural, ecological and genetical studies. Nevertheless, natural regeneration often originates from a small number or even from single fructificating beech trees.

For the investigation presented, a natural forest cell has been chosen in the central Ore mountains, which includes parts of pure beech stands as well as parts composed of beech and spruce in different proportions and areas dominated by spruce with small beech groups or single beech trees included.

The genetic structure of adult trees and natural regeneration has been described using 10 isozyme gene loci. The genetic parameters have been compared among the subpopulations of the adult trees, among the regeneration spots and between the adult trees and the regeneration of the corresponding part.

The results confirm the relatively homogeneity of the observed beech population. In some parts, family structures can be studied by the occurrence of rare alleles. On average, the genetic structure of the offspring from small groups or single trees shows only slight decrease of genetic variation in comparison with regeneration from clear stands. Possible recommendations for the integration of the beech regeneration are discussed.

Keywords: *Fagus sylvatica*, ecological reorientation of silviculture, natural regeneration, isozymes

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[Ute.Troeber@lfp.smul.sachsen.de](mailto:Ute.Troeber@lfp.smul.sachsen.de)

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## **Deforestation and its impacts on the environment: empirical evidence from Nepal**

Upadhyay T.P.

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This paper reviews the issue of deforestation, and the major agents behind it and their links to deforestation in different regions of the world. The issue is further analysed and reviewed in the context of the Nepalese economy. Significant differences in the distribution of and changes (dynamics) in such features as forest area, population and livestock population were observed among the mountain, hill and Terai (southern plain regions in Nepal). Regression analyses yielded the coefficients for the forest land cover as (-0.21), (-0.65), (- 0.55), (- 0.85) (1) for population, (2) for livestock population, (3) for fuel wood consumption and (4) for revenue variables. In addition, some administrative practices and political instabilities were also found to be responsible for deforestation. The major environmental impacts of deforestation and the best forest management policies are discussed in brief.

Keywords: environmental impact, deforestation, forest management, Nepal

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**Structure and successions of the natural forests in the Nadsyanskyi landscape conservation area (part of the “East Carpathians” international reserve)**

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The valuable forest massifs provide a basis for the protected areas in the Ukrainian Carpathians and the regional ecological network, and are important for the conservation of biodiversity in natural ecosystems. This study aimed to analyse the forest structures and successions in the Nadsyanskyi landscape conservation area. The following main forest types were investigated: mixed fir-beech, pure fir and spruce, and pioneer stands (24 plots in total). The stand structure was studied in 2002, making a total inventory of all layers. Native fir-beech forests remained close to the watershed areas, and are uneven-aged, mixed stands with beech dominant in the upper layers and a large number of fir in the lower storey and undergrowth. Their characteristics vary greatly, and the diameter distribution is decreasing. The successions are aimed to be close to spruce-fir-beech virgin forest. Fir stands, with a very diverse structure, are found on the lower slopes. The pure, conventionally uneven-aged fir forests, have a dense vertical structure, but a small admixture of beech, spruce and other species are formed naturally. The successions within these forests are aimed to form uneven-aged forests with fir dominating. Secondary artificial spruce stands are found on the lowest slopes. These are simple, even-aged and heavily thinned stands. The successions mean the stands will progressively disintegrate. Pioneer stands on the forest lands contain natural regeneration of fir, beech, spruce, birch, willow, hazel, and aspen. Their characteristics are very variable and successions are aimed to regenerate native stands. In the non-forest lands, the expansion of juniper with an admixture of forest species is marked. The successions allow the forest cover to regenerate.

Keywords: “East Carpathians” international reserve, natural forests, stand structure, successions, Ukraine

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( 24 ). 2002

## **Naturalness levels in German forest nature conservation: definition and application**

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In Germany since the 1990s maps of forests' habitat quality are produced. Within this context, the naturalness of forests is examined among other things (habitat type/plant community, diversity, representativity, rareness, endangerment, etc.). Several naturalness levels are distinguished following the continuum between natural and artificial. The levels describe the degree of human impact and the distance between the examined forest habitat and the site's potential natural vegetation.

Germany is a federal state, which consists of 16 Länder (states). Habitat mapping is under the responsibility of these Länder. This is the reason why a lot of different systems are officially used for describing the naturalness of forests in Germany. The Institute for Forest Policy, Forest History and Nature Conservation, Göttingen, is carrying out an investigation which aims at giving a survey of the different systems of naturalness used nation wide. The investigation is based on inquiries in the Länder (forest administrations) and on existing literature.

The work is strongly connected with the COST Action E27 Profor (Protected Forest Areas in Europe - Analysis and Harmonisation). Profor is part of the European COST programme (Cooperation in the field of scientific and technical research), that is supported by the European Community. One goal of the action is to examine and to describe the role of the concept of naturalness in nature conservation throughout Europe.

The poster presents one application of the concept of naturalness in German forest nature conservation, the forest habitat mapping defining different levels of naturalness.

**Keywords:** naturalness, naturalness level, potential natural vegetation, habitat mapping, forest nature conservation, protected forest area, Germany

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## **Biodiversity in strict forest reserves of Hesse: faunistic and mycological studies**

Willig, J.

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Hesse, a federal state of Germany, is situated in the middle of the German low mountain range. Its main climatic factors like air temperature, precipitation and relative moisture content are not extreme. In most parts beech communities dominate; sessile-oak communities only occur in lower regions. Strict forest reserves (1230 ha) were established in 1987. Main subject of the research is the investigation of natural forest ecosystems and the long term monitoring of unmanaged comparing with managed forests to optimise both silviculture methods on one hand and nature conservation on the other. A programme for faunistic research in strict forest reserves was developed in 1993 by the Senckenberg Research Institute in Frankfurt. Zoocoenoses of most arthropod taxa, mammals, amphibians and birds have been studied in reserves of the lower mountain region. After a two-year period of trapping and collecting the animals were determined by specialists. In an forest area less than 0,75 square kilometres 2328 species were determined and about 4500 were estimated. A lot of rare and endangered species in all faunistic groups were present. Because of their immense mineralisation capability fungi are very important for recycling of dead wood. Since 1991, after a windthrow in an old beech stand of a forest reserve in central Hesse the development of wood destroying mycoflora has been investigated. The appearance and succession of the most important fungi on damaged trees, fallen trunks, broken twigs and wooden debris are described in detail and connections with the degree of wood decomposition was established.

Keywords: fauna, fungi, strict forest reserves, biodiversity

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## Comparative study of rare herbaceous species in the natural mountain forests of the Ukrainian Carpathians

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This reports on our observations in the Ukrainian Carpathians in 1994-2000, on a critical examination of a herbarium (mainly KW and LW) and the relevant literature. We studied the rare herbaceous plants in the natural mountain forests of the Ukrainian Carpathians, mainly in the communities of *Picea abies* (L.)Karst., *Abies alba* Mill. and *Fagus sylvatica* L. We included only scyophytes (mainly hydropytes). The flora of the herbaceous cover in these mountain forests is rather poor and the total number of rare herbaceous species quite low (only 14 species), especially in comparison with data on the alpine flora. We note that a few species (e.g. *Blechnum spicant* (L.) Roth., *Corallorhiza trifida* Chatel) grow mainly in the coniferous forests, and others are restricted to the mixed forest communities (e.g. *Diphasium complanatum* (L.) Rothm., *Epipogium aphyllum*) or to *Fagus* forests (e.g. *Botrychium virginianum* (L.) SW., *Cypripedium calceolus* L.). Another characteristic of the mountain forest flora is the absence of the rare endemic species. Most of them have wide distribution areas, mainly Eurasiatic or Holarctic. Moreover, there are only a few relicts (*Cypripedium calceolus* and *Goodyera repens*). The most species of the first (disappearing species) category of rareness are absent, whereas half belong to the species of the second (vulnerable) category of rareness (e.g. *Cypripedium calceolus* and *Epipogium aphyllum*). The rest are neither endangered nor vulnerable plants.

Keywords: herbaceous species, natural forests, Carpathians, Ukraine

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[sziman@botan.kiev.ua](mailto:sziman@botan.kiev.ua) 2, 01601, -4,

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KW LW)

*Picea abies* (L.) Karst., *Abies alba* Mill. *Fagus sylvatica* L.  
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Roth., *Corallorhiza trifida* Chatel)

Rothm., *Epipogium aphyllum*  
(L.) SW., *Cypripedium calceolus* L.).

(*Blechnum spicant* (L.)  
,  
(*Diphasium complanatum* (L.)  
*Fagus* (*Botrychium virginianum*

( *Cypripedium calceolus* *Goodyera repens*).

(*Cypripedium calceolus*, *Epipogium aphyllum* ).),

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**Natural Forests in the Temperate Zone of Europe –  
Values and Utilisation**

International Conference in Mukachevo,  
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Abstracts

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цінності та використання**

Міжнародна конференція в Мукачеві,  
Закарпаття, Україна. 13–17 жовтня, 2003

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