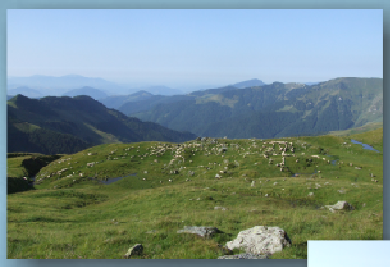
Science for the Carpathians

S4C

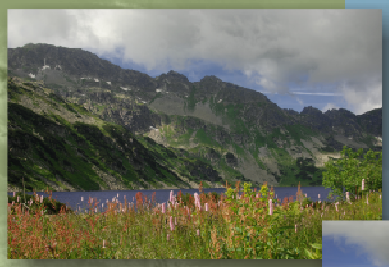


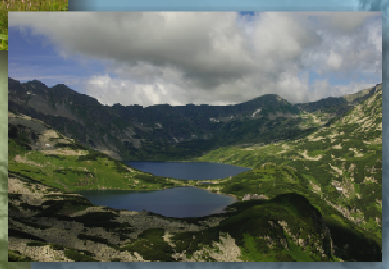
CONFERENCE PROCEEDINGS

Katarzyna Ostapowicz & Jacek Kozak (Eds.)

FORUM CARPATICUM

Integrating Nature and Society Towards Sustainability





September 15-18, 2010, Krakow, Poland

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Kraków 2010

The Conference Proceedings of the 1st Forum Carpaticum:
Integrating Nature and Society towards sustainability

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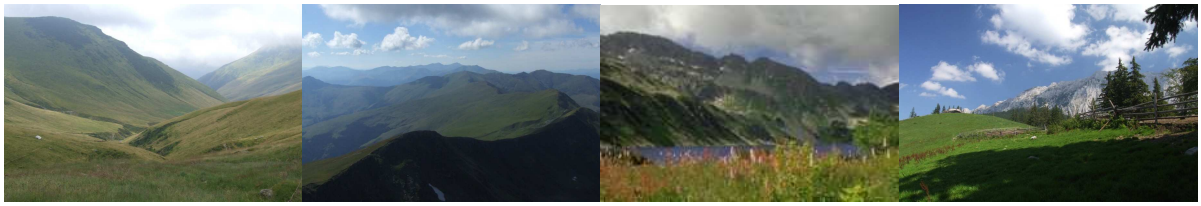
The 1st Forum Carpaticum

Integrating Nature and Society Towards Sustainability

15th-18th Semtember 2010, Kraków, Poland

Conference proceedings

Katarzyna Ostapowicz & Jacek Kozak (Editors)



Kraków 2010

Preface

The Carpathians are a prominent European mountain range with a unique natural and cultural diversity, a true 'European Green Backbone'. The mountain arc stretches across countries once positioned unfavourably east of the Iron Curtain, and now, 20 years after its fall, they still experience rapid socio-economic transformation with a number of challenges to sustainable development. These challenges include land use change, depopulation of marginal areas, environmental degradation and pressure on natural resources. Decision makers and planners have to deal with these challenges, consequently, they rely on the strong support of science in the new reality after European Union enlargement.

Both the value of the Carpathian region and the high complexity of ongoing changes called for concerted actions on the part of the global mountain research community. Mandated by the United Nations Environment Programme Vienna – Interim Secretariat of the Carpathian Convention (UNEP Vienna ISCC) and in response to these needs a group of researchers got engaged in the development of a science network for the region. With the support of UNEP Vienna ISCC, the European Program of the Mountain Research Initiative (MRI), European Academy of Bozen/Bolzano, the Institute for Mountain Research (IGF-ÖAW), the Institute of Geography and Spatial Management of the Jagiellonian University and the Slovak Academy of Sciences research meetings were organized in Kraków, Poland (May 2008) and in Bratislava, Slovakia (June 2009), resulting in the launch of the Science for the Carpathians (S4C) initiative. S4C attempts to integrate different fields of scientific expertise to generate value for the Carpathians and to enhance the region's visibility within the global mountain research community.

By no means Carpathians are the scientific '*terra incognita*'. Studies in the fields of geography, biology, history, and anthropology were carried out on large scale already in the 19th century. In spite of many excellent achievements, the Carpathian science has suffered two major drawbacks since the post-war period. One is a weak relation to global mountain research community, the other – quite common in the European research area – an insufficient transfer of research results into practice.

The interim Scientific Steering Committee (SSC) of the S4C addressed these difficulties with the organization of the Forum Carpaticum: an open international and interdisciplinary mountain conference bringing together scientists and stakeholders interested in the sustainable development of the Carpathian region. The obvious precursor of Forum Carpaticum is the Forum Alpinum – an important bi-annual event in the European mountain science calendar, oriented towards practical problems of the Alpine development.

The leading title of the 1st Forum Carpaticum – *Integrating Nature and Society towards sustainability* – clearly reflects the aims of the meeting: to support scientific actions leading towards sustainability in the Carpathian region, to increase the visibility of the Carpathian region in the global change research agendas, and to link research with practice in the field of coupled human-environmental systems in mountain regions.

The 1st Forum Carpaticum was convened in Kraków at the Institute of Geography and Spatial Management of the Jagiellonian University, one of the first centres of geographical research in Europe, carrying out research in the Carpathians since the mid-19th century. An open call for presentations and posters resulted in almost 200 submissions structured into 12 major themes. Plenary sessions, a workshop session and a special session dedicated to mountain forestry completed the final program of the 1st Forum Carpaticum.

With this volume of abstracts, we would like to draw the attention of researchers and practitioners of various fields of science, policy and decision-making to the idea of integrated, multi- and trans-disciplinary research dedicated to the sustainable development of the Carpathian region.

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At the moment of preparation of the abstract book – few days before the start of the 1st Forum Carpaticum – we would like to express our gratitude to all who contributed to this important step in the long-term research and networking strategy envisioned by S4C. From the very beginning, the Interim S4C SSC members were the leading group working on the preparation of the 1st Forum Carpaticum. Later on, scientists from various fields of expertise were invited to join the Scientific Committee of the 1st Forum Carpaticum. All Scientific Committee members have been acting voluntarily as thematic session leaders and reviewers, thereby contributing their valuable experience and ideas into the process of program development. Both the worldwide response of scientists involved in the Carpathian research to the call for proposals, and the work of the Scientific Committee members were of exceptional value for the final outcome of the 1st Forum Carpaticum.

We would like to thank the authorities of the Jagiellonian University and the Institute of Geography and Spatial Management of the Jagiellonian University for the continuous assistance in the organizational work, and the authorities of the Faculty of Forestry, University of Agriculture in Kraków who have taken the responsibility to prepare the special plenary session on mountain forestry. We do appreciate the hard work of the Organizational Committee and the Jagiellonian University Events Office.

We are also grateful to the Director General of the State Forests National Holding, Regional Directorate of the State Forests in Kraków, the International Visegrad Fund, the Committee on Geographical Sciences of the Polish Academy of Sciences and UNEP Vienna ISCC for their support.

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Katarzyna Ostapowicz *(Chair of the Forum Carpaticum Organizational Committee)*

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Visegrad Fund 2010 years		UNEP CARPATHIAN CONVENTION	PAN POLSKA AKADEMIA NAUK

Programme overview

WEDNESDAY 15.09.2010	
8:00 – 9:00: Registration	
9:00 – 10:45: OPENING SESSION Auditorium P 0.1.1	
10:45 – 11:30: Coffee break	
11:30 – 13:15: Thematic sessions	
Auditorium P 0.1.1 Integrated Land Resource Management and Regional Development Policy	Room P.1.1 Chemical Environment
13:15 – 14:15: Lunch	
14:15 – 16:00: Thematic sessions	
Auditorium P 0.1.1 Ecosystem Services and Human Well-being	Room P.1.1 Conservation and Sustainable Use of Biodiversity
16:00 – 16:45: Coffee break	
16:45 – 18:30: Conference workshops	
19:30: CONFERENCE DINNER, Franciscan Monastery (the city centre)	

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9:45 – 11:00: Thematic sessions		
Auditorium P 0.1.1 Natural Hazards and Risks	Room P.1.1 Climate Change: Implications for Nature and Society	
11:00 – 11:30: Coffee break		
11:30 – 13:15: Thematic sessions		
Auditorium P 0.1.1 Land Use and Land Cover Change	Room P.1.1 Traditional Knowledge	
13:15 – 14:15: Lunch		
14:15 – 16:00: Thematic sessions		
Auditorium P 0.1.1 Urban and Rural Development – Opportunities and Challenges	Room P.1.1 Water Resources and Management, Fluvial Processes and Interactions with Biotic Processes	
16:10 – 16:45 Auditorium P.0.1.1: *Side Event*	*16:00 – 16:45: Coffee break*	
16:45 – 18:30: Thematic sessions		
Auditorium P 0.1.1 Chemical Environment	Room P.1.1 Water Resources and Management, Fluvial Processes and Interactions …	Room 1.21 Integrated Land Resource Management and …
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FRIDAY 17.09.2010		
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11:30 – 13:15: Thematic sessions		
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13:15 – 14:15: Lunch		
14:15 – 16:00: Thematic sessions		
Auditorium P 0.1.1 Forests, their Management and …	Room P.1.1 Tourism (Re-)development and Sustainability	Room 1.21 Conservation and Sustainable Use of Biodiversity
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SATURDAY 18.09.2010
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Chairs:
Andrzej Bytnerowicz (USDA Forest Service, USA),
Lubos Halada (Slovak Academy of Sciences, Slovakia),
Stanisław Małek (University of Agriculture in Kraków, Poland),
William J. Manning (University of Massachusetts, USA),
Robert C. Musselman (USDA Forest Service, USA)

The session focuses on the chemistry of air, water and soil resources from a perspective of understanding their background levels, contamination and potential impacts that are related to various anthropogenic activities. Spatial and temporal trends will be characterized and linked to forest and human health as well as ecosystem services (such as providing clean water and air to local people and visitors in the Carpathians).

ORAL PRESENTATIONS

AMBIENT OZONE AIR POLLUTION IN THE CARPATHIAN MOUNTAINS AS COMPARED TO SELECTED MOUNTAIN RANGES IN EUROPE AND NORTH AMERICA

*Andrzej Bytnerowicz[1], Robert C. Musselman[2]

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Keywords: Air pollution, ozone, mountains, remote areas, Europe, North America

Introduction

Ozone (O_3) is the third most important greenhouse gas and air pollutant that is toxic to humans and vegetation (Shindell et al., 2009). Both in Europe and North America it is a criteria pollutant regulated by the European Union and United States and Canadian federal and state standards. Primary standards are used for protection of human health and secondary ones to protect vegetation. At present in Europe the O_3 exposure index (AOT40) is used as the secondary standard for evaluation and recommendations for protection of sensitive vegetation (Fuhrer et al., 1997). Since the AOT40 index has been met with substantial level of criticism, new standards based on the "O_3 effective flux" are being developed (Matyssek et al., 2007). In the United States, the US EPA has recently proposed a revised primary standard for improved protection of human health as well as a new secondary standard (W126) to protect vegetation (http://www.epa.gov/groundlevelozone/). Both in Europe and North America, only limited information exists on ambient O_3 in remote areas, especially those not directly affected by anthropogenic emissions. This is also true for the Carpathian Mountains where O_3 data is scarce. However, the O_3 concentrations measured in parts of the Carpathians as well as the O_3-exposure indices there were found to be at the phytotoxic levels (Bytnerowicz et al., 2004b). Updated knowledge on long-term O_3 trends is essential for future projections of potential phytotoxic O_3 effects on forests and other sensitive ecosystems as well as for protection of people residing and visiting the mountains. Information on high altitude O_3 concentrations is also essential for a better understanding of the long-range transport of O_3 and its precursors and continental and global background levels of the pollutant. For example, it is estimated that ~18% of background O_3 on the western coast of the United States (California) can be attributed to the transport of O_3 and its precursors from Asia and that such contribution is continuously growing (Law, 2010). Similarly, the O_3 background levels in Europe are affected by polluted air masses transported from North America (Brasseur et al., 2001).

Methods

Data collected with passive samplers (Koutrakis et al., 1993) as well as active UV-absorption monitors (Bognar and Birks, 1998) will be used for our comparisons. Ozone concentrations will be presented as peak hourly values, monthly, seasonal and annual averages. Values of O_3 exposure indices, such as AOT 40 and W126, will be calculated to understand phytotoxic potential of the pollutant in the Carpathian Mountains and other mountain ranges in Europe and North America (the Alps, Sumava Mountains, Brdy Mountains, Jizerske Hory, Rila Mountains in Europe, as well as the Sierra Nevada, San Bernardino Mountains, White Mountains, Cascade Mountains and Rocky Mountains in North America).

Expected Results

Ozone concentrations from various mountain ranges that will be used for comparison of O_3 concentrations and exposures indices are presented in Table 1. Results of these comparisons will help in a better understanding of the present status of ambient O_3 in the Carpathians and in establishing a knowledge base related to O_3 risks to human and forests health. This will help in recommending the air quality monitoring needs and proper practices for the air and land resource managers of the Carpathian Region.

Table 1. Summary of data sources to be used for comparison of O_3 concentration statistics and exposure indices

Study area	Years of data	Active ozone monitoring data	Passive sampler data	Source of data
Carpathians (entire range)	1997-1999	Yes	Yes	Bytnerowicz et al., 2004b
Tatra Mountains (Poland & Slovakia)	1999-2001	Yes	Yes	Bytnerowicz et al., 2004a
Retezat Mountains (Romania)	2000-2002	No	Yes	Bytnerowicz et al., 2005
Bucegi Mountains (Romania)	2006-2008	No	Yes	Badea et al., unpublished
Alps (Austria, Germany, Switzerland, Italy)	1995- 2010	Yes	Yes	Smidt and Gabler, 1995
Jizerske Hory (Czech Republic)	1998-1999	No	Yes	Cerny et al., 2002
Sumava Mountains (Czech Republic)	1994-1999	No	Yes	Moravcik et al., 2002
Brdy Mountains (Czech Republic)	1994-1999	Yes	Yes	Musselman et al., 2002
Rila Mountains (Bulgaria)	1994-1995	Yes	No	Zeller et al., 1997
Sierra Nevada, entire range (California & Nevada, USA)	1999	Yes	Yes	Fraczek et al., 2003
Lake Tahoe Basin, Sierra Nevada (California & Nevada, USA)	2002, 2006	Yes	Yes	Gertler et al., 2006
Sequoia National Park (California, USA)	1999	Yes	Yes	Bytnerowicz et al., 2002
San Joaquin River drainage, Sierra Nevada (California, USA)	2002	Yes	Yes	Cisneros et al., submitted for publication
Southern Sierra Nevada (California, USA)	2006-2008	Yes	Yes	Bytnerowicz et al., unpublished
San Bernardino Mountains (California, USA)	2002-2006	Yes	Yes	Bytnerowicz et al., 2008
Cascade Mountains		Yes	Yes	Cooper and Peterson, 2002
Rocky Mountains, selected sites (Colorado, Wyoming)		Yes	Yes	CASTNet monitoring network (2000- 2010)
Glacier Lakes Ecosystem Experiments Site (Wyoming, USA)		Yes	Yes	Wooldridge et al., 1997

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LONG-TERM MONITORING OF ATMOSPHERIC DEPOSITION INTO THE FOREST ECOSYSTEMS OF THE TATRA MTS.

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Keywords: atmospheric deposition, acidification, critical loads, model PROFILE, Norway spruce ecosystems, the Tatra Mts.

Polluted atmosphere and large-scale forest decline in 1990's in the Tatra Mts region motivated formation of a long-term monitoring of atmospheric deposition into the forest ecosystems. According to the ICP protocol four sites were established along 2 vertical transects (1200-1500 m a.s.l) on a south slopes of the Tatra Mts in 1998. Two-week samples were collected all year round from closed Norway spruce forest (throughfall) and forest gaps. Precipitation and stream water samples were analyzed for pH, conductivity, and concentration of selected ions ($SO4^{2-}$, $NO3^-$, $NH4^+$, Cl^-, Na^+, Ca^{2+}, K^+, Al^{3+}, Mg^{2+}).
In this paper we present trends of pH, concentration of $SO4^{2-}$, $NO3^-$ and $NH4^+$ in precipitation and stream water along a transect Vysne Hagy (VH, 1200 m a.s.l.) – Popradske pleso (PP, 1500 m a.s.l.). We compared and discussed precipitation chemistry with the air quality data measured at the local EMEP site (Stara Lesna, 830 m a.s.l); and annual deposition of H^+, S and N with recommended values for forest protection. Based on current deposition data we recalculated critical loads by the PROFILE method.Concentrations of observed elements were significantly higher in throughfall precipitation when compared with gaps. Indexes of enrichment by canopy at the VH and PP sites were: 2.4 – 2.8 (for H^+), 1.2 – 1.7 for ($NO3^-$), 3.7 - 3.0 (for $SO4^{2-}$), and 5.2 – 5.1 (for $NH4^+$). We noted remarkable decline of H^+ concentration trend at the higher site (PP), where till 2003 pH of throughfall was below 3.5. Annual deposition of H^+ declined from 5 $kg.ha^{-1}y^{-1}$ in 2001 to 0.2 in 2008. Average annual depositions into forest at VH and PP sites were as follows (in $kg.ha^{-1}y^{-1}$): for $N\text{-}NO3^-$, 3.9 and 5.9, for $N\text{-}NH4^+$: 21.1 and 17.1, for $S\text{-}SO4^{2-}$:20.4 and 17.6. Despite strong reduction of sulphur emissions we haven´t recognized any significant changes in S concentration in precipitation. Sound trend of elevated total N deposition was detected at the PP site (R^2 0.74 in forest) and even in a gap (R^2 0.89). Seasonal mass load had its maximum during growing season, minimum in winter. Opposite situation we observed in a stream water chemistry, concentration of all elements culminated from late fall to spring. This tendency was more evident at the higher site (PP). On the other hand, a trend of elevated mass concentration in stream water was detected at the lower (VH) site only (for $NH4^+$ index R^2 0.72).
Deposition values were below calculated critical loads for acidity at the VH site. At the PP site we identify the 10% risk critical loads were slightly exceeded. Elevated N input might negatively influence buffer capacity of Norway spruce ecosystems developed on very acid and shallow soils developed on nutrient poor parent material. It might be one of the reasons for a catastrophic natural forest dieback in high elevations in the Tatra Mts during recent years.

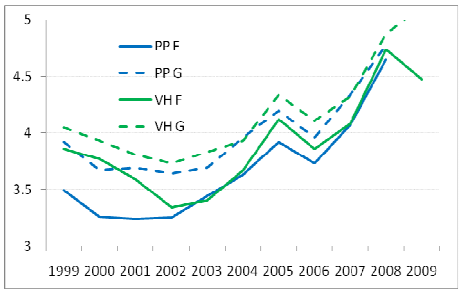

Figure 1. Annual pH at the PP and VH sites in forest (F) and gap (G)

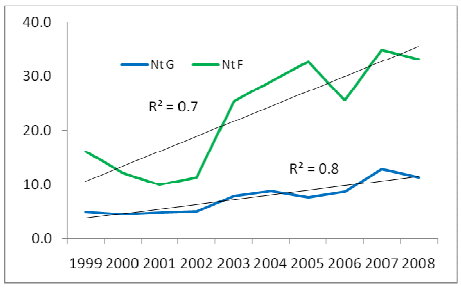

Figure 2. Annual Nt (N-NO3-, N-NH4+)deposition in kg.ha^{-1}y^{-1} at the PP site, in forest (F) and gap (G)

EFFECTS ON EXPERIMENTALLY INCREASED NITROGEN DEPOSITION ON ALPINE GRASSLANDS IN WESTERN TATRA MTS. (SLOVAKIA)

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Introduction

Deposition of anthropogenic nitrogen (N) influences ecosystems in different ways, including changes in species composition and diversity, primary production, loss of cations, increases soil acidity and aluminium concentrations (Vitousek et al. 1997, Aber et al. 1998, Tomassen et al. 2004, Stevens et al. 2004). These effects are often considered in the contexts of "eutrophication" and acidification. Although there has been recorded a significant decrease of S and N emissions since 1990s in Central Europe, N deposition represents still significant negative pressure on natural and managed ecosystems. The majority of research on effects of N deposition have focused on forest ecosystems. However, alpine grasslands dominated by herbaceous plants may be more sensitive to increase of N deposition because of lower N mineralization, biomass and primary production in comparison with forests. Therefore their biotic capacity to sequester increased N deposition is lower.

The experimental research in Salatín (Western Tatra Mts., Slovakia) address the impact of nitrogen (N) deposition on ecosystem of alpine grasslands. The research was established in co-operation with the University of Colorado (Boulder, USA) in 2002, the site is included into the International Long-Term Ecological Research (ILTER) network. The experimental design consists of 5 replicated treatments: 20, 60, and 150 Kg N ha^{-1} yr^{-1}, 50 Kg P ha^{-1} yr^{-1} and the control, 25 plots in total. The responses of the structure of plant community, biomass production, soil, water and plant tissues chemistry were studied.

Results

The results achieved so far indicate significant effects of N deposition on the grassland ecosystem chemistry and productivity in very acid conditions of the site. Soil pH values measured in the study plots are in the range of the most acidified soils reported for Europe. Both pH and base cation concentrations of the study soils decreased further with increasing inputs of inorganic N. We recorded decrease of extractable Al^{3+} with increasing inputs of inorganic N. The decrease in Al^{3+} indicates leaching losses exceeded weathering rates with simulated increases in N deposition. In contrast to the response of Al^{3+}, extractable Fe^{3+} increased with increasing N inputs.

Species-poor plant community of the alliance *Juncion trifidi* occurs in the experimental site. Species composition consists of grasses *Oreochloa disticha* (dominant), *Festuca supina, Agrostis pyrenaica, Avenula flexuosa, Avenastrum versicolor*; rush *Juncus trifidus*; sedge *Carex nigra*; herbs *Campanula alpina, Hieracium alpinum, Homogyne alpina, Bistorta major*. Lichen *Cetraria islandica* and moss *Polytrichum alpinum* dominate in lichen and moss layers. During the experiment, we did not record usual consequence of increased N input - decrease of species richness. However, we registered quantitative changes in species abundance in N15 treatment: significantly decrease of lichen *Cetraria islandica* and increase of *Festuca supina* abundance.

We used standard destructive method for the aboveground biomass estimation: vascular plants were clipped just above the soil surface in 75 samples (30*30 cm each). The mean value of 109.39 $g.m^{-2}$ of vascular plant aboveground biomass was recorded, grasses represented the
dominant portion of the biomass (83%). The analysis of variance indicated that there was a significant treatment effect on biomass value. Phosphorus plots had significantly higher biomass (58% mean difference) than all other treatments. It seems that P limits production of the studied ecosystem at the first place. Addition of nitrogen decreased aboveground production (significantly negative effect in 15N plots), the production is inhibited after N addition.

Discussion

During acidification, soils undergo a transition through different ranges of buffering associated with the weathering and liberation of different elements (van Breemen et al., 1983). Most temperate-zone soils are buffered by base cations, which are replaced by Al^{3+} at pH ranges below pH 4.5. The next buffering stage - beyond Al, towards Fe buffering of soils - was hypothesized by Ulrich (1983), but it was not observed experimentally in association with N deposition. The responses of extractable Al and Fe in soils to simulated N deposition in our experiment differs from most experimental studies, which show that soil extractable Al increases with increasing soil acidification or inorganic N inputs. We recorded opposite relationship what indicates in correspondence with hypothesis of Ulrich (1983) that soils at our study site are at a threshold between Al and Fe dominated buffering of the soil. Chronic anthropogenic N deposition acidifies soils, depletes soil nutrients, and increases the amount of soluble toxic elements - aluminium and iron (Bowman et al., 2008).

The experiments with N addition to ecosystems usually lead to increase of the primary production and decrease of species richness (Suding et al., 2005; Clark et Tilman 2008). We did not record decrease of plant species richness in our experiment, changes were observed in abundance of individual species. We suggest that the long-term (50 years) increased N deposition already selected tolerant species and therefore further experimental increase of N deposition is not resulting in elimination of species from recent species-poor community.

The addition of N to ecosystems is often labelled as "fertilisation" as N belongs to main nutrients and its deficiency can limit primary production. Thus, usually its increased input leads to increased production (Fenn et al. 2003). We recorded opposite effect of N addition (decrease of production). The possible explanation is that current levels of N deposition inhibit plant growth due to a combination of loss of nutrient base cations and Al and Fe toxicity.

The cumulative effect of high acid deposition over six decades causes regions such as Tatra Mts. sensitive to elevated rates of N deposition and brought them dangerously close to toxic conditions. This can have negative consequences to the integrity of ecosystem services provided by the alpine and high-mountain ecosystems (Bowman et al., 2008).

Acknowledgements

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AMBIENT OZONE PHYTOTOXIC POTENTIAL FOR CZECH MOUNTAIN FORESTS

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Keywords: AOT40, temporal trends, spatial pattern

Introduction

Ambient ozone monitoring in the Czech Republic (CR), reveals that ozone poses a risk both for human health and also for vegetation and ecosystems (Hunova et al., 2003; CHMI, 2009), similarly as in many regions in Europe (EEA, 2009). The contribution estimates the ambient ozone phytotoxic potential for forests in the Czech Republic using the AOT40 exposure index (Fuhrer et al, 1997; UNECE, 2004). The AOT40 trends for selected rural sites operated by the CHMI during 1994–2008, and maps showing the AOT40 spatial distribution for 2003, 2006 and 2007 are presented.

Methods

Real-time ambient ozone levels have been measured in the CR since 1993 by UV-absorbance, a reference method as declared by the EC (EC, 2002). The ozone analyzer used is the Thermo Environmental Instruments (TEI), M49.

The maps are based on continuous monitoring ambient ozone data from 24 rural sites (Fig. 1), the mapping method uses the linear regression model with subsequent IDW interpolation of its residuals. For interpolation in northern border areas we used also the data from neighbouring countries (Germany and Poland).

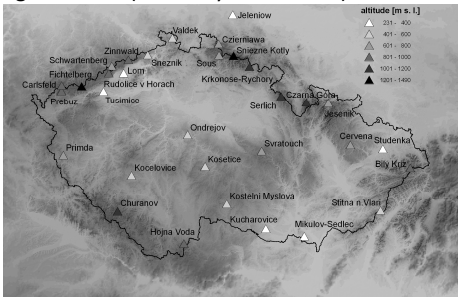

Figure 1. Spatial distribution of ambient ozone real-time monitoring sites (2007)

Results and discussion

The high ambient ozone levels recorded in 1994 and 1995 decreased substantially after the decrease of ozone precursor emissions (NOx and VOC) in Europe during the 1990s. The high ozone levels recorded later, particularly in 2003 and 2006, resulted from meteorological conditions extremely conducive for formation of ambient ozone and it accumulation in atmosphere.

Our results indicate high phytotoxic potential for most of the CR. The interannual variability in AOT40 is considerable. The highest AOT40 values within the entire measuring period (Fig. 2) were recorded at the Sous site (Jizerske hory) in 1994 (39 ppm.h), at the Prebuz (Krusne hory) and Rychory (Krkonose) sites in 2003 (38 ppm.h) and at the Bily Kriz (Beskydy) site in 1995 (37.7 ppm.h). The curve of AOT40 increase for individual vegetation seasons differs significantly regarding the meteorological conditions, the critical level for forets, set up as of 5 ppm.h (UNECE, 2004) is usually exceeded rather early, in the beginning of the vegetation season, generally in May (Fig. 3). In vegetation periods with meteorological conditions conducive for ambient ozone formation the critical level is exceeded more folds as compared to the vegetation periods with non-conducive conditions; nevertheless it is exceeded at all stations always since the very beginning of the ambient ozone monitoring in the CR in 1993. In extremely hot and dry 2003 vegetation season (Luterbacher et al., 2004), the critical level for forests was exceeded over the 31 % of the Czech forested area even more than 6 times (Fig. 4). In spite of the ambient ozone levels measured over the Czech territory, no significant forest injury, ascribed explicitly to the elevated ambient ozone exposure, has been reported so far.

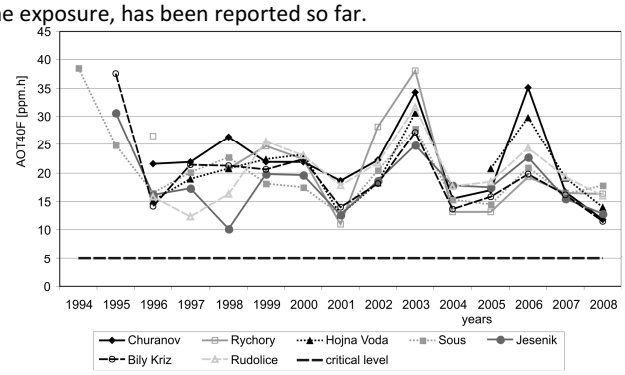

Figure 2. Exposure index AOT40 for forests st selected sites operated by the CHMI, 1994–2008

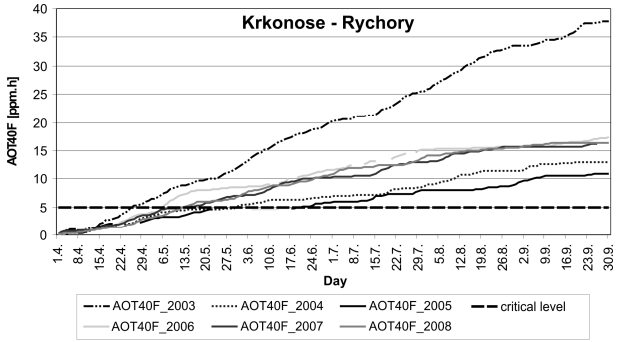

Figure 3. AOT40 for forests growth in time for the Krkonose-Rychory site (1001 m a.s.l.), 2003–2008 vegetation seasons

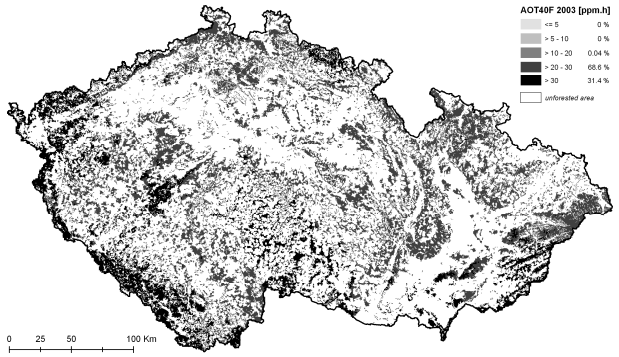

Figure 4. Exposure index AOT40 for forests spatial pattern, CR, 2003

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TRENDS IN SULPHUR AND NITROGEN DEPOSITION IN MOUNTAIN FORESTS IN THE CZECH REPUBLIC

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Keywords: temporal trends, spatial pattern, precipitation

Introduction

Profound socio-economic changes in Central Europe in 1989 resulted in significant improvement of many environmental indicators. Severe air pollution, ranking the former communist Czechoslovakia to the most polluted European countries, decreased substantially (Moldan, Hak, 2007). Remarkable decrease of SO2 emissions during the 1990s was followed by a statistically significant downward trend in SO2 ambient levels, SO42- concentration in precipitation and S/SO42- wet-only deposition (Hunova et al., 2004). The decrease in NOx emissions and consequently of NOx ambient levels and N/NO3- wet-only deposition has been much less pronounced, however. The most loaded sites are at the northern part of the country, including the Krkonose, Jizerske hory, Orlicke hory and Beskydy Mts. (Hunova et al., 2003). The contribution presents the temporal trends and spatial patterns of sulphur and nitrogen deposition in Czech mountain forests in 1990–2008.

Methods

For the analysis we used the data from sites operated by the Czech Hydrometeorological Institute. The precipitation samples were taken by the automated wet-only samplers in a regular monitoring network on weekly basis and analyzed by standard methods. Dry deposition was calculated from the mean concentration of relevant gases (SO2, NOx) in ambient air. For the temporal trend analysis we applied the Mann-Kendall non-parametric test used widely in environmental science and recommended by the WHO.

Total deposition maps were produced by adding S and N wet and dry deposition maps. Wet deposition maps were derived from the field of the respective ion concentrations in precipitation (based on annual mean concentrations weighted by precipitation totals calculated from the data measured) and from the field of annual precipitation totals which was generated from data from 750 precipitation gauging stations, taking into account the altitude´s effect on precipitation total. Wet S deposition was calculated from SO42- in rain and snow, wet N deposition was calculated from NO3- and NH4+ in rain and snow. Dry deposition maps were calculated using the fields of annual mean SO2 and NOx concentrations for the CR and the deposition velocities for SO2 0.7 cm.s-1/0.35 cm.s-1, and NOx 0.4 cm.s-1/0.1 cm.s-1 for the forested/unforested areas. The deposition from fog, low clouds and rime was neglected. The maps of spatial patterns were prepared in in 1 x 1 km grid. We used the ArcGIS Geostatistical Analyst (Johnston et al., 2001).

Results and discussion

Our results reveal many significant changes over the period observed, not only in concentrations of respective ions but also in the share of ions in precipitation. This for example applies for the ratio between sulphates and nitrates, used in the past as a logical check of the correct chemical analysis. Whereas this ratio used to be approximately 2:1 (SO42- : NO3-) before 1989, we have been observing coincidental gradual SO42- decrease and NO3- increase. The NO3-/SO42- ratio shows statistically significant increasing trend for all types of Czech sites, with the most prominent change at the mountain forests (Fig. 1). The above development is consistent with the changing trends in SO2 and NOx emissions. We observe statistically significant increasing trend in pH of the precipitation at all types of sites. Fig. 2 presents the mean trend in pH at the mountain sites.

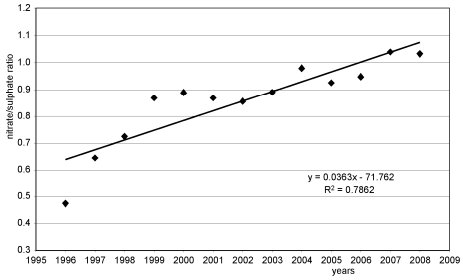

Figure 1. The ratio of NO3-/SO42- concentrations in precipitation, mean for the Czech mountain forest sites, 1996–2008

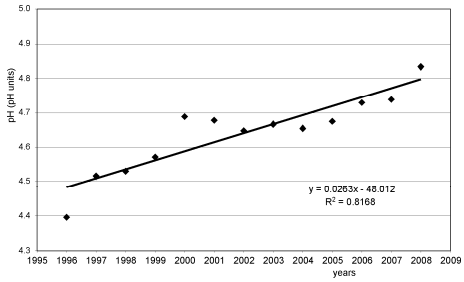

Figure 2. The pH in precipitation, mean for the Czech mountain forest sites, 1996–2008

The spatial patterns of the annual total deposition flux of sulphur reveal that in most parts of the CR sulphur is not a problem any more (Fig. 3). In contrast the annual total deposition flux of nitrogen (Fig. 4) still represents in many regions a considerable stress. The value of 1 g.m-2.year-1, the critical load set up for Central European coniferous forests (Bobbink, Roelofs, 1995), is exceeded over significant portion of the country. Moreover, as the deposition from fog, low clouds and rime is due to the methodological reasons and significant uncertainties neglected in our models, we can reasonably assume even higher deposition fluxes, particularly in mountain regions. Cloud, fog and rime deposition represents a substantial proportion of the total deposition as shown e.g. for the Krusne hory Mts. by Bridges et al. (2002).

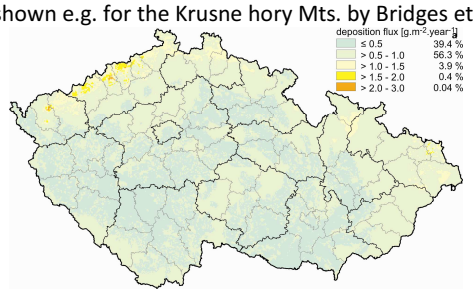

Figure. 3. Spatial pattern of the annual total deposition flux of S, CR, 2008

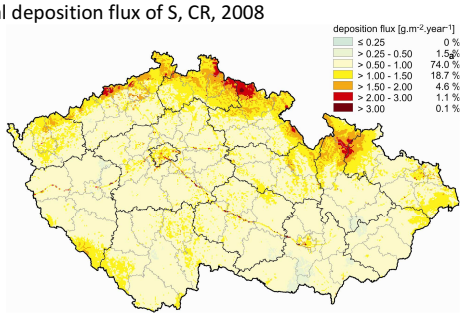

Figure. 4. Spatial pattern of the annual total deposition flux of N, CR, 2008

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NUTRIENT FLUXES IN PLANTED NORWAY SPRUCE STANDS OF DIFFERENT AGE IN SOUTHERN POLAND

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Keywords: bulk precipitation, throughfall, surface flow, stemflow, soil water, runoff water, LAI, the Dupniański stream catchment, The Silesian Beskid, Southern Poland

The fluxes of $N\text{-}NO_3^-$, $N\text{-}NH_4^+$ $S\text{-}SO_4^{2-}$, Na^+, K^+, Ca^{2+} and Mg^{2+} from bulk precipitation to throughfall, stemflow and soil water surface flows were studied during 1999-2003 in planted Norway spruce forest stands of different age (11, 24, 91 and 116 years in 1999). Also, runoff from the corresponding Potok Dupniański catchment in the Silesian Beskid Mts was studied. N deposition was above the critical load for coniferous trees. The interception increased with stand age as well as LAI, and so did the leaching from the canopy of almost all the analyzed elements, but especially $S\text{-}SO_4^{2-}$, H^+ and K^+. The nutrient fluxes varied with age of the spruce stands. Throughfall showed a high amount of S and of the strong acids ($S\text{-}SO_4^{2-}$ and $N\text{-}NO_3^-$) deposited to the soil, especially in older spruce age classes. Decomposition of organic matter caused a rise in water acidity, and an increase in the concentrations of all the analysed ions; the leaching of minerals, however, was low (under 1%). The horizontal soil water flow showed an increase in the amount of water and amount of ions and contributed to a further decrease of pH at the soil depth of 20 cm. Element concentrations and their amounts increased with water penetrating vertically and horizontally on the slopes. Considerable amounts of ions, especially S and alkaline cations, were carried beyond the reach of the root system, and then left the catchment. In the long-term these mineral losses will adversely affect health and growth of the spruce stands, and the increased acidity with stand age will presumably have negative effects on the run-off water ecosystem.
Synopsis: Nutrient fluxes depends on the age of planted Norway spruce stands. Mineral imbalances may in the long-term adversely affect the health and development of the stands.

TROPOSPHERIC OZONE IN MOUNTAIN REGIONS: INCIDENCE VS EFFECTS ON NATIVE VEGETATION

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Keywords: ozone, vegetation, EDU, foliar injury, growth effects

Ozone (O_3) is a normal variable concentration gas that occurs in the troposphere, primarily in warmer months of the year, coinciding with growth of indigenous vegetation.Normal background concentrations (25-40 ppb) are not considered harmful to plants or humans. Increased emissions of volatile organic compounds (VOCs) and oxides of nitrogen (NOx) from anthropogenic combustion, accelerate the photochemical oxidant cycle that produces O_3 and reduce normal breakdown, allowing O_3 to accumulate beyond normal background levels to pollution levels in summer. O_3 has been monitored in many of the world's mountain ranges. In many cases, O_3 levels can be high there due to long-range transport and interception at high elevations.The use of passive samplers for O_3 has made it possible to monitor O_3 in areas too remote for active analyzers. Much has been learned about the incidence of O_3 at pollution levels in the Rocky Mountains in Colorado and the Green and White Mountains in Vermont and the Appalachian Mountains of the Eastern USA. Similar surveys have been conducted in European Mountain Ranges, including the Carpathian Mountains. In some cases, native plants have been identified as bioindicators for O_3, but little is known about the biological or ecological consequences of O_3 injury on native vegetation. This is well-illustrated by results from a 10-year study program in the Carpathian Mountain Region, which I will use as an example. Beginning in 1991, Dr. Andrzej Bytnerowicz and Dr. Robert Musselman, USDA Forest Service and Professor William J. Manning, University of Massachusetts, USA, began collaborations with researchers in the Carpathian Mountain regions of the Czech Republic, Poland, Romania, Slovakia and Ukraine, continuing until 2001. Passive samplers for O_3 were placed in forested regions in the summer in these countries. These samplers provide average O_3 concentrations over a given time of exposure. This enabled the construction of season-long average concentrations of O3 by seasonal mean and ranges for semi-monthly values over a ten-year period. It also allowed the identification of geographic areas with high O_3 levels. Increases in pollution levels of O_3 have been noted in Slovakia, Czech Republic and Poland during the ten-year assessment program. Increased economic activity and numbers of cars and trucks in the region have contributed to this as has long-range transport of O_3 and precursors from Western Europe. The Slovak part of the Carpathian Mountains and Jizerske Hory of the Czech Republic may experience levels of O_3 that could injure native vegetation. O_3 concentrations may also be higher at higher elevations in other parts of the region. In conjunction with placement of passive samplers for O_3, ground surveys were conducted for incidence of ozone injury on native plants. We verified the O_3 sensitivity of 16 native plant species and recommended that they be used as detector in situ bioindicators for ambient O_3 in the region. Typical O_3 injury symptoms occur when soil moisture is sufficient to drive photosynthesis and

gas exchange and allow uptake of O_3 at a concentration high enough to cause foliar injury. Incidence of elevated levels of O_3 do not, however, necessarily correlate well with incidence foliar O_3 injury on native plants. Through use of passive samplers, much was learned about the incidence of O_3 at varying levels in the Carpathian Mountain Region. Ground surveys detected native detector bioindicator plants for O_3 near the passive samplers. The biological significance of O_3-caused foliar injury on native bioindicator plants was not determined. Information about long-term exposure of these plants to ambient O_3 on plant growth, reproduction and competitive ability was not obtained. The ecological significance of O_3 incidence in the Carpathian Mountain Region in relation to native plants was not established. The question remains: Do elevated levels of O_3 in the Carpathian Mountain Region, and other mountain regions, significantly affect growth, reproduction, competitive ability and ecological function of native plants that are O_3-sensitive? Are plants that do not exhibit O_3 injury symptoms also affected by O_3? Answers are not available. The purpose of this presentation then is to raise the issue of the lack of ecological significance for O_3 incidence and native plant responses in the Carpathian Mountain Region and other mountainous regions of the world. Having done this, an additional purpose is to recruit collaborators to establish some study plots in areas with known elevated O_3 and known O_3 bioindicators and to determine the effects of O_3 on these native plants. These plots can be in various mountain ranges of the world. There is a way to do this in situ. It has long been established that the chemical compound N-[2-(2-oxo-1-imidazolidinyl)ethyl]-N'-phenylurea (ethylenediurea, abbreviated as EDU) can protect vegetation from O_3 injury under ambient conditions. EDU prevents O_3 effects and allows comparisons with non-treated EDU plants that serve as controls. This is done under natural edaphic and environmental conditions and with naturally fluctuating concentrations of O_3. The use of passive O_3 samplers would allow determination of the extent of exposure to O_3 for each study plot. Monitoring air for O_3 concentrations is useful for identifying geographic areas where elevated O_3 levels occur. The data, however, cannot be used to imply that high O_3 levels will cause plant injury where they occur. This has to be verified with actual plant responses. When that is done, the air quality data become more useful as they can be related to biological and ecological effects. I propose that this should be done in the Carpathian Mountain Region and in other mountainous regions of the world.

NATURAL FACTORS AFFECTING THE CHEMICAL COMPOSITION OF WATER IN THE CATCHMENT OF WOŁOSATKA STREAM (HIGH BIESZCZADY MTS.)

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Keywords: Bieszczady Mts., water chemistry, natural factors

Introduction

The chemical composition of water in the catchment is shaped by an array of factors – the most important of which is usually the lithology of the parent material. Yet, even in catchments with a fairly uniform lithology, spatial differences in water chemistry can be observed. Such differences arise from different types of plant cover, relief, as well as water circulation patterns at different elevations. The purpose of this paper is to identify the principal natural factors determining spatial differences in water chemistry in the flysch-type Carpathians using the Wołosatka Catchment (High Bieszczady Mountains) as an example.

Study area

The High Bieszczady Mountains are the highest range within the Polish part of The Eastern Carpathian. Hydrochemical research was conducted in the upstream portion of the Wołosatka Stream catchment (9.5 km^2) (Fig. 1) in Bieszczady National Park. Today, the area experiences little human pressure, and for that reason, it is a good place to learn about natural factors affecting the chemical composition of water in the flysch Carpathians.

The catchment's parent material is made up of Oligocene flysch formations in Krosno-type horizons of the Silesian Nappe. The principal constituents of the parent material – in terms of surface area – are thick layers of medium- and coarse-grained Otryt sandstone and so-called fine-rhythmic flysch, which includes thin and thick sandstone horizons and clay-marl schist**.** The entire study area is characterized by NW-SE folds. Faults are an important structural feature in the area. The largest of the faults has a drop of about 1,000 m NE-SW (Tokarski, 1975, Haczewski, Kukulak, Bąk 2007).

A total of 227 natural outflows of groundwater were detected in 2007 – mostly in the form of spring and wetlands. The majority of the outflows were small (under 0.5 dm^3/s). However, several large outflows were also detected (over 1 dm^3/s) (Rzonca et al. 2008, Siwek et al. 2009).

Despite the relatively uniform geologic parent material and small surface area, the catchment is quite spatially diverse in terms of physical and chemical characteristics of water. Total mineral content in the water ranges from 30 to 315 mg/dm^3, with a pH of 6.8-8.2 (Siwek, Rzonca 2009). The most common water type is "three-ion water" with HCO_3, Ca, and Mg. Four-ion water is also found at a number of locations, where the fourth ion is sulfate (Rzonca, Siwek 2009).

Methods

Fieldwork was conducted on three different occasions: Sept. 2-3, Oct. 1-3, and Oct. 16-17, 2007. Weather conditions during the period of research were variable. Fieldwork in the northeastern part of the study area was conducted during a period of elevated soil moisture and lower air temperatures relative to the remainder of the study area. Spring and stream

discharge, temperature, specific electrolytic conductivity, and water pH were measured in the field. Water samples were collected for laboratory analysis at 79 sites. The following common ions (1) and biogenic ions (2) were analyzed for: 1) Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}, HCO_3^{-}, SO_4^{2-}, 2) NH_4^{+}, NO^{2-}, NO_3^{-}, PO_4^{3-}. A Dionex ICS-2000 ion chromatograph was used to analyze the water samples. Principal Component Analysis (PCA) was used to identify independent factors explaining the spatial variability in ion concentrations.

Results

PCA identified three factors that altogether explain 85% of the variance in the ion concentrations in the water samples analyzed. The main principal factor (F1) explained 51% of variance and was unequivocally associated with all common ions. F1 was poorly correlated with the concentrations of the following ions: NO_3, SO_4, and Cl. This factor reflected the fundamental influence of the parent material determining the water chemistry in the catchment of interest. The parent material is likely a key determinant of covariance in the concentrations of different ions.

A number of interesting conclusions could be drawn from the other two factors identified. The second factor (F2) primarily affected differences in SO_4 and Cl concentrations and explained 21% of variance. However, the relationship was inversely proportional. In general, high F2 values were characteristic of sites located across the upstream portion of the catchment. Sulfate concentration was found to increase and chloride concentration was found to decrease with increasing elevation.

The third factor (F3), which explained 13% of variance, affected primarily nitrate concentrations. While nitrate concentrations across the catchment are very low (from 0.16 to 5.25 mg dm^{-3}), there does exist a certain spatial trend. Generally higher nitrate concentrations were detected in the eastern part of the study area, which is characterized by somewhat different water circulation patterns. Soil horizons in the eastern part follow a downward northeasterly direction, which runs counter to the local fall line, and may result in an influx of shallow circulation water. This type of water contains larger quantities of organic matter converted into inorganic substances. It must also be noted that none of the three factors identified were directly correlated with outflow type, morphologic location, and rate of spring discharge.

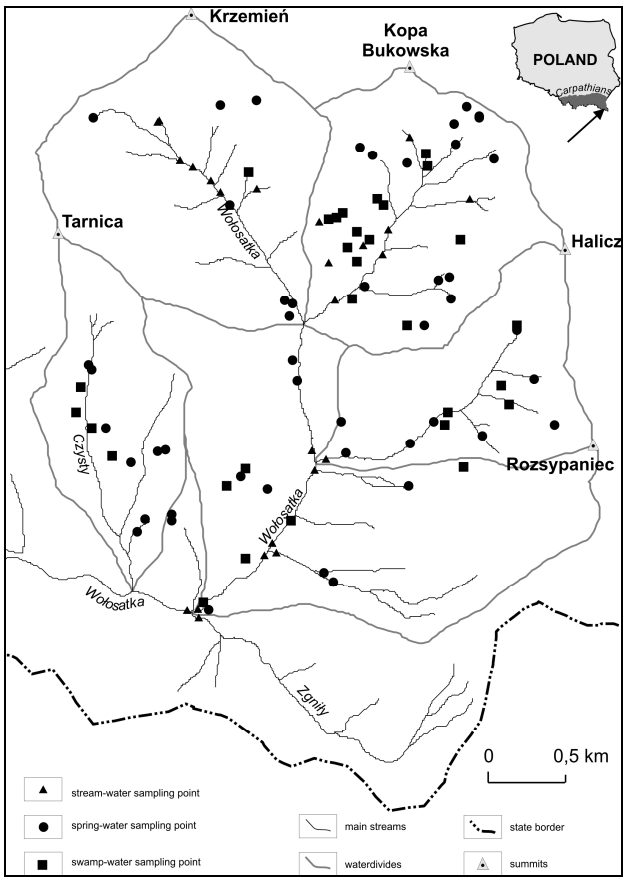

Figure 1. The study area and sampling point types

Conclusions

Even small natural catchments in the flysch Carpathians, featuring uniform lithology, can possess a spatially diverse water chemistry. The fundamental factor shaping the proportions between different ions is water-bearing horizon lithology. Differences in water chemistry can also be related to some extent to elevation in mountain areas. Different elevations feature different climate conditions, different species of plants, and different conversion mechanisms of organic matter into inorganic matter. Precipitation totals are higher at higher elevations as are water circulation patterns.

Finally, it must be noted that only a certain part of variance is shaped by the elevation factor, which makes any analysis of this relationship difficult using other statistical methods that analyze total variance.

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ENVIRONMENTAL AND LAND USE DETERMINATIONS OF STREAM WATER CHEMISTRY DURING FLOOD EVENTS IN SMALL CARPHATIANS FOOTHILL CATCHMENTS IN POLAND

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Key words: stream water chemistry, floods, land use, Carpathian Foothills

The dynamics of stream water chemistry depend on a large number of factors, both natural and anthropogenic. The paper shows the degree to which differences in geologic structure, land use, and flood origin affect changes in the chemical composition of stream water in small catchments located along the northern fringe of the Carpathian Foothills.

Study Area

The research was conducted in the northern edge zone of the Carpathian Foothills in the Stara Rzeka catchment (22.2 km^2) featuring two distinct sub-catchments: Leśny Potok (0.48 km^2) and Kubaleniec (1.03 km^2) (Fig. 1). The Stara Rzeka catchment straddles two elevations in the Carpathian Foothills – the higher being built of resistant *flysch* of the "Silesian tectonic unit" and the lower being built of less resistant *flysch* of the "Sub-Silesian tectonic unit" consisting of two subunits: "Sub-Silesian I" and "Sub-Silesian II" (Olewicz, 1973). The area is lined with a thick layer of dusty loess-like formations. The catchment is characterized by a complex land use structure (woodland 42%, arable land 36%, meadows and pastures 15%). The Leśny Potok sub-catchment is located at the higher of the two elevations. More than 99% of its area is woodland. The Kubaleniec sub-catchment is located at the lower elevation. Arable land accounts for 69%, meadows and pastures – 20% (Święchowicz and Michno, 2005).

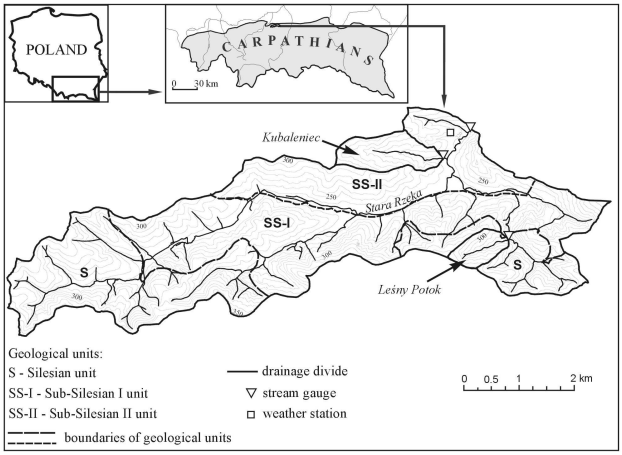

Figure 1. Study area

Method

Twenty nine flood events from 2002 to 2004 were selected for hydrochemical research. Stream water was sampled during each flood at terminal gauging stations. The sampling frequency depended on discharge rates and ranged from minutes to more than ten hours. Stream water levels were measured on a continuous basis until May of 2003, and after that at ten-minute intervals. Rates of discharge were calculated based on rating curves developed experimentally. Weather data were obtained from a local station. The following stream water characteristics were analyzed: 1) specific electrical conductivity (SC), 2) pH, 3) temperature, 4) main ions: Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, HCO_3^{-}, SO_4^{2-}, Cl^{-}, and 5) nutrient ions: NH_4^{+}, NO_2^{-}, NO_3^{-}, PO_4^{3-}. The correlation between water properties and specific runoff was determined using ***Pearson's linear correlation*** after the data had been standardized and normalized first. In order to describe the influence of flood nature on the chemical

properties of the water samples collected, different types of floods were identified: (i) storm event floods, (ii) prolonged rainfall floods, (iii) and floods induced by snowmelt and rain-on-snow events taking place with the soil (iii_a) frozen and (iii_b) unfrozen. All statistical calculations assume a significance level of $p \leq 0.05$.

Results

Taking all flood types into account, a negative correlation has been shown to exist between pH, SC, main ion concentrations, and specific runoff for all the catchments of interest (Table 1). The strongest correlation was observed in the woodland catchment, while the weakest in the mixed-use catchment. The strong correlation in the woodland catchment was the result of the homogeneous geological structure of the area (resistant sandstone), while the weaker correlation in the mixed-type catchment resulted from more heterogeneous geology. The proportion of water flowing from different parts of the catchment, built of different types of rocks, changes during flood events and distorts the normally strong relationship between water chemistry and specific runoff.

Table 1. Coefficients of correlation between stream flow and stream water chemical characteristics in catchments characterized by different land use – taking all floods into account. Only correlation coefficients with a significance level $p \leq 0.05$ are shown

Parameters		Woodland (Leśny Potok)	Agricultural (Kubaleniec)	Mixed-use (Stara Rzeka)
	pH	-0.92	-0.41	-0.38
	SC	-0.94	-0.87	-0.74
Main ions	Ca^{2+}	-0.94	-0.87	-0.81
	Mg^{2+}	-0.79	-0.88	-0.77
	Na^{+}	-0.90	-0.84	-0.73
	K^{+}		-0.27	-0.28
	HCO_3^{-}	-0.90	-0.89	-0.88
	SO_4^{2-}	-0.74	-0.61	-0.36
	Cl^{-}	-0.74	-0.90	-0.49
Nutrients	NH_4^{+}	0.40		
	NO_2^{-}	0.77		
	NO_3^{-}	0.54	-0.52	0.22
	PO_4^{3-}	0.73	0.26	

The correlation between concentration of nutrient ions and specific runoff was positive but weaker. Once again, the strongest correlations were noted in the woodland catchment. In the agricultural catchment, the correlation was significant in the case of NO_3^{-} and PO_4^{3-}, while in the mixed-use catchment, only in the case of NO_3^{-}.

The general relationship between SC, pH, most main ions, and specific runoff with respect to particular types of floods was similar to that without considering flood type (Table 2). Values of the above characteristics, except K^{+}, decreased with increasing specific runoff, which was the result of dilution processes, with less mineralized waters entering stream channels. In the case of K^{+}, a positive correlation with specific runoff was noted in the woodland catchment during storm-induced and snowmelt-induced floods with both frozen and unfrozen soil, as well as in the mixed-use catchment during storm-induced floods. This indicates that event water was a principal source of K^{+}. However, in the case of prolonged floods, the correlation between K^{+} and stream flow becomes negative with the passage of time as a result of a slowly diminishing supply of K^{+}. In the case of most streams, the majority of chemical characteristics were more closely correlated with specific runoff when considering particular types of floods rather than when considering all floods together. This was determined by an array of different conditions present before and during flood events. The conditions were more homogeneous for specific types of floods versus all types of floods considered together.

Table 2. Coefficients of correlation between stream discharge and chemical characteristics of water within particular classes of floods. Only correlation coefficients with a significance level $p \leq 0.05$ are shown

Characteristic		Woodland (Lesny Potok)					Agricultural (Kubaleniec)					Mixed-use (Stara Rzeka)			
		S	L	SM_f	SM_{uf}		S	L	SM_f	SM_{uf}		S	L	SM_f	SM_{uf}
	pH	-0.64	-0.96	-0.98			-0.74	-0.74	-0.40				-0.54		-0.38
	SC	-0.50	-0.97	-0.97	-0.98		-0.94	-0.94	-0.91	-0.96		-0.84	-0.83	-0.93	-0.87
Main ions	Ca^{2+}	-0.62	-0.92	-0.95	-0.99		-0.96	-0.96	-0.94	-0.95		-0.84	-0.80	-0.87	-0.93
	Mg^{2+}		-0.96	-0.96	-0.93		-0.91	-0.91	-0.92	-0.94		-0.85	-0.81	-0.82	-0.90
	Na^{+}		-0.95	-0.97	-0.92		-0.93	-0.93	-0.90	-0.95		-0.82	-0.83	-0.93	-0.84
	K^{+}	0.42		0.72	0.90					-0.65		0.52	-0.36		
	HCO_3^{-}	-0.47	-0.95	-0.95	-0.95		-0.92	-0.92	-0.94	-0.94		-0.84	-0.90	-0.90	-0.94
	SO_4^{3-}		-0.84				-0.88	-0.88	-0.77	-0.92		-0.62		-0.41	-0.76
	Cl^{-}		-0.90	-0.92			-0.93	-0.93	-0.91	-0.93		-0.75	-0.70	-0.86	-0.60
Nutrients	NH_4^{+}			0.65	0.70									-0.34	
	NO_2^{-}	0.72	0.71	0.57	0.89				0.81	0.43			0.57	0.34	
	NO_3^{-}			0.87			-0.52	-0.52					0.55	0.47	
	PO_4^{3-}	0.66	0.73	0.82			0.46	0.46	0.77				0.49		

S – storm events, L – prolonged rainfall events, SM_f – snowmelt events with frozen soil, SM_{uf} - snowmelt events with unfrozen soil

Conclusions

Changes in discharge taking place during flood events affect changes in water characteristics including the concentrations of different ions. The correlation between discharge and water characteristics is stronger in relatively homogeneous catchments, where homogeneity means similar land use and geologic structure. Flood origin is another key factor, which determines how water reaches stream channels. Decreasing concentrations of main ions along with increasing discharge suggest that water is being diluted by groundwater as well as snowmelt and precipitation water that contains smaller quantities of dissolved substances. On the other hand, increasing concentrations of biogenic ions are the result of dissolution processes taking place following periods of drought. A shortage of K^+ and certain biogenic ions can occur in the course of a flood event. This can reverse the relationship between ion concentration and discharge.

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HYDROCHEMICAL STREAM WATER TYPES IN THE TATRA MOUNTAINS (POLAND, SLOVAKIA)

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Keywords: Szczukariew-Priklonski classification, stream nodes, water type, water chemistry

Introduction

The chemistry of mountain streams is shaped by a number of key factors including parent material lithology, tectonics, and variable supply patterns. A key characteristic of natural mountain streams is the change in water chemistry with valley length and drainage basin size. This is the result of differences in the geologic structure of sub-basins as well as differences in water circulation patterns at different elevations.

Hydrochemical classification systems are particularly useful in research on spatial differences in stream water chemistry, allowing for a grouping of waters based on main ion content. The purpose of the paper is to identify which hydrochemical types occur most often in streams draining Tatra Mountain basins.

Study area, Methods, and Scope

Hydrochemical stream water research was performed in Tatra National Park (TNP) in Poland and in Slovakia (TANAP). There are three types of geologic structure (Földvary, 1988): 1) a crystalline core (metamorphic and plutonic rocks) with a Permian-Mesozoic sedimentary cover (quartzite, dolomite, limestone, shale, conglomerate, marl), 2) high-tatric nappes (shifted from the south and formed of sedimentary rocks similar to the high-tatric series along with some crystalline rocks), 3) sub-tatric nappes (upper, middle, and upper – formations similar to the high tatric naples).

The mean annual air temperature ranges from 6ºC at lower elevations to just under 4ºC at the highest elevations in the Tatra Mountains. The area is also characterized by the presence of climate and plant zones (Hess 1965) with zone boundaries found at higher elevations on the south-facing slopes of the Tatra Mountains (Slovakia) than the north-facing slopes in Poland. Precipitation totals range between 1,000 mm and 1,700 mm (Landscape Atlas of the Slovak Republic, 2002). Mean total runoff in the region depends on climate conditions and especially on precipitation amounts (Dynowska 1971).

Floods take place in the spring (melting of snow) and in the summer (rainfall). Low discharge rates can be detected in the autumn (September and October) as a result of low precipitation and substantial evaporation and in the winter (January – February) as a result of lingering snow cover. The HCO_3–Ca–Mg type is the dominant water type in the Polish Tatra Mountains (B. Paczyński, A. Sadurski, 2007).

A total of 642 water samples were taken from the largest of streams in the Tatra Mountains. Two samples were collected from independent streams and one sample was collected from a “mixed” stream – beyond the point of confluence of two streams. The samples were collected in 0.5 dm^3 polyethylene bottles. Specific conductance, pH, as well as water temperature were measured in the field using an ELMETRON CX-401 and a CPC 400 (ERH-11 electrode and conductometric sensor with a constant k = 0.4 – 0.55). Water samples from crystalline areas featuring low mineral content were analyzed using a Hamilton-type pH electrode and a WTW 350i meter with a conductometric sensor constant of k = 0.1.

Water chemistry was analyzed at the Hydrochemical Laboratory at the Jagiellonian University Institute of Geography and Spatial Management in Kraków using ion chromatography (DIONEX ICS-2000). The chromatographic system was programmed to identify both anion and cation content (AS18-4mm and CS16-5mm columns). The concentration of 14 ions was determined: Ca, Mg, Na, K, NH_4, Li, HCO_3, SO_4, Cl, NO_3, NO_2, Br, F, PO_4. The hydrochemical type of each water sample was determined using the Szczukariew-Prikłoński classification system (Macioszczyk A., Dobrzański D., 2002).

The Szczukariew-Prikłoński classification system assumes that the dominant cations can be Na, Mg, and Ca, and the dominant anions can be Cl, SO_4, and HCO_3. The names of water types are constructed based on dominant ions with the anion being listed first. In this paper, main ions also include the H cation and the NO_3 anion, as they tend to exceed 10% mval of total ion content in low mineral content waters of the crystalline near-ridgeline core of the Tatra Mountains.

The research was conducted in Poland in the autumn of 2007 during periods featuring low water levels in August and October as well as in Slovakia in September of 2009.

Results

Both Ca and HCO_3 (with one exception) normally exceeded 10% of total ion content, Mg exceeded 10% quite often (67% of the time), while SO_4 exceeded 10% about a third of the time (31%). The water type was determined by Na only in 6% of cases, while NO_3 and H determined the water type less than 1% of the time (Tab. 1). In most cases, three-ion hydrochemical types were the norm (Tab. 2). Two-ion and four-ion hydrochemical types were less common – 15.6% and 17.5%, respectively. Only 1.3% of samples could be classified as 5-ion types.

Ten hydrochemical types were identified in the waters of Tatra Mountain streams (Tab. 3). Two-ion water was identified for one hydrochemical type only – a type dominated by HCO_3 and Ca. Three-ion water involved three hydrochemical types: 1) a single dominant ion type (over 53%) – mostly HCO_3 with some Ca and Mg, 2) the SO_4-HCO_3-Ca type (12%), and 3) the SO_4 and NO_3 anion type (rare) with the main cation being Ca.

Four-ion water involved four hydrochemical types. The first three included two of the same anions – HCO_3 and SO_4 – and the same dominant cation – Ca. The hydrochemical types were different in terms of the second cation, which could be either Mg or Na (one case of H). The fourth four-ion type was found in two waters featuring three anions (HCO_3, SO_4, NO_3) and one dominant cation (Ca). Five-ion water involved two hydrochemical types. The former included three anions (HCO_3, SO_4, NO_3) and two cations (Ca, Na), while the latter included two anions (HCO_3, SO_4) and three cations (Ca, Mg, Na).

In terms of main ions, the number of cations was normally smaller than the number of anions (Tab. 4). In 32% of cases, the number of cations was the same as the number of anions, while in 13% of cases, the number of cations was larger than the number of anions. Most water samples from the Tatra Mountains were dominated by the HCO_3 cation, while Ca was the second most common ion. In 25% of cases, Ca was the dominant ion (Tab. 5). The third most common ion was usually Mg, although SO_4 also occupied this position in many cases.

Summary

The chemistry of water in streams draining high mountain basins in the Tatras (TNP, TANAP) is dominated by the HCO_3 anion and the Ca cation. Ten hydrochemical types of water were identified based on the Szczukariew-Prikłoński classification system.

The dominant three-ion water type is the HCO_3–Ca–Mg type (53.4%). Two-ion and four-ion water types are less common. A small number of cases of five-ion water have been identified. In a very small number of cases, the ions determining hydrochemical type were Na, NO_3, and H. The modification of hydrochemical types results from a significant presence of SO_4, Na, and Mg in the water – all of which are linked to the complex geologic structure of the Tatra Mountains.

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Table 1. Dominant ions (over 10% of total ion content) in Tatra Mountain water samples

Dominant ion	Number of Cases	Percentage %
H	1	0.2
Ca	640	100.0
Mg	427	66.7
Na	39	6.1
HCO_3	639	99.8
SO_4	198	30.9
NO_3	4	0.6
* Total number of samples – 640 = 100%		

Table 2. Number of dominant ions in different hydrochemical types

Number of ions in type	Number of cases	Frequency %
2	100	15.6
3	420	65.6
4	112	17.5
5	8	1.3

Table 3. Hydrochemical types of Tatra Mountain water samples

Lp.	Type	Number of cases	Frequency %
1	HCO_3–Ca	100	15.6
2	HCO_3–Ca–Mg	342	53.4
3	HCO_3–SO_4–Ca	77	12.0
4	SO_4–NO_3–Ca	1	0.2
5	HCO_3–SO_4–Ca–Mg	78	12.2
6	HCO_3–SO_4–Ca–Na	31	4.8
7	HCO_3–SO_4–H–Ca	1	0.2
8	HCO_3–SO_4–NO_3–Ca	2	0.3
9	HCO_3–SO_4–Ca–Mg–Na	7	1.1
10	HCO_3–SO_4–NO_3–Ca–Na	1	0.2

Table 4. Number of dominant cations (K) versus number of dominant anions (A)

Relationship	Number of Cases	Frequency %
K < A	81	12.7
K = A	210	32.8
K > A	349	54.5

Table 5. Position of main ions relative to their content (% mval)

Ion	Position				
	1	2	3	4	5
H	0.0	0.0	0.0	0.2	0.0
Ca	23.6	74.5	1.9	0.0	0.0
Mg	0.0	1.9	59.4	4.5	0.9
Na	0.0	0.0	1.6	4.4	0.2
HCO_3	76.4	22.2	1.1	0.0	0.2
SO_4	0.0	1.4	20.3	9.2	0.0
NO_3	0.0	0.0	0.2	0.5	0.0

POSTER PRESENTATIONS

AIR POLLUTION, PRECIPITATION CHEMISTRY AND FOREST HEALTH IN THE BUCEGI MOUNTAINS, SOUTHERN CARPATHIANS, ROMANIA

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Keywords: air pollution, acid rain, climate conditions, drought, crown condition, growth losses.

In the Bucegi Mountains located in southern Carpathians, Romania, concentrations of selected air pollutants were monitored during the 2006-2008 summer seasons. Ozone (O_3), nitrogen dioxide (NO_2) and ammonia (NH_3) concentrations were measured with the Ogawa passive samplers as monthly averages. Monitoring network consisted of 11 monitoring sites with a good spatial distribution throughout the study area. Strong temporal and spatial trends were detected for all the measured pollutants. Ozone concentrations were generally elevated and occasionally exceeded 70 ppb. Such high levels of monthly averages indicate a strong potential for phytotoxic effects of the pollutant. Concentrations of NO_2 were generally low, with the highest values <4 ppb. Ammonia levels in most monitoring locations were also low, generally <1 ppb, but in some locations reached values >5 ppb. Such concentrations could be a prerequisite for high nitrogen (N) dry

deposition in some of the forest stands. In addition, high frequency (more than 50%) of acid rain with pH values <5.5 contributed to the already increased acidity of forest soils, especially in their upper layers. In conjunction with elevated levels of air pollution, climate conditions, in particular excessive drought period and high temperatures, have affected forest health status in the Bucegi Mountains. Generally, health of forest stands in the Bucegi Mountains was below normal, with the share of damaged trees (crown defoliation > 25%) higher than 30% (30.7% in 2006, 30.6% in 2007 and 30.9% in 2008). The increased damage of forests had a strong influence on annual volume of trees. Growth losses for the entire research area were estimated to be ~ 33.0 %. The main forest species (*Picea abies, Abies alba* and *Fagus sylvatica)*, which were characterized by higher defoliation rate, had also lower annual radial increments compared with the tree species with lower defoliation rate. However, in general, no specific O_3-injury symptoms were detected on foliage of the main tree species in the Bucegi Mountains.

DIFFUSIVE SAMPLERS AS A SUITABLE TOOL FOR DETAILED AMBIENT OZONE EXPOSURE ASSESSMENT IN MOUNTAIN FORESTS. CASE STUDY FOR THE JIZERSKE HORY, CR

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Keywords: Ambient ozone, diffusive sampler, exposure maps

Introduction

To develop the ambient ozone surface in a higher resolution, providing a more accurate insight into the spatial ozone distribution pattern, more measuring sites are needed than are currently available. For such purposes diffusive samplers have recently been widely used in environmental studies (e.g. Krupa and Legge, 2000). We have been using the diffusive samplers for measuring of the ambient ozone levels in selected Czech mountain forest areas since 2004. The indicative measurements were set up in the Ceské Svycarsko National Park, Landscape Protected area Orlicke hory Mts. and Natural Park Novohradske hory Mts. in vegetation periods of 2004–2005. In 2006 we focused on Landscape Protected Area Jizerske hory Mts. where 13 sites covering the region as to the geography and altitude were set up. Temporal trends and space variability of mean 2-week concentrations were observed during 2006–2009 vegetation seasons. The results from the Jizerske hory are presented.

Methods

We set up 13 monitoring sites throughout the Jizerske hory Mts. covering 714–1000 m a.s.l. of altitude (Fig. 1). The samplers were placed in forest clearings. We used commercially available Ogawa samplers (Ogawa & Co., USA, Inc., Pompano Beach, Florida), which have been applied e.g. in the US (Cooper and Peterson, 2000; Bytnerowicz et al. eds., 2003; Yuska et al., 2003) and in the Carpathians in Europe (Bytnerowicz et al., 2002). The technique is based on the oxidisation of nitrite (NO_2^-) to nitrate (NO_3^-) on a filter and the calculation of the ozone available for the reaction. The NO_3^- formed on the filter is extracted with ultrapure water and measured by ion chromatography. The calculation of the ozone concentration for each site was based on the empirical uptake rate obtained from the results of the collocated (Fig. 2) real-time analyzer (Thermo Environmental Instruments TEI, M49 using the UV-absorbance method) and diffusive sampler at the Sous site. We measured two-week exposures.

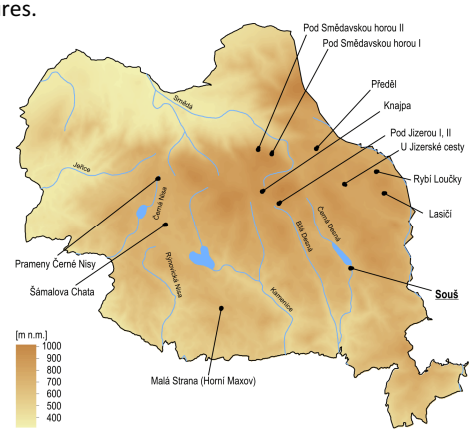

Figure 1. Spatial distribution of ambient ozone real-time monitoring sites (2007)

Figure 2. Collocated measurement of Ogawa sampler and real-time monitor

We estimated AOT40 for all diffusive sampling sites based on polynomial regression (Karlsson et al., 2002) formulated from the real-time UV-absorbance analyzer data recorded at the Sous site for the vegetation periods 2002–2007. The ambient concentration and AOT40 exposure index maps were prepared using the Inverse Distance Weighted (IDW) spatial interpolation technique (e.g. Isaaks and Srivastava, 1989) with a weighting grid corresponding to the regression coefficient for ozone concentration dependence on altitude. The interpolation has been carried out for the altitude of 714–1100 m a.s.l. The maps were prepared in a 50x50 m grid using a 25x25m DEM resolution. We used the ArcGIS Geostatistical Analyst (Johnston et al., 2001).

Results and discussion

Ambient ozone concentrations are highly variable in time and space and depend strongly on altitude. We found a significant ambient ozone gradient of 5.4 ppb and 4.0 ppb per 100 m difference in altitude in 2006 and 2007 respectively in the range of 370 and 1100 m a.s.l. Our results show that AOT40 threshold value is regularly exceeded over the entire area. The highest values are recorded in the upper portions of the mountains, where the threshold might be exceeded by as much as 12 times (e.g. in 2006), see Fig. 3.

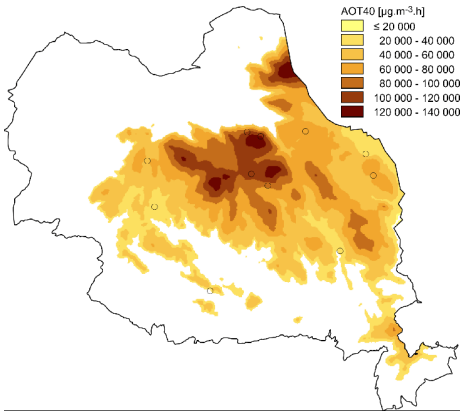

Figure 3. AOT40 calculated for 2006 vegetation season

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THE ATMOSPHERIC PARTICULATE POLLUTION RECORD OF MOUNTAIN LAKES IN THE ROMANIAN CARPATHIANS

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Keywords: lake sediments, human impacts, atmospheric pollution, mineral magnetism, heavy metals

Introduction and rationale
It has been widely recognised that mountain lakes can act as sensitive monitors of environmental change and human impacts due to their remoteness and their extreme climatic conditions. The Carpathian Mountains in Romania hold over 200 glacial lakes and transverse a region where there are considerable environmental concerns, but relatively sparse environmental data. However, despite a long tradition of palaeoecological study in the region, relatively little has been published on the alteration of their sediment characteristics due to recent human-induced environmental impacts.
Methodology and materials
This palaeolimnological study has sampled ten lakes in two of the highest sections of these mountains (the Rodna (Munții Rodnei) (n = 5) and Maramureş (Munții Maramureşului) Mountains) (n = 1) at their northernmost and the Făgăraş Mountains (Munții Făgăraşului) (n = 4) towards their southern limits in Romania respectively. Additional sampling has also undertaken at Lacul Sfanta Ana which occupies a volcanic crater in the Ciomad Massif in the Harghita Mountains in the central part of the Eastern Carpathians. Short lake sediment cores (via HTH gravity corer) sampled at high resolution (0.25cm) have been characterised both mineral magnetically (magnetic susceptibility (*X*) and remanence measurements) and geochemically (via microwave digestion and ICP OES), providing a country-wide assessment of the potential of these mountain lakes' sediment records as a retrospective monitor of diffuse atmospheric pollution.
Results and discussion
Rapid assessment via mineral magnetic characteristics suggests that recent, surface sediments have been affected by atmospheric particulate pollution associated with fossil fuel combustion and vehicle emissions. The distribution of metals (*e.g.*, Pb, Cu, Ni and Zn) in both contemporary (surface) and ancient (pre-industrial) sediments has also been assessed as has their down core depth distribution at selected sites. Metal enrichment factors for contemporary sediments also reveal that remote mountain lakes in the Romanian Carpathians have been impacted by the long-range atmospheric transport of metallic pollutants.
Some of the lakes in this study may ultimately be suboptimal as sites for recent palaeoenvironmental reconstruction (particularly those from the Maramureş region) due to the apparent post depositional disturbance (both natural and anthropogenic) of their sediments. However, elsewhere, initial findings suggest that they can provide lake sediment-based pollution histories that will thereby contribute to a fuller, Europe-wide understanding of the impact of atmospheric pollutants in upland regions.

BIOGEOCHEMISTRY OF A MOUNTAIN FOREST IN THE AUSTRIAN ALPS – "MÜHLEGGERKÖPFL"

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Keywords: N cycle, C cycle, spruce forest, North Tyrolean Limestone Alps

The intensive investigation site "Mühleggerköpfl" (920 m a.s.l.) in the Tyrol/Austria is a montane mature spruce-rich forest, where interdisciplinary forest research has been conducted since 1990.
The nitrogen cycle was measured in the field and further parameters were modelled, also with regard to climate change. Critical Loads of the nitrogen deposition are exceeded when the total deposition (wet, dry, and occult deposition) is taken into account. Especially at approx. 1800 m a.s.l. the amount of occult deposition (fog) amounts up to 25 % of the total deposition. At the intensive investigation site (920 m a.s.l.), the analysis of a long-term record of the nitrate concentration in the soil solution suggests a transient nitrogen eutrophication of the ecosystem. The nitrate concentrations were lowered again due to a high N demand when - under the canopy of the old spruce stand - a dense understory vegetation of beech and maple developed. According to a new? modeling study, higher temperatures and elevated nitrogen will increase the emissions of NOx and N2O as well as N-leaching into the groundwater.
Carbon cycle: Currently, the forest soil at the research site is a moderate C sink. The C fixation of the slowly growing forest is low and only slightly larger than the C release due to soil respiration. In a perennial climate manipulation experiment, the soil is artificially warmed by 4 °C. The warming enhanced the rate of soil respiration significantly and turned the ecosystem into a C source. About 2.8 t CO2 ha-1 yr-1 are released by soil respiration. About 12 % of the total annual soil respiration was released from the snow-covered soil.

LEACHING OF Ca^{2+} AND Mg^{2+} FROM SOIL OF GRASS AND FERN STANDS ON DEFORESTED MOUNTAIN SITES

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Keywords: lysimeter experiment; N fertilization; nutrient leaching; soil acidification

Grasses (*Calamagrostis arundinacea*, *C. villosa*) and, as well as, the tall fern *Athyrium distentifolium* form large stands on many deforested sites in Central European mountains. We wanted to know if in these stands, in comparison with bare forest soil, their soil environment is improved and base cations (Ca^{2+} and Mg^{2+}) leaching is lowered. To test this, free-tension lysimeters with growing grasses and ferns, and with bare forest soil were installed in field conditions in the Beskydy Mts. (the Czech Republic). The lysimeters were treated with 50 kg N ha^{-1} yr^{-1}. We monitored the pH, conductivity, and the amount of Ca^{2+} and Mg^{2+} in lysimetric water during several growing seasons. The presence of both growing grasses and ferns resulted in a decrease of both the acidity and conductivity of percolates. Losses of Ca^{2+} (about 10 kg ha^{-1} per growing season) from soil with grasses were less than a half those in the treatment without grasses. Similarly, calcium leaching (about 7.9 kg ha^{-1} per growing season) was three to five times lower from fern stands than from bare soil. Increasing input of N resulted in increasing acidity and conductivity of percolates and a greater amount of leached Ca^{2+} and Mg^{2+} from bare soil without both ferns and grasses. However, there was no increase in amount of leached Ca^{2+} and Mg^{2+} from soil with growing plants after N applications. These results indicate that stands of both grasses and ferns can improve soil environment through a slight decrease of acidity and conductivity of lysimetric water and they can partly eliminate losses of base cations (Ca^{2+} and Mg^{2+}) even from soil affected by higher N depositions.

Thematic session: Climate Change: Implications for Nature and Society

Chairs:
Anita Bokwa (Jagiellonian University, Poland),
Lola Kotova (Max-Planck Institute, Germany),
Zbigniew Ustrnul (Jagiellonian University, Poland

The session focuses on ongoing and future climate change at different vertical climatic zones in the Carpathian regions. Special emphasis is placed on the investigation of spatial and temporal climate trends of main meteorological and hydrological variables, for example temperature or precipitation. The objectives are to identify climate change indicators on the regional level, and to assess their impacts on nature and society of the Carpathian countries. Additionally, particular regional aspects of mountain climates could be discussed.

ORAL PRESENTATIONS

CLIMATE CHANGES IN THE VERTICAL ZONES OF THE WESTERN POLISH CARPATHIANS IN THE LAST 50 YEARS

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Keywords: the Western Carpathians, vertical climatic zones, climate change

The aim of the paper is the definition of the climatic variability tendencies in the particular vertical climatic zones of the Western Polish Carpathians. The original concept of the zones was established by M. Hess in 1965, but the observed climatic changes forced the need of the concept's update. The data used comprise main climatic elements (air temperature, precipitation, cloudiness, sunshine duration and snow cover) from the period 1951-2006, from 5 stations located in various points of the vertical profile, reaching from the Carpathians' foothills to the Tatra Mts. Summits:

Bielsko-Biała: 398 m a.s.l., 49º48'N, 19º00'E;
Kraków-Balice: 237 m a.s.l., 50º05'N, 19º48'E;
Zakopane: 857 m a.s.l., 49º18'N, 19º57'E;
Kasprowy Wierch Mt.: 1991 m a.s.l., 49º14'N, 19º59'E;
Katowice: 284 m a.s.l., 50 º 14'N, 19 º 02'E.

The focus was on the differences in the climate changes' rate and trends in particular vertical zones. From all mentioned climatic elements, mean annual air temperature is the most universal and complex index, well correlated with other elements in particular vertical zones. Figure 1 shows changes of mean annual air temperature at three stations, representing three different vertical zones:

1) the temperate cold zone: Kasprowy Wierch Mt. (mean annual air temperature in the years 1951-2006: -0.6ºC),
2) the temperate cool zone: Zakopane (5.3ºC),
3) the temperate warm zone: Kraków (8.0ºC).

All three series are well correlated (above 0,8) and in all three zones, the air temperature increase in the research period can be observed. However, in the highest zone the increase was the smallest. In Kraków, mean annual air temperature was rising 0.21K per 10 years, in Zakopane 0.20K per 10 years and at the Kasprowy wierch Mt. only 0.14K per 10 years. Additionally, in the highest parts of the Carpathians, the extremely cold and hot years occur in a bit different mode than in the lower zones. The lowest mean annual air temperature was noted in 1956: 6.3ºC in Kraków, 3.6ºC in Zakopane and -2.1ºC at the Kasprowy Wierch Mt., but in 1980 the value for the Kasprowy Wierch Mt. was equally low (i.e. -2.1ºC), while at other stations it reached 6.6ºC and 4.0ºC, respectively. A similar situation was observed in case of the highest mean annual air temperature. In 2000, it reached 9.9ºC in Kraków, 7.1ºC in Zakopane and 0.8ºC at the Kasprowy Wierch Mt., where the same value was noted also in 2002; in that year the value for Kraków was 9.5ºC and for Zakopane 6.6ºC. Probably the most significant environmental consequences are connected with the fact that at the Kasprowy Wierch Mt., mean annual air temperature exceeded 0ºC only 4 times in the 40-year period 1951-1990, and 6 times in the 16-year period 1991-2006. That can be a signal of a gradual, but inevitable warming in the whole vertical profile of the Polish Western Carpathians, connected with the shift of the vertical zones' borders and serious consequences for the mountain environment functioning.

The results obtained suggest that the magnitude of the air temperature changes may be more pronounced in the lower part of the vertical profile studied than at the mountain peaks. However, even though the air temperature increase rate is lower in the highest zone than in the lower ones, the environmental effects may be more serious.

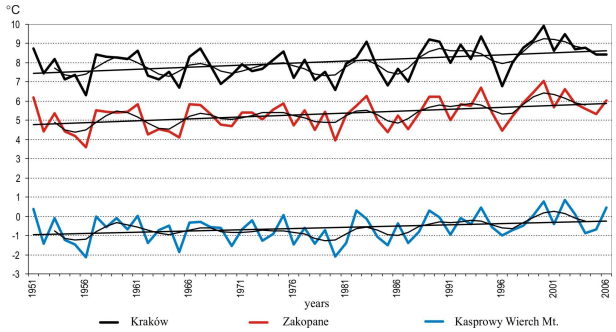

Figure 1. Mean annual air temperature in Kraków, Zakopane and at the Kasprowy Wierch Mt. in the years 1951-2006, together with 5-year Gauss filter averages and linear trend lines

SPATIAL AND TEMPORAL CLIMATE TRENDS IN SLOVAKIAN PART OF THE CARPATHIANS

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Keywords: air temperature, precipitation, trends, climate regions, climate scenarios

In this contribution temporal trends of air temperature and precipitation as well as the territorial shifts in climate regions in Slovakian part of the Carpathians during the 20th century and at the beginning of the 21st century are studied. Temperature series show an increasing trend at all meteorological stations in Slovakia. Climate in the southern part of the Slovakian Carpathians and in particular in adjacent lowlands (e.g. the Danubian Lowland) has become more arid, while, the northern part of the Slovakian Carpathians has become more humid during the 20th century and at the beginning of the 21st century. Climatic regions in Slovakia by the Köppen`s and Konček`s climatic classifications have been specified as follows. According to these two classifications some shifts in climatic regions towards the higher altitudes were registered in Slovakia during this period as well. Also selected results of climate-change scenario projection based on climate models (GCMs) outputs for the region of Slovakian Carpathians up to 2100 are outlined. Scenarios based on three GCMs show additional warming on this territory by 2 to 4°C at the end of the 21st century.

IMPLICATIONS OF CLIMATE CHANGE IN THE DEVELOPMENT OF WINTER TOURISM ACITIVIES WITHIN THE SKI AREA OF THE BUCEGI MOUNTAINS

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Keywords: climate change, snow layer, skiing activities, Bucegi Mountains

The present study refers to one of the most popular holiday destinations from Romania which is visited throughout the year, but rather well known for winter activities. These are the Bucegi Mountains. They are located in the Eastern end of the Southern Carpathians, have the shape of an amphitheatre orientated north – south with its opening towards the south. Regarding their winter-sports (mostly skiing) activities, they can be divided into two sectors: northwards of the Furnica peak, encompassing the Bucegi Plateau, the Babele area until the Omu Peak, where the afore mentioned activities are conducted in an unorganized manner – there are no clear delineated or groomed ski trails, which is the realm of free-riders and randoneé skiers and southward of the Furnica Peak until the Vânturiş Peak where on both sides of the mountain (western and eastern slopes) the ski activities are conducted in a semi-organized manner. This pertains to the best well-known ski area of the Bucegi Mountains administrated by the municipality of Sinaia. Winter sports have been practiced here since the 1920s, making it one of the first such resorts. Besides prestige, Sinaia profits from exploiting one of the highest ski domains in Romania. This ski domain is divided in two areas: westwards, where the altitude Valley called Valea Dorului is located (1800 to 2000 m altitude) equipped with one chair-lift and one drag and eastwards towards the city of Sinaia which has steeper slopes and a large variation in altitude. Here, part of the ski domain descends under 1500 m (the middle station being located at 1400 m) even to 900 m in altitude (with its latest development). It is an area endowed with three cable cars and one chair-lift.
The most precious asset in this industry is the persistence of the snow layer for more that 120 days with a depth of at least 30 cm. Its presence, its quality and its depth are all characteristics connected to other important climatic elements:

temperature variation, solid precipitation, wind speed and direction, snow-storms and of course on the other hand its economic management.
Within the last years of observations, by processing the data of the Bucegi Mountains weather stations (Omu Peak 2505 m, Babele 2200 m and Sinaia 1500 m), we detected an unequal repartition of the snow layer in altitude between years and between the same decades of different years. The unattended ski areas in the north, which are situated at higher altitudes (2200-2500 m) and which are rather remote in terms of access (there is only one cable car in the area) are endowed with the largest snow depth (largest average registered in April-May with more that 100 cm of snow) and the persistence of the snow layer from November up to May or even June in the glacial areas Omu-Bucşoiu, therefore in most years exceeds 200 days of snow-covered surface.
In the ski area of the Sinaia resort, the snow layer was traditionally a constant presence until the first decade of April down to the middle station. Unfortunately in the past years, as a consequence of climate change, of the warming tendency more accurately, the snow layer tends to disappear up to a month earlier 100 m above the middle station. This issue has important economic consequences for the whole 2.4 km ski trails that end at mid-mountain, making skiing rather uncomfortable for the tourists that have to go through the last 100 m (level difference) on foot or to resume their skiing only to the Dorului Valley.
Consequently, for a reasonable management of the problem we suggest a thorough analysis of the characteristic climatic elements in the frame of the present climate chance conditions. This means that on the basis of the processed data from the weather stations we can create a model of the present status and one based on the tendency of these elements based on the past 50 years of observations. These would allow investors to decide whether to start spending on snow-canons (if the average temperature will not exceed 0°C for the provisioned months of usage – the ideal temperature for the best quality artificial snow being between -7°C and -4°C) or to move the middle station 100 m upward and start expanding the resort towards the north of the massif where the altitudes are higher, but there is almost no infrastructure though before the 1990s, besides the existing cable car there were a couple of drags on the Bucegi Plateau.
Concluding, the present study will have put forth the consequences of the climate warming tendency regarding the most important economic activity of the area – winter tourism and would provide decision makers with the necessary material for planning future developments.

VARIABILITY OF AIR TEMPERATURE IN THE HIGH TATRA MOUNTAINS

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Keywords: air temperature trends, air temperature model, local factors, mountains

Air temperature at eight meteorological stations covering nearly the whole range of the High Tatra mountains altitude range and upper-air temperature measurements from the station Poprad were elaborated in period 1961- 2007. Homogeneity of temperature time series was checked by the standard-normal test. The upper air temperatures were interpolated to altitudes corresponded to ground stations.
In comparison with climatic normal period 1961-1990, increase in annual temperature of 0.16 – 1.0 °C was detected at all stations in both upper air and ground data in last years 1991 -2007. Significant 1961-2007 annual temperature linear trends in range of 0.21 - 0.34 °C /decade were found at investigated altitudes in upper-air data. The trends obtained from ground stations ranged from 0.01 to 0.30 °C /decade and they were insignificant at some places. Different trends were detected in particular months.
The higher range in trends or no significant trends at some places in ground temperature in comparison with the upper-air data indicate that some local factors manifesting close to the surface can mitigate the temperature increase. The aim of the contribution is to find the factors affecting local temperature trends using ancillary data (air humidity, radiative characteristics, and land cover) and simple modelling.

POSTER PRESENTATIONS

SPATIAL DISTRIBUTION OF THE PRECIPITATION IN SKALNATA DOLINA VALLEY, THE HIGH TATRAS, SLOVAKIA

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Keywords: mountain precipitation change, land cover zones, rain and snow seasons

The aim of this work is to investigate spatial distribution of the precipitation in mountain environment. Study area includes Skalnata dolina valley with size 6.5 km x 7.5 km and elevation 759-2635 m a.s.l. Long-term daily precipitation observations at stations Tatranská Lomnica (49°09'52´´N, 20°17'17´´E, 827 m a.s.l.), Skalnaté Pleso (49°11'23´´N, 20°14'09´´E, 1778 m a.s.l.) and Lomnický štít (49°11'43´´ N, 20°12'54´´E, 2635 m a.s.l.) were used for comparison between climate normal 1961-1990 and last decades 1991-2007 periods. Statistically significant polynomical regressions were applied in digital elevation model of study area by 3D surface mapping program Surfer. Summary statistics indicate increase of mean annual sum of precipitation over the last decades about 1-14% in dependence on altitude as well as on land cover. Obtained results show the highest precipitation enhancement at altitutes above 2 000 m a.s.l. (Fig. 1) Rainfall input into water balance of the tree zone (800-1500 m a.s.l.) during vegetation season (May-October) of last decades exceeds climate normal around 4-5%. Precipitation changes should be positive for revitalisation process in tree zone (800-1100 m a.s.l.) damaged by windstorm on November 2004. On the other hand, decrease of -5% for area with altitude <800 m a.s.l. and slightly increase of 1.5% for area with altitude 800-1100 m a.s.l. during colder months (November-April) suggest not appropriate conditions for development of ski industry resort situated near Tatranská Lomnica.

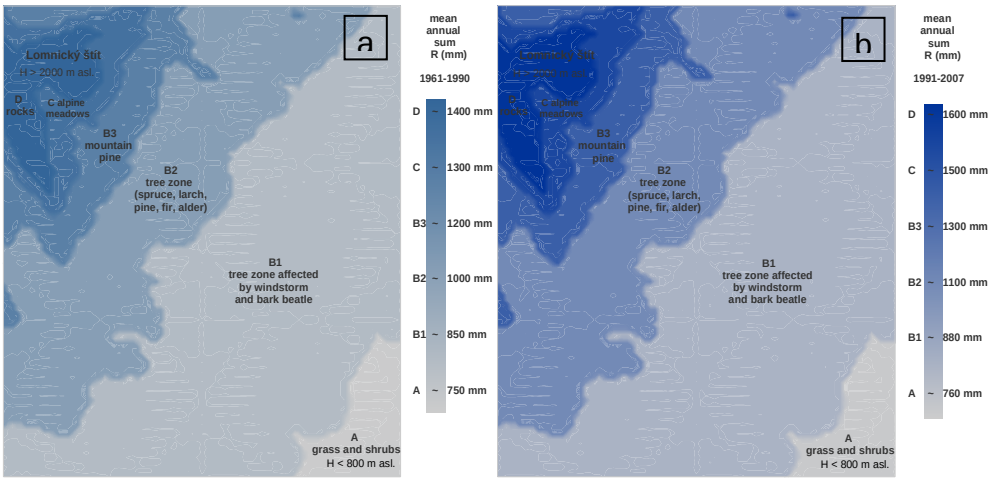

Figure. 1. Spatial distribution of mean annual precipitation R(mm) in Skalnatá dolina valley for climate normal 1961-1990 (a) and last decades 1991-2007 (b) periods

ARIDIZATION TRENDS FOR SELECTED METEOROLOGICAL STATIONS IN SLOVAKIA ON THE BASE THORNTHWAIT'S MOISTURE INDEX

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Keywords: Thornthwait's moisture index, aridity trends, increase of aridity, increase of humidity

The problem of drought and aridity of climate is very common issue in many countries at the present time and Slovakia is not an exception. In this paper the Thornthwait's moisture index is used as an indicator of aridity trends of climate. This index is based on relationship among water surplus, water deficit and potential evapotranspiration in the individual months with water surplus or deficit. This index is more exact in measuring of aridity of climate, because it considers evapotranspiration and not only the air temperature and precipitation. This type of calculations has not been used for region of Slovakia yet. In this paper eight meteorological stations with consider on their altitude and location in different

types of country (lowlands, hollow basins and mountains) were selected for the analysis. There are three trends of changing climate: increase of aridity, increase of humidity and climate without change. The growing of aridity is the most evident at stations Hurbanovo, Myjava, Sliač and Boľkovce. They are situated at the lowland and in the hollow basins in the south of Slovakia, and therefore they are in the precipitation shadow of surrounding mountains. On the other side, there are two stations in the north of the Slovakia with climate of increasing humidity. They are in the mountain region of the Carpathians, therefore they have more precipitation and lower evapotranspiration than three previous stations. The third trend, climate without changes in aridity, was recorded at the stations Kamenica nad Cirochou and Somotor in the east of Slovakia. It is interesting that despite Somotor is located at the lowland in the south of the Slovakia, its moisture index is not increasing. All cases of phenomena are analyzed in this paper.

THE WINTER CLIMATIC CONDITIONS FAVORABILITY FOR TOURISM DEVELOPMENT IN THE EASTERN CARPATHIANS. CASE STUDY: HARGHITA MOUNTAINS

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Keywords: ski slopes, global warming, Harghita Mountains, tourism, favorability

Having maximum altitudes of 2545 m (Moldoveanu Peak, Fagaras Massif, The Meridional Carpathians), with a complex structure of the underneath surface, responsible of the local climatic differences, also the multitude of the elementary and complex topoclimates (local climates), the Romanian mountain space possesses a medium potential for the winter sports development.
In the latest decade, along with the increasing requests in the field of services, connected to winter sports, the offer also rose. Thus, the chosen locations for the arrangements of the ski slopes became more numerous and used to spread in all the three branches of The Romanian Carpathians. In certain cases, the choice of the ski slopes locations was not correlated to the specific local climatic conditions of that place. In such situations, those who lose are both the users and the owners of that particular settlement and, nevertheless, the ecosystems themselves, as their naturalness is certainly damaged.
The purpose of the present study is to identify if – due to the general context created by the global warming – the existing slopes on the western side of The Eastern Carpathians, generally talking, as well as those in Harghita Mountains offer the opportunities for the development of some winter sports resorts, considered to have a national standard. Despite the fact they present important advantages (on the western side, the dominant specific area for a species is the one with the lowest temperature values, recorded during the winter ‹-35˚C›, being the minimum in January 2010; during November-April, the resorts Baile Harghita, Baile Tusnad and Baile Homorod, situated in the south-eastern and south-western parts of the massif, benefit by a considerable snow layer, a lot of mountainsides having different inclinations and favorable exposures), nowadays Harghita Mountains are known and capitalized in this way, specially on local bases. The research which generated the present study was fulfilled in two ways: a classical analysis based on numerous data registered at Miercurea Ciuc meteorology point and another one, based on digital modeling (SNHTHERM and GIS-ASTER).
The results of the research show that on the southern Harghita mountainside one can find the favorable climatic conditions to modernize the existing infrastructure, as well as those to create a new infrastructure for the winter sports, mainly for ski. Due to the relatively low altitudes of the resorts in Harghita Mountains, it is recommended that the ski slopes should be placed in forestry specific areas, also taking into account their importance in maintaining the snow layer for a long time.

AIR TEMPERATURE AND PRECIPITATION EXTREMES LONG-TERM VARIABILITY IN THE POLISH CARPATHIANS

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Keywords: air temperature extremes, precipitation extremes, long-term variability, Polish Carpathians

Introduction
The main objective of the research is to present the tendencies in air temperature and precipitation extremes variability in Polish Carpathians during the latest decades. The basic research material, daily maximum and minimum air temperature values and daily precipitation totals, was based on the data from 10 meteorological stations. The data covers the period of 56 years from 1951 to 2006. The extremes were identified by the probability approach. To differentiate the extremes the thresholds of 10% and 90% were applied that is the 10^{th} and 90^{th} percentiles respectively.

The data were analyzed regarding the long term variability of extreme values: minimum winter (DJF) and maximum summer (JJA) daily air temperatures as well as daily precipitation totals and the frequency of their occurrence within the period under examination.

Results

The analysis of particular extreme phenomena showed that they occurred at various moments from 1951 to 2006. Many extremes were recorded in the latest two decades (since 1990), however a considerable number of them have also been observed in the 1950s and 1960s. The obtained results show spatial differentiation of both extreme air temperature values and their long-term tendency. Summer maxima demonstrated statistically significant positive trends at five stations (the increase reaches about 1.0 day/10 years) whereas minimum winter air temperature extremes showed the slight decreasing tendency but at only two of the stations it is a statistically significant change. In case of precipitation extremes none statistically significant tendencies are observed.

Conclusions

The research proved that the region is characterized not only by the slight spatial differentiation of extremes especially regarding particular vertical zones. The same tendencies can be observed also all over the entire study area what means that they are mainly caused by mesoscale factors especially atmospheric circulation conditions.

The obtained results confirm also the small local differentiation of climate conditions and subsequently the problem of stations representativity, especially those used in extreme meteorological phenomena research

Thematic session: Conservation and Sustainable Use of Biodiversity

Chairs:
Per Angelstam (Swedish University of Agricultural Sciences, Sweden),
Lubos Halada (Slovak Academy of Sciences, Slovakia),
Katalin Mazsa (Hungarian Academy of Sciences, Hungary),
Lenka Stará (Academy of Sciences of the Czech Republic, Czech Republic)

The session focuses on the conservation and use of natural and cultural biodiversity, including the services provided by ecosystem. The Carpathian Mountains have unique natural and cultural biodiversity. The intact mountain forests and traditional village systems represent two complementary visions for biodiversity conservation. Biodiversity conservation can occur at different scales: from the protection of single species or viable populations, to the conservation of ecosystems or even the maintenance of resilient socio-economic and environmental changes in recent decades pose serious threat to biodiversity in the Carpathians.

ORAL PRESENTATIONS

BIODIVERSITY OF CARPATHIAN GRASSLANDS UNDER IMPACT OF SOCIO-ECONOMIC CHANGES

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Introduction

The grasslands generally contribute significantly to the biodiversity of rural landscape. In the Carpathians, this contribution is even more substantial than in other parts of Europe because of long-term continuity of low-intensity grassland management that is considered to be a typical feature of most valuable habitats of agricultural landscape (e.g. Ihse andLindahl 2000).

The increased need for meat and milk products in Europe after the World War II leaded to high pressure towards intensification of agriculture with significant impacts to grasslands, especially their conversion to arable land, intensification, drainage and pollution. During last few decades many grasslands lost their economic importance (provision of forage and/or fodder to livestock) and their management becomes more environmentally oriented. Currently we can record trend to polarisation of grassland use: intensive use of productive grasslands vs. abandonment of less productive or remote ones. The BioForum project (FP5, http://www.edinburgh.ceh.ac.uk/bioforum/) identified following main biodiversity conflicts related to grasslands in countries of Central and Eastern Europe: land use change, abandonment and natural succession, genetic pollution and introduction of non-native taxa (Halada et al., 2003). There are at least 4 reasons why to protect and maintain whole spectrum of Carpathian grassland types: their high biodiversity, productivity with low inputs; and because they represent the cultural heritage and form important part of the landscape character.

This paper highlights the biodiversity values of Carpathian grasslands, characterizes processes affecting grasslands in the Carpathians (illustrated by two case studies from Western and Eastern Carpathians) and discus ways for maintenance of their high biodiversity in the future.

Results

The Carpathians are typical by high diversity of grassland plant communities, documented e.g. by number of plant associations described for Romanian and Slovak Carpathians. They have usually natural species composition and high species richness - in mesophile conditions often occur grassland communities with more than 50 plant species per vegetation record. The nature conservation importance of Carpathian grasslands is documented by analysis of national red lists of Carpathian countries. The Carpathian grasslands host 40 species listed in the Habitat Directive Annex II), 11 of them are endemic to Carpathians. In total, 19 grassland habitat types of European importance (listed in the Habitat Directive Annex I.) occur in Carpathians.

Grassland abandonment and conversion to other habitat types between 1960 and 2000 resulted in decrease of their area by 0.3-3.0% in Czech Republic, Hungary, Poland and Slovakia; in Romania an opposite trend was registered – increase by 2.3%. The grassland area decrease was recorded also in 8 transects of project BioPress distributed across Slovakia - from more than 5.000 ha in year 1949 to 2.700 ha in 2003. During the same period in the Poloniny NP (NE Slovakia), area of extensively used grasslands decreased from 7.669 ha to 3.096 ha; 1.186 ha were converted to intensive grasslands and remaining area mainly to forests, arable land or they were overgrown by shrubs. The abandonment represents the main threat to semi-natural grasslands in Carpathians. In harsh mountain conditions the establishment of shrubs and trees in grasslands is often slow or blocked and grasslands persist for long time after abandonment. Our results from experiments in permanent plots in different grassland types in the Poloniny NP during years 1994-2009 indicate that species richness in abandoned plots is maintained, but quantitative changes in abundance of individual species are significant. This situation is probably temporally – grasslands abandoned for long time in the same or similar environmental conditions have species richness significantly lower than managed grasslands. Our attempt to restore species-poor abandoned meadow dominated

by *Calamagrostis arundinacea* was not successful: after 15 years of re-introduced management, no species returned to the community despite of diaspores source in close proximity.
The second case study is focused to consequences of agriculture changes to plant communities of fen, wet and mesophile grasslands in Liptov basin (N Slovakia) in period 1974-2003. In detail were studied changes of wet meadows of the community *Trollio-Cirsietum* (*Molinion*) under impact of several pressures, especially their direct destruction by conversion to arable land, intensification, drainage and abandonment. The absence of mowing leaded to accumulation of dead matter, soil enrichment by nutrients and shrubs establishment. Also large changes in the community structure were recorded: decreased abundance of species typicalc for permanently wet and fen meadows and increased abundance of seasonally dried, mesophilous and thermophilous meadows. During studied period, a large group of mesophilous and thermophilous species appeared newly in this community.
Discussion
Traditional methods of agricultural management that are favourable for maintenance of biological and landscape diversity belong usually to low-intensity land use types (Bignal et McCracken 1996, Plieninger et al. 2006). Significant transformation of agriculture took place in Central Europe during the second half of the 20th century; their negative consequences to the biodiversity of agro-ecosystems and landscape were documented by many studies (e.g. Linusson et al. 1998, Beaufoy 1998, Vos et Meekes 1999, Jongman 2002, Pärtel et al., 2005, Dajić-Stevanović 2008). The recognition of importance of rural agricultural landscape for biodiversity leaded to incorporation of Agri-Environmental Programme (AEP) to the EU agricultural policy. With accession to the European Union of majority Carpathian countries (2004 a 2007), the AEP was implemented in Carpathians as well. A short time of AEP application in Carpathians does not allow comprehensive assessment of their impact, but first experience is available. Their contribution is evident (especially restoration of management of grassland abandoned for long time), but also their limits are visible. For example, in each of 3 scenarios of future development prepared in the project BioScene (FP5; http://www.edinburgh.ceh.ac.uk/biota/bioscene_page.htm) is expected decline in number of patches for almost all types of grasslands (Halabuk et Halada 2006). As for grassland area, the scenario representing continuation of current trend expects moderate increase in area of majority grassland types, but significant decrease (-80%) in the area of mountain "poloniny" grasslands that are the most valuable for biodiversity. It is evident that more complex approach to grassland protection is needed, but no consistent strategy for grassland conservation exists currently. By our opinion, the AEP should represent a main tool for maintenance of grasslands in Carpathians, but it should be accompanied by other measures developed for High Nature Value Farmland areas and by measures of a state nature conservancy and NGOs. Some complementary activities could be implemented in framework of the land consolidation process and agro-tourism.
Acknowledgements
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POPULATION GENETIC VARIATION OF TWO NATIVE PINE SPECIES FROM THE CARPATHIANS SUGGESTS LONG TERM CONSERVATION ABILITY AND REFLECTS THE STRONG SURVIVAL POTENTIAL OF THE SPECIES

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keywords: *Pinus cembra*, *Pinus sylvestris*, chloroplast SSR, haplotipic variation,

The challenge to sustain biodiversity of the extreme ecosystems of the Carpathians inquires detailed knowledge of the species' history and the trails of the recent population structure.
Among the three *Pinus* species native to the Carpathians *Pinus mugo* is the only one that inhabits large territories and establishes zonal communities along the subalpine belt. In contrast Swiss stone pine *(Pinus cembra)* and Scotch pine (*Pinus sylvestris)* are considered to be remnant species, with small populations inhabiting only the extreme habitats. The once existed large distribution range of these two species became highly fragmented and because of the competitive exclusion, populations survived on isolated, specific habitats. The small territory of the habitats as well as the decreased population size made both species highly threatened along the Carpathians. Moreover, in consequence of the anthropogenic impact the native genetic material suffered strong erosion along the Carpathian habitats in the last centuries. The natural community structure was destroyed mainly by plantations and the extensive forest exploitations.
Beginning from the nineties izozyme studies and DNA based molecular analyses focused on the analysis of the population structure, in the aim to reveal the similarities and divergence between populations or to find relict populations worth to be protected. Most of the isozyme studies revealed generally high within-population variability and sometimes reported the selection of some allozymes proper to survive on specific habitat types (Szmidt 1982, Mátyás 2002, Belokon et al. 2005). Non-coding DNA markers like microsatellites (chloroplast SSR) supported the high genetic variability of the remnant, small populations and reported a generally decreased divergence among populations. The populations' genetic patterns allowed the delimitation of the genetic zones, refugee territories, and of the migration routes as well.

Although there are many similarities among the life traits of the two pine species each should be treated separately. *Pinus cembra* is a highly threatened species of the Carpathians. Populations inhabit the high mountains ecotones where forms mixed stands with spruce or may grow in clusters within the *Pinus mugo* stands or on rocky surfaces. Studies based on chloroplast SSR markers were conducted on populations native to the Carpathians and the Alps. The results showed that despite their low size Carpathian populations were able to maintain high haplotypic variation, even higher than Alpine populations. While the populations within the two parts of the species' range still share many cpDNA haplotypes, it is presumed that a common gene pool was conserved from a previously large, continuous distribution range(Höhn et al. 2005, 2009).
The chloroplast SSR analysis performed on *Pinus sylvestris* populations of very different habitat types revealed also high genetic variation within the stands. Although the populations originated from many types of ecological sites - most extreme raised bogs to dry sandy or rocky surfaces – they did not diverge strongly from each other and from the larger Scandinavian stands (Höhn et al. 2010).
According to the above listed results we have to conclude that these pine species are able to maintain a stable, long-term population structure even along a fragmented habitat network. The population decline only appears when the habitat availability decreases beneath a critical value.

EUROPEAN BISON HABITAT AND METAPOPULATION VIABILITY IN THE CARPATHIAN MOUNTAINS

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European bison (*Bison bonasus*) barely escaped extinction in the early 20th century and now only occur in small isolated herds scattered across Central and Eastern Europe. The species' survival in the wild depends on establishing bison metapopulations via enlarging current herds and additional reintroductions. The Carpathian Mountains are Europe's largest contiguous stretch of temperate forest and may be one of the few places that could support a large bison population. Our goal was to assess European bison habitat and population viability across the entire ecoregion to analyze the connectivity among bison herds and to inform reintroduction efforts. We used maximum entropy modeling to analyze bison habitat use data and to map European bison habitat suitability across the Carpathians. The habitat map was input for a spatial population model (RAMAS-GIS) to analyze the population viability of Carpathian European bison herds and to evaluate different management scenarios. Our results showed that bison prefer mosaic-type landscapes of forest and grasslands. Abundant suitable bison habitat occurred in the Carpathians, most of which is unoccupied. The population viability analyses showed that bison populations could grow substantially, mainly in Ukraine. Our analyses also showed that barriers, most notably north-south running major highways, isolate existing European bison herds and will prevent natural dispersal into a major fraction of the Carpathians. Reintroductions in Romania as well as softening of dispersal barriers (e.g., via wildlife corridors and highway over-passes) could greatly increase population viability. The Carpathians are one of the view places where a viable Carpathian metapopulation could be established, especially if recent trends of declining human pressure and reforestation of abandoned farmland continue. Establishing the first European bison metapopulation would be a milestone in efforts to conserve this species and other large carnivores and herbivores in the wild and demonstrate a significant step towards restoring the ecological roles of large grazers in human-dominated landscapes across the globe.

CONSERVATION AND RESEARCH IN SEMI-NATURAL FORESTS: STRICT FOREST – RESERVES IN HUNGARY

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In the nineties, a national forest reserve network was established (similarly to other European networks). It consists of 63 forest reserves, which represent the most characteristic (semi-natural) forest types of Hungary and the Carpathian Basin (Pannonian ecoregion): riverine and swamp woodlands, mesic deciduous (oak, oak - hornbeam or beech dominated) woodlands, closed & open dry deciduous (dominated by dry-tolerant oaks) woodlands, and rocky mixed forests. The total extent of the strictly protected core areas are cca. 3600 hectares, surrounded by protected buffer zones (cca. 12.000 hectares all together). Forest stands of the core areas are more or less matured or old-growth ones, unmanaged since several decades. They have been withdrawn of management by law, let to develop the ecosystem freely without direct human intervention. The aims of the Forest Reserve Program of the Ministry of Environment and Water (MEW) are basically twofold: a) to ensure conservation of natural/seminatural forest stands, b) to get new sound knowledge, as natural reference about the biodiversity, stand structure and ecological processes of our forest ecosystems.

The development of Long Term Forest Dynamics & Ecological Observation Network of Natural Forests (FOREST+n+e+t) has been started within forest reserves in 2005. It is a grid system of permanent sampling points set up in forest stands of selected core areas, where standard & modular inventories started. The aim is to describe: forest stand, shrub layer, regeneration layer, ground vegetation and site (soil) conditions as base.
The research team of the IEB HAS coordinates the inventory of Hungarian forest reserves and carries out more detailed research in the Vár-hegy Forest Reserve (Bükk Mts., Hungary) Recently the following projects were running based on "FOREST+n+e+t" inventory data:
investigating forest stand compositional and structural changes after 30 years after the large scale oak decline in the 1970/80-s (partly in cooperation with the Síkfőkút Project, Hungarian LTER);
reconstruction of stand development in the previous 130 years (management period) based on land-use history documents and field surveys of forest stands;
estimation of carbon stored in forest biomass (and soil), adaptation and parameterisation of the CO2FIX carbon sequestration model for near-natural, uneven-aged, mixed forests.
The aim of the presentation is to overview the sites, the "FOREST+n+e+t" inventory concept and recent projects of IEB HAS of the Hungarian forest reserves.

Acknowledgements
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THE METHODOLOGY FOR THE INTEGRATED ASSESSMENT AND MAPPING OF THE APPROPRIATENESS FOR ASSIGNING PROTECTED STATUS FOR THE SITES IN THE UKAINIAN CARPATHIANS

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Keywords: habitat diversity, topographic variance, NDVI, Ukrainian Carpathians

Introduction
The natural preserves and other categories of protected areas are characterized by restrictions placed on land utilization and certain kinds of economical and social activities. So far as this places a certain burden on society, the placement of such areas should be based on sound methodology, minimizing such a burden, while maximizing the efficacy of their establishment and functioning towards their aims. The Article 8 of The Convention on Biological Diversity requires for each contracting party to develop guidelines for the selection of protected areas or areas where special measures need to be taken to conserve biological diversity.
There are two major kinds of purposes such areas can serve, namely: 1) the protection of single endangered, rare, endemic or otherwise valuable species or a small collection thereof; and 2) the protection of the whole biological communities, ecosystems, natural landscapes, and valuable combinations of natural and cultural features and practices. When the first kind of purposes are the main focus, the ambit of the protected area should be based either on the observed range of species or on the predictions of models of their potential habitat. When the second kind of purposes are mostly pursued, the aim is not so clear, thus there are no definite criteria for the placement of protected areas.
One of the possible criteria for the selection of the sites most appropriate for protected status could be the habitat diversity and richness. Plant and animal habitats are characterized by the sets of indirect, direct and resource environmental gradients (Austin and Smith 1989). The local habitat diversity is mostly determined by abiotic factors like soils, microclimate, hydrologic conditions, etc. These factors are by turn often regulated by topographic differences.
The other criteria for the designation of sites for protected areas could be the overall “naturalesness” of the site conditions measured by the ecosystem species richness, primary production, the proportion of area covered by natural vegetation, etc. The respective sites are characterized by a smaller degree of antropogenic disturbances, more intact biota, and are often less suitable for agriculture and other intensive uses, lessening the costs needed to compensate current land users to restrict their nature-disturbing activities.
The methodology is proposed to integrate these two criteria with the aim to arrive at an integral many-sided assessment and mapping of the appropriateness of the sites for their designation to multipurpose protected areas. This methodology has been applied to identify the areas in Ukrainian Carpathians most appropriate for their designation as protected areas.

Materials and Methods
Two sources of digital data have been used in the study: 1) the SRTM digital elevation model (DEM) with 90 m spatial resolution; 2) LANDSAT 7 ETM+ multiband image with 30 m resolution from an on-line USGS archive. These data were projected to a common coordinate system, and LANDSAT image has been resampled to 90 m resolution.
DEM was used to obtain the three measures of habitat diversity: 1) the variance of elevation (measured in local window); 2) the variance of slope values; 3) the relief horizontal dissection and aquatic habitat richness measured by a local density of stream network. The local variance of elevation and slope values are indicative of the diversity of local climatic and insolation conditions and indirectly indicate the diversity of geological structures and processes with according diversity in

soil edaphic and hydrologic properties. The stream network density was derived using the method described by (Montgomery and Foufoula-Georgiou 1993), wherein the variable flow-accumulation area thresholds are calculated using slope raised to a power. There are a number of studies proving the relationships between the measures of topographic variation (TD) and the measures of biodiversity (Hofer et al. 2008; Tang et al., 2006).

LANDSAT image has been used to obtain Normalized Difference Vegetation Index (NDVI), commonly used to indicate the photosynthetic capacity of plant canopies and the concentrations of green leaf vegetation. It is calculated by the formula

$$NDVI=\frac{NIR-RED}{NIR+RED}$$

where RED and NIR are the spectral reflectance measurements acquired in the red and near-infrared regions, respectively (Rouse et al. 1973). There are studies showing the relevance of this index as an indicator of the biodiversity potential. (Bawa et al. 2002; Oindo, de By and Skidmore 2000).

It is known from landscape-ecological studies that different species are functioning in different spatial scales; therefore landscape management should comprise different scales, each one pertinent to a certain set of species (Mc Garrigal, Marks 1994). Wiens shows examples when changes in scale affect the size and even the sign of habitat relationships and interspecific associations, concluding that scaling issues are fundamental to all ecological investigations, as they are in other sciences (Wiens 1989). Processes determining and influencing most ecological factors often also show scale-dependency (Levin 1992, Blöschl 1995, Clark 1985). Thus, the evaluation of the afore-mentioned criteria should take into account different scale domains in the landscape. This was achieved by the calculation of measures of habitat diversity and richness in series of local neighborhoods with different window sizes, each being a triple of its predecessor, namely: 270*270 m, 810*810 m, 2430*2430 m, and 7290*7290 m. Then the average among all scale levels was used as a value to be entered into the model. NDVI has likewise been averaged among these scale levels, and the average thereof has been calculated.

At the final stage of the modeling, the three measures of habitat diversity were standardized (subtracting the minimal value and then dividing by the maximum one) to a scale of [0;1] and then summed to arrive at the integral measure of habitat diversity. This was then multiplied by a standardized NDVI measure to obtain a final assessment.

Results and discussion

The resulting map (Fig. 1) shows a distinct pattern: the appropriateness is higher in mountains then on adjacent plains. The largest values of the appropriateness index are observed on south macroslope of the Polonynsky range, characterized by the highly dissected relief with a big variance of altitudes and covered by rich beech and mixed forests. The second most appropriate region is Vygorlat-Guta low-mountain range made up of volcanic rocks. The third most appropriate region is the northern macroslope of the Skybovi Carpathians, made up of flysch rocks and covered with mixed forests.

The sites with the highest values of the appropriateness index lie mostly on both slopes of the transversal valley in south-western part of Ukrainian Carpathians, known as Perechyn-Lypha natural region (Herehchuk, 1981) (Fig. 2). Of all the administrative regions of Ukraine, Transcarpathian region has by far the largest area of the sites most appropriate for assigning a protected status.

The proposed methodology should be regarded as tentative, as it can be improved by elaborating the criteria of habitat diversity and richness, as well as the rules or their aggregation to better meet the aims of nature conservation.

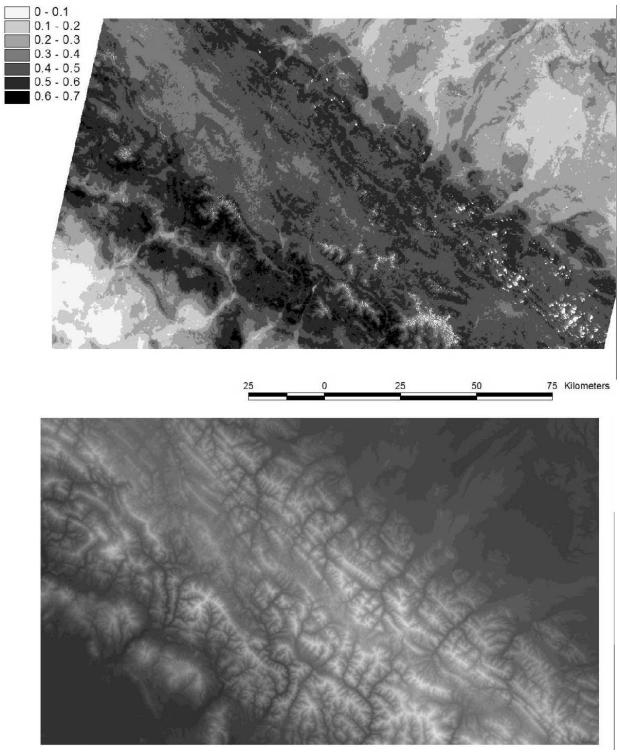

Figure 1. The index of the appropriateness of the sites in Ukrainian Carpathians for their designation to multipurpose protected areas (above); the relief of the same area (below)

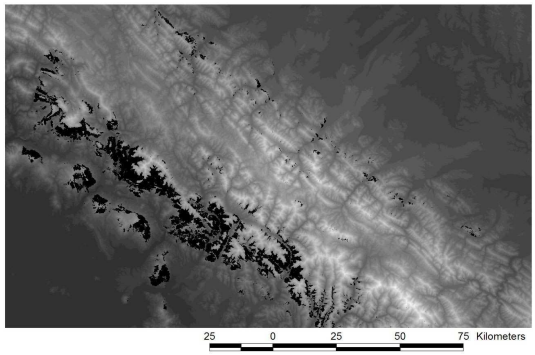

Figure 2. The most appropriate sites for nature-conservation activities (shown in black)

POPULATION VIABILITY ASSESSMENT OF NARROW ENDEMIC *DIANTHUS CALLIZONUS* FROM PIATRA CRAIULUI MASSIF (THE ROMANIAN CARPATHIANS)

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The perennial *Dianthus callizonus* Schott et Kotschy (the "carnation of Piatra Craiului"), family *Caryophyllaceae*, is confined to a small area (Piatra Craiului Massif), growing on screes and alpine and subalpine meadows, on calcareous substrate. *D. callizonus* is a rare and endemic species, has a limited patchy distribution (at the local to regional scale) from the high-alpine to the subalpine zone of the Piatra Craiului Massif.

Studying the geographic and ecological distribution of the species in the Massif and also the integrative plants associations, we demonstrated that the expansion and growth of *Dianthus* ramets in space depend on local resources and on particular protective plant associations. These island-like patches are regarded as interdependent fragments (demes) of a population.

AFLP analysis demonstrated that the genetic diversity is high among sub-populations/demes of *D. callizonus* population, in spite of a very fragmented habitat. There is a gene flow (through seeds and/or pollen) between fragmented sub-populations due to individuals (genets) scattered between larger patches that act as sink source. The gene flow is rather high due to these individuals that act as links. This species seems to not be threatened by genetic drift, probably due to high longevity of the individuals reacting slow at the environmental changes. It have been applied also the metapopulation

concept; the habitat fragmentation process and the low stability of the habitat increasing the fragmentation of the population.
In Piatra Craiului, *D. callizonus* finds conditions that are somewhat different to those that apply to surrounding alpine areas, with a warmer climate (because to its position on limestone in the Bârsa depression). *D. callizonus* has a different life-span comparing with its relatives, and has remained in the area, isolated as on an island. It is supposed that the species arose in the Tertiary and occupied the present distribution area, whence it became isolated with the uplifting of the Leaota and Iezer mountains and with the submerging of the peri-montane areas and the formation of the Bârsa depression. Due to the disjunction of its distribution area and geographic isolation, *D. callizonus* remained in the Piatra Craiului Massif, which behaved rather as a nunatak during a glacial age. In the surrounding areas, *D. callizonus* disappeared during the Pleistocene glaciations. Taken together, the evidence of diploidy, the geographical and ecological distribution patterns lead to the conclusion that the area of the Piatra Craiului Massif from Romanian Carpathians acted as glacial refuges for populations of endemic *D. callizonus* species.
Multivariate statistical analysis of the integrative plants association for this species revealed that Piatra Craiului Massif is well individualized and separated from the other mountainous Massifs from Romanian Carpathians. The oneness of Piatra Craiului Massif is given by the fact that it is isolated (like an island) in Bârsa depression, here have been formed and evolved the most Carpathians endemics. Even some plants associations are endemic in Romanian Carpathians; the mountain ranges where they are distributed are conservative regions and florogenetic centres. The characteristics of the floristic composition of the integrative plants associations of endemic *Dianthus* species show the complexity and the differentiations of the environmental conditions at local and regional scale.
The population dynamic and life cycle studies of perennial D. callizonus species have been very difficult to realize in the field. Therefore we can argue that the study is not finished yet. The population dynamic is varied according with habitat and environmental conditions. High number of new ramets represents the entering of new individuals in population (vegetative multiplication). The life cycle of this species determinate the persistence of the population in the Massif, in spite of increased natural and especially anthropic impacts. The existence of small areas not affected by tourisms and grazing where genets of *D. callizonus* can survive induces the existence of the population at the level of the entire Massif.
Experiments developed regarding the entrance of new individuals through seed germination revealed that the number of germinated seeds is low. Also the seeds of this species needs light and quite acidic pH (5.8), demonstrating that *D. callizonus* germinates and develops in meadows and fixed/semi-mobiles screes; the integrative plants associations playing an important role in forming and transforming the soil.
In *in situ* conditions, without *ex situ* experiments, it have been very difficult to establish if the small young ramets developed from seeds or they are vegetative buds developed on underground shoots, therefore we considered all young aerial shoots as individuals entering in the population. Exits from population have been considered all damaged aerial shoots (grazed, affected by fungi, trampled, etc). The impact of grazing is high in the studied areas. The juveniles' aerial shoots (0.3-4 cm height) are very sensitive to fungi and they die without reaching the maturity.
Applied to *D. callizonus,* the metapopulation concept stimulated studies on regional/large-scale population dynamics, the dynamics of species interactions, and the effect of habitat fragmentation on biodiversity. These leads to proper management strategies for the continued survival of this narrow endemic and relict species, brought together in cohesive practical conservation applications.

MACROFUNGAL REFUGEES IN THE EAST CARPATHIANS, TRANSYLVANIA, ROMANIA: OLIGOTROPHIC PEAT-BOGS

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Keywords: East Carpathians, macrofungi, peat-bogs

Several oligotrophic peat bogs have formed in the Eastern Carpathians between 900-1200m altitudes above sea level. These bogs can be characterized by stands of Sphagno-Betuletum pubescentis, Pino-Sphagnetum magelanicii and/or Eriophoro vaginato-Sphagnetum recurvi-magellanici plant associations, encircled by Sphagno-Piceetum stands. Dominant tree species in these stands are Betula pubescens, Pinus sylvestris, respectively Picea abies. In the under layers several Sphagnum species are dominants, together with Polytrichum and Vaccinium species, as characteristic ones. The special characteristics of these peat-bogs are low temperature and pH, wet and oligotrophic conditions, resulting unique habitat type for macrofungi.
Systematic field surveys have been made from 1998 up to now in order to investigate the macrofungi of these special habitats in 5 peat-bogs in the East Carpathians: Poiana Stampei (700 hectares; 880m altitude); Sfînta Ana Lake (small circle around the lake, 950m altitude); Comandău environs (9 hectares; 1017m altitude); Mohoş (30 hectares; 1050m altitude); Luci (120 hectares; 1079m altitude). The species recorded were documented with fungaria and/or photo, in many cases with description, too.
As a result of the total 31 field surveys 186 species were documented with 533 occurrence data from the territories. The richest habitat was Sphagno-Piceetum with 335 occurrence data of 160 macrofungi species.

Several species documented can be regarded as common in these habitats, occurring mainly in Sphagnum bogs: Galerina paludosa (Fr.) Kühn., Lactarius bresadolianus Sing., Lactarius glyciosmus Fr., Pholiota scamba (Fr.:Fr.) Moser in the Sphagno-Betuletum pubescentis stands; Cortinarius (Derm.) palustris (Mos.) Mos., Cortinarius (Derm.) tubarius Ammirati & Smith, Hebeloma longicaudum (Pers.:Fr.) Kumm. ss. Lge., Hypholoma udum (Pers.:Fr.) Kühn., Omphalina sphagnicola (Berk.) Moser in the Pino-Sphagnetum magelanicii stands; Calocera furcata (Fr.) Fr., Elaphomyces granulatus Fr., Laccaria proxima (Boud.) Pat., Lactarius lignyotus Fr., Lactarius trivialis Fr., Mitrula paludosa Fr., Onnia tomentosa (Fr.) Karst., Russula amoenicolor Romagn. in the Sphagno-Piceetum stands.
Several rare and endangered species occurred, too: Amanita regalis (Fr.) Michael, Cortinarius armillatus (Alb. & Schwein.) Fr., Cortinarius muscigenus Peck, Lactarius picinus Fr., Leccinum vulpinum Watling, Leccinum variicolor Watling, Leccinum holopus (Rostk.) Watling, Pholiota astragalina (Fr.) Singer, Pholiota flammans (Batsch) P. Kumm., Pseudohydnum gelatinosum (Scop.) P. Karst., Russula claroflava Grove.
It must be mentioned the occurrence of several rare Hydnellum species, too: Hydnellum suaveolens (Scop.) P. Karst., Hydnellum geogenium (Fr.) Banker, Hydnellum peckii Banker, Hydnellum scrobiculatum (Fr.)Karst.; as well as Catathelasma imperiale (Fr.) Singer, a species rare in European level, and the first occurrence of Lactarius fennoscandicus Verbeken & Vesterh. in the Carpathians.
The functional composition of the fungal communities is very characteristic, differing significantly from the functional spectra of the zonally developed deciduous and coniferous forests. The most important function seems to be the mycorrhizal (63%; 117 species). The percentages of the other groups are much lower. It must be mentioned the moss-associated species (3%; 5 species), not characteristic to other woody habitats.
Many of the species documented are connected exclusively to the oligotrophic peat bogs so these habitats represents refugees for these macrofungi. Long term aims of investigations are the inventarisation of macrofungi of peat bogs as well as their characterisation both in qualitative and quantitative points of view.

CARPATHIAN CATCHMENTS AS LABORATORIES FOR KNOWLEDGE PRODUCTION TO SUPPORT IMPLEMENTATION OF THE EU WATER FRAMEWORK DIRECTIVE

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Keywords: ecological integrity, EU Water Framework Directive, landscape laboratories, integrated landscape approach, gap analysis.

The EU Water Framework Directive (WFD) prescribes that water bodies should have a good ecological status. This is defined as that biological and chemical characteristics should represent ecologically sustainable ecosystems. To implement this vision, actors and stakeholders at multiple levels and sectors involved with catchment management need to be equipped with appropriate ecological knowledge, as well as practical and reliable tools for on-the-ground policy implementation. Based on the concept ecological integrity, and inspired by both top-down hierarchical forest sector planning, as well as collaborative and communicative bottom-up participatory approaches, we present a step-wise iterated approach to support the implementation of good ecological status of riverine landscapes. This is consistent with a proactive adaptive policy cycle approach that links policy, governance, management, monitoring and assessment within entire catchments. At the strategic planning level, regional quantitative gap analysis is a tool for assessing the extent to which ecological integrity is maintained by appropriate combination of protection, management and restoration of representative habitat types in an ecoregion. A second tactical level tool is Habitat Suitability Index (HSI) spatial modeling that combine quantitative knowledge about focal species' requirements and the spatial distribution of resources into maps for visualization and scenario building. This allows both for assessment and subsequent spatial planning at different scales and time horizons. These two steps guide operational management needed for the protection, maintenance and restoration of ecosystems at instream, riparian and landscape scales.
There is, however, a mismatch between the need for this kind of systematic planning approach and reality. Thus, monitoring programs and performance target for assessment need to be in place, and tools for adaptive governance and management towards ecological integrity by various formal and informal organizations need to be developed. In addition to hierarchical planning, participatory approaches that include relevant actors and stakeholders and enhance communication and collaboration are needed.
To fill knowledge gaps about performance targets and tools for adaptive governance, applied interdisciplinary research is needed, which must become systematic in two dimensions. First, reference landscapes with ecological integrity should be compared with altered systems to determine how much are enough of different structures and processes to secure viable populations of species used as indicators, and thus operationalise the terms good ecological status and ecological integrity. Second, the idea that analytic deliberation, nested institutions and institutional variety open up for continuous experimentation, learning and change in society needs to be evaluated by studies of local and regional governance arrangements' ability to deliver good ecological status as prescribed by the EU WFD.

Implementation of policies about conservation and restoration of aquatic ecosystems requires rapid biodiversity assessment methods. First, there is a need to evaluate the usefulness of indicators for rapid assessment in gradients from reference conditions for ecosystem functionality to anthropogenically disturbed sites. Second, the functionality of indicators should be evaluated with respect to how the results from monitoring could be communicated to and used by different societal actors. The landscapes of the Carpathian Mountains of Central Europe, spanning a steep gradient of land-use intensity, offer unique opportunities for evaluating such methods. This ecoregion was selected because of a large variation in the environmental history of forest and agricultural ecosystems among neighboring countries, thus providing a suite of unique landscape scale experiments.

First, we compared landscape composition, riparian vegetation and instream habitat characteristics with stream macroinvertebrate assemblage structure in 25 catchments located in the Eastern Carpathian Mountains in Central Europe. Loss and fragmentation of forests were major threats to ecological integrity. Our findings suggest that governance and management at the catchment scale is needed for efficient conservation and restoration of stream invertebrate communities. To satisfy the EU Water Framework Directive's objectives of good ecological status, the requirements of stream ecosystems' composition, structure and function to secure ecological integrity need to be quantified. Carefully designed habitat-species dose-response studies covering the gradient from reference landscapes to severely altered landscapes are an important next step.

Second, we evaluated three approaches for assessing macroinvertebrate species richness in second and third order streams: (1) the use of data at higher taxonomic levels, (2) the use of species-level data, and (3) the use of abundance data. The number of families was a reliable indicator of species richness within EPT, suggesting that analyses focusing on that taxonomic level could offer a cost-efficient alternative to species-level assessments. Species richness of Trichoptera was strongly correlated to species richness in Ephemeroptera and Plecoptera, and thus in the EPT group as a whole, whereas species richness in Ephemeroptera and Plecoptera did not perform as well. We found little evidence for the usefulness of abundance data as a surrogate for species richness, except within Plecoptera. Taxa richness in EPT was generally positively related to forest cover in the catchments and negatively related to the proportion of agricultural land.

Finally, we tested the hypothesis that Plecoptera is a suitable bioindicator for intact ecological integrity of catchments by comparing the abundance and numbers of taxa of Plecoptera and forest proportions in the catchments and by logistic regression identify thresholds associated to forest proportion as a surrogate for catchment integrity. Plecoptera abundance and Plecoptera taxa richness were positively correlated to each other as well as to forest proportion in the catchments, but negatively correlated to catchment area, inorganic carbon, alkalinity and conductivity. Abundance gave a higher rate of correct classifications of catchments' with high forest proportion compared to taxa richness. Considering this and that counting Plecoptera individuals is easier for non-experts than recognizing different Plecoptera taxa, abundance was chosen as indicator. This dose-response study of habitat characteristics and Plecoptera abundance indicates that this group is an effective bioindicator in headwater catchments for predicting the ecological status of headwater streams. A decrease of catchments' forest proportion below 79% should definitively reduce or affect Plecoptera abundance and taxa richness in second order streams.

An indicator system suitable to support implementation of the EU Water Framework Directive's local water management plans should build on a suite of well-documented indicator and umbrella species for different stream orders. Further studies are required to validate these results in landscapes of other regions and to develop methods to effectively communicate the requirements of indicator taxa to managers and stakeholders in headwater streams. Assuring high communication value of ecological indicators, and collaborative spatial planning using an integrated landscape approach for restoring ecological integrity in impaired headwater streams to whole drainage basins are critically important challenges to be solved.

TREE-SPECIES INFLUENCE TO THE HERB LAYER OF FIR-BEECH FORESTS

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Keywords: herb species, vegetation change, tree influence potential, *Fagus sylvatica*, *Picea abies*, *Eu-Fagenion*, Central Slovakia

The biodiversity became one of the central topics of biology and ecology (Ehrlich, Wilson 1991, Vačkář ed. 2005, etc.) after a dramatic global increase of species extinctions caused by human activities. Large forest areas in the Western Carpathians still cover natural species diversity, which is in contrast with the situation in cultivated agricultural landscape in present cultural period (Bakker 2006). However, management of forests also affects species diversity of extended areas. Intensive forest utilization can lead to a rapid diversity decline on the landscape level, as observed in the Czech Republic (Fanta 2007) or Finland (Pitkänen 1998). To find the balance between profitable management and diversity conservation is the goal of modern sustainable forest management. Ecologists and forest managers need measures of success or failure of management regimes designed to sustain species diversity (Lindenmayer et al. 2000).

Herb layer is not a direct subject of forest management. Thus, its composition is used for the permanent site properties indication (Zlatník 1976). However, indirect effect of changing stand structure and especially by the change of tree

composition was frequently observed. Serious decline of originally common and typical species is documented after massive conversions of broadleaved forests (Petříček 1999). Some studies depicting the change of herb layer in secondary coniferous forests are published from Slovakia recently (Máliš 2009, Križová et al. 2007). Influence potential of particular tree species was studied by Saetre (1999) and Kuuluvainen, Pukkala (1989) with the background of Ecological field theory (Walker *et al.* 1989).

The aim of our study is: to prove if and how tree-species change affect the species composition of the herb layer; to find relations between particular tree and herb species; to quantify changes of herb layer between natural and commercial forest and to find the indicators of this change.

Dobročský prales National Nature Reserve and its buffer zone was selected as an ideal model area. It represents the most widespread case of tree-composition change in Western-Carpatian mountain ranges – replacement of mixed fir-beech forests by spruce plantations. The reserve is situated on the granite bedrock of the Veporské vrchy Mts. in the Central Slovakia (Western Carpathians) on mild northern slopes of cca 900 m a.s.l. Herb-rich communities of the reserve belong to the *Dentario enneaphylli-Fagetum* association. They are dominated by beech (*Fagus sylvatica*) and fir (*Abies alba*), with a regular admixture of sycamore (*Acer pseudoplatanus*), rarely also with spruce (*Picea abies*), elm (*Ulmus glabra*), ash (*Fraxinus excelsior*) and maple (*Acer platanoides*). Complicated structure of developmental stages is developed. It sharply contrasts with even-aged commercial stands in the surroundings. There are mostly spruce plantations, partly beech and mixed stands, cca 80 years old, with closed or locally opened canopy.

Two 20 m wide belt transects were led perpendicularly to the reserve borders, comprising approximately the same part in the reserve and outside. On 94 square sample-plots of 2.25 m^2 in 13m span, vascular plant presence and cover was recorded within nine 0.25 m^2 subplots, along with registration of tree rejuvenation abundance. Plot positions, tree positions and diameters in 1.3m height (DBH) were measured in the whole transect using the FieldMap technology (IFER 2008). For each plot we calculated tree influence potential index (IP) reflecting both density and size of trees in its neighbourhood (Saetre 1999), defined as 10m circle: $IP = \Sigma\ DBH \cdot e^{(-c \cdot r)}$, where r is the distance from the centre of the plot and the tree. Species frequencies and several dendrometric variables were calculated. Direct gradient analysis RDA within the Canoco (ter Braak, Šmilauer 2002) was used to find relation between dendrometric variables and herb-layer species. MonteCarlo permutation test was performed to assess significance of variables.

Differences in the species composition between predominatly beech natural forests (41 plots) and predominantly spruce stands out of reserve (33 plots) were analysed using *phi* coefficient and tested by Fisher´s exact test on $p<0.05$ level (Tichý 2002). In total 54 herb species were recorded, 33 occurring in both stand types. Several species occurred exclusively in spruce, no one in fir-beech stands. However, *Dentaria enneaphyllos* were significantly concentrated in the reserve, whereas *Asarum europaeum, Festuca altissima, Rubus idaeus, Senecio ovatus, Viola reichenbachiana, Luzula luzuloides, Moehringia trinervia, Veronica officinalis, Dryopteris carthusiana* agg. in spruce stands. Among common species, *Mercurialis perennis, Salvia glutinosa, Dentaria bulbifera, Geranium robertianum, Sanicula europaea, Paris quadrufolia* and *Anemone nemorosa* had higher constancy and average frequency in fir-beech stands, while *Prenanthes purpuraea*, *Oxalis acetosella* and *Galium odoratum* in spruce stands.

Analyses of whole data set (94 plots; not regarding management type) confirm, that species change is a consequence of tree-herb relations. The MonteCarlo test results show, that most of dendrometric variables affect herb layer species composition significantly. Highly significant were numbers of trees with DBH > 7 cm, IP factors and mean DBH. IP factors and numbers of individuals calculated for particular tree species explain more % of variability than general IPs and numbers if species was not considered. It means, that tree species affect herb layer more, than just a tree-stand structure.

RDA analysis show positive reaction of *Dentaria enneaphyllos* and *D. bulbifera* to increasing beech diameter and stand density, whereas most of species show opposite relation. Several species react positively to the spruce parameters – especially *Festuca altissima, Rubus hirtus, Luzula luzuloides, Oxalis acetosella, Prenanthes purpurea* and *Viola reichenbachiana*. Fir and relatively rare noble broadleaves do not exhibit higher influence to herb species in our data set.

The results (especially of RDA ordination) are quite consistent with recent findings of Máliš (2009) from parallel plots in the Veporské vrchy Mts. *Festuca altissima, Prenanthes purpurea* and *Luzula luzuloides* had optimum in spruce dominated stands there, whereas *Oxalis acetosella*, *Dryopteris carthusiana* agg, *Rubus idaeus* and *Veronica officinalis* in mixed forests with high spruce cover. *Oxalis acetosella* and *Dryopteris carthusiana* agg. belongs among the most constant species of spruce forests of Eastern Alps, Bohemian Massif and Western Carpathians (Chytrý et al. 2002). Glončák (2009) show, that above mentioned species persist during whole developmental cycle of natural spruce forests in the Nízke Tatry Mts., as they withstand strong competition of dense spruce stands. Increasing constancy and cover of *Oxalis acetosella* and *Majanthemum bifolium* in secondary spruce stands is reported from carbonate bedrock of Slovenský raj (Križová et al. 2007) and Pieniny Mts. (Benčaťová 2006).

The affinity of *Dentaria* species to the beech dominance is well known in phytosociology. *Dentaria bulbifera* is the characteristic species of the *Fagion* alliance (Wallnöfer et al. 1993, Jarolímek, Šibík 2009) and *Dentaria enneaphyllos* is the diagnostic species of *Dentario enneaphylli-Fagetum* association (Moravec et al. 2000).

Beech seems to be stronger competitor for herb layer species, thus, higher species richness was found in old secondary spruce stands. It can be a consequence of artificial tree density reduction in commercial stands, as well. However, typical fir-beech forest species were reduced (mainly *Dentaria enneaphyllos*) and higher richness was partly caused by introduction of several acidophilous spruce-forest species and few non-forest species. Higher occurrence of oligotrophic and acidophilous species indicate further direction of changes if spruce would be repetitively planted in the site.

POSTER PRESENTATIONS

BIODIVERSITY AND PROTECTION OF DRAGONFLIES IN THE SLOVAK CARPATHIANS

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Keywords: dragonflies, biodiversity, protection, Slovak Carpathians

The Carpathian mountain system is reaching to Slovakia with the Western Carpathians (35 700 km2) and the Eastern Carpathians (4 500 km2). Area of the Slovak Republic is 49.035 km2 out of which 82 % is covered by the Carpathians. Since the Carpathians vary significantly in altitude, there are diverse climate, substrate and vegetation conditions. From the territory of the Slovak part of the Carpathians we processed 4 243 records from 536 localities. Species richness of dragonflies consists of 66 species, N = 30 807 specimens. Eudominant (more then 10 %) are two dragonfly species Coenagrion puella and Platycnemis pennipes, dominant species (5 to 10 %) are Aeshna cyanea, Enallagma cyathigerum, Ischnura elegans, Lestes sponsa etc. Using the descriptive statistics, hypsometric distribution of dragonflies of the Slovak Carpathians was processed. Most of the observations (1 600 cases) come from the altitude of 400 to 600 metres. The average hypsometric altitude of dragonflies in the Slovak part of Carpathian Mountains is 486,5 m a.s.l., the minimal altitude (102 m a.s.l.) refers to the species of Ischnura pumilio, Orthetrum albisytlum and O. cancellatum. Above 1 000 m a.s.l., there were found 26 species, the highest altitude is reached by the species Aeshna subarctica (1 566 m), Enallagma cyathigerum (1 620 m), Aeshna cyanea (1 674 m), A. juncea and Somatochlora alpestris (1 674 m). According to the EU Habitats Directive (92/43/EEC), in the Slovak Carpathians area there occur the "species of Community interest" which are included in Annex II: Coenagrion ornatum, Cordulegaster heros ssp. heros, Leucorrhinia pectoralis, Ophiogomphus cecilia, and another specis listed in Annex IV: Gomphus (Stylurus) flavipes Leucorrhinia caudalis and Sympecma paedisca. Twelve dragonfly species are of the national importance according to Notice No 24/2003 Ministry of Environment of the Slovak Republic, such as Anax parthenope, Brachytron pratense, Orthetrum coerulescens and species of the genera Cordulegaster and Somatochlora. Of the 66 species of dragonflies of the Slovak Carpathians there are 41 species listed in the Red List of Dragonflies of Slovakia. Damselfly Coenagrion lunulatum and Nehalenia speciosa are extinct (EX) nowadays, to the category of endangered species there belong Aeshna subarctica, Coenagrion scitulum, Leucorrhinia dubia , L. pectoralis, Somatochlora alpestris, S. arctica etc. In the Slovak Carpathians dragonflies were found in 154 habitat types and their microhabitats according to national classification (type of running and standing waters, predominant bank material, vegetation type and structure, land-use etc.). The number of collected specimens from different habitats is from 1 to 3 362 (the highest number in fens. The average number of specimens per habitat is 198. The most threatened habitats of dragonflies in the Slovak part of Carpathians (code and nomenclature according to the Habitats Directive) are: 3130-Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea, 3160 Natural dystrophic lakes and ponds, 7110 Active raised bogs and 7120 Degraded raised bogs still capable of natural regeneration. The most important risk factors are destruction of habitat by human activities, natural secondary succession and changes in hydrological regime.

SURVEY OF HUNGARIAN LILAC (SYRINGA JOSIKAEA), A THREATENED ENDEMIC OF THE EASTERN CARPATHIANS

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Keywords: Syringa josikaea, species conservation, Carpathian endemic, population genetics

Hungarian lilac (Syringa josikaea Jacq. fil., Oleaceae) is a shrub endemic to the Eastern Carpathians. Its distribution range is highly disjunct, consisting of a northern area in western Ukraine and a southern area in western Romania. Since fossil remains were reported, Hungarian lilac is considered to be a Tertiary relict species. This is also suggested from its closest relatives from the Syringa sect. Villosae living in the Far East. The lilac typically occurs in bogs and wetlands along creeks in Ukraine and on stream shores in steep hallows in Romania. Having spectacular flowers Hungarian lilac is a plant widely grown in gardens and is used for breeding lilac cultivars. Some populations found in the wild thus may have human mediated origin. Literature mentions overall about twenty-five populations, out of which ten populations are from the northern and fifteen from the southern area. The populations in most cases are small and are isolated from each other. In spite of its rarity and botanical curiosity, the Hungarian lilac is barely known for conservationists and botanists. Relevant books list the data of occurrences but these are mostly copied from older literature, without checking the actuality of the data. An extensive census of the populations was done one hundred years ago, since then no research has been performed on Hungarian lilac.

In this study our main aims were to look up and confirm existences of the species, to assess their vulnerability. We collected DNA samples to unravel the genetic distances between Hungarian lilac and its close relatives and also to assess the genetic variability of the populations. Genetic distances between the sibling lilac species can show the separateness of the species and the time since their divergence. Assessment of the spatial distribution of genetic variants among populations of Hungarian lilac can reveal area changes of the species in the past. These genetic surveys can test the current view that Hungarian lilac and its relatives had their last common ancestor with a large distribution prior to the Quaternary glaciations and create distinct lineages since that time. An alternative hypothesis might be that Hungarian lilac subsequently came distant from other lilacs by long distance dispersal. The genetic dissimilarity of the northern versus southern populations presents the way how Syringa josikaea reacted to the glaciations: higher variability in the southern area and common genotypes shared in the two regions suggest that Hungarian lilac survived in a southern glacial refugium. Alternatively high rates of genetic variability with individual genotypes in both ranges imply survival of the lilac in distinct, a northern as well as a southern glacial refugia. We would also like eventually to contribute to a conservation management plan for the species.

From spring 2008 we began to explore and survey the populations. Our work covers populations both from Ukraine and Romania. We collected all available literature of the species and systematically visited the known locations of the species. By interviewing local forest managers, botanists and field tour guides we attempted to find unknown populations. We surveyed the size of the populations and measured whether there are any factors that endanger them.

For our genetic survey we collected samples of specimens from populations both in the southern and northern area of the species. We used inter simple sequence repeat (ISSR) markers to compare the variability of the populations. We also measured the variations within and between populations and the genetic variance of Hungarian lilac and its closest relatives with the using chloroplast and nuclear ribosomal ITS DNA sequences.

In our field surveys we confirmed the existence of several populations not known for decades, while found some new ones previously not known. Most populations have a small number of individuals, many consists of only a few clones. Populations are threatened by forest management, agricultural land use and road construction. From these the latter seems to be the biggest threat: new-built roads following creeks cause landscape change with the loss of suitable habitats and with the change of hydrologic state. This occurs in some populations from the Romanian as well as from the Ukrainian area.

The preliminary results of our genetic survey on the base of 49 individuals and overall 52 unambiguous bands show that samples clustered according to the natural population structure, and each population has its distinct genetic character. Two of the Romanian populations are relatively similar which may stem from being located by the same creek. Furthermore, similarity found between the two sampled Ukrainian populations may be explained by their close location. Revealed by the five ISSR primers, two small Romanian populations clustered close to the two Ukrainian populations, while the other two Romanian populations were distinct from all others and from each other.

Kováts; D.; Urbán, H.

MORPHOLOGICAL DIFFERENCE BETWEEN NIGHTINGALES IN SYMPATRIC HABITATS IN HUNGARY

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Keywords: North-East Hungary, Luscinia megarhynchos, Luscinia luscinia, discriminant analysis, wing-morphology

The morphometrical variations of the Nightingale (Luscinia megarhynchos) have been studied in the area of river Tisza, the Bódva-valley and the Szatmár-Bereg Landscape Protection Area between 2005 and 2008. 74 specimens were caught in mist nets with tape recorder. The birds were ringed with individually numbered aluminium rings. The bird's wing lenght, tail lenght, relative lenght of the first primary, thirdth primary lenght, total wing form and body mass was measured. The maximal wing- and tail lenght of 59 individuals were longer than ssp. megarhynchos. In the study areas, the relative lenght of the first primary lenght (P1) was –5 to +8 mm, wing lenght 82–93 mm and tail lenght 67–81 mm. Birds were generally caught in the ecotone zone of forests. Depths of the older forests are avoiding by Nightingales. The main type of the habitats were oak (Quercus robur)-, alder (Alnus glutinosa)- and poplar (Populus alba, P. nigra) woods. Based on the discriminant analysis, three different groups were identified. According to these experiences the population of Bódva, Tisza and Szatmár-Bereg were markedly separated from each other. We suppose that these populations compose several morfological groups which are not depend on the type and year of the forests.

ECONET OF UKRAINIAN CARPATHIANS AS PART OF NATIONAL AND EUROPEAN NETWORKS: FROM CONCEPTUAL JUSTIFICATION TOWARDS APPROACHES IN IMPLEMENTATION

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Keywords: PEEN, Ukrainian Carpathians, scheme of econet, protected areas, eco-corridors

The conservation, restoration and sustainable use of biological and landscape diversity of the Carpathians, ensuring the conservation, maintenance and sustainable use of natural and semi-natural habitats, and securing their continuity and connectivity, restoration of degraded habitats; conservation and sustainable use of species of flora and fauna characteristic to the Carpathians are the actual tasks, especially taking into account the social-economic situation in the region, which is on the eve of serious changes. The eastern area of the Carpathians contains one of the most valuable areas of the Carpathian Mountains, including extensive stands of beech forests, and urgent measures should be made by Ukraine in respect of their protection. The possible instrument of such measures can be econet formation under the context of Pan-European Ecological Network (PEEN) and National Econet of Ukraine.

The Law of Ukraine "On the state Program of National Ecological Network Formation for the Years 2000-2015" (Program) has been approved by the Parliament of Ukraine (2000). The principal objective of this Program is to increase the area of lands in the country under natural landscapes to a level sufficient for the preservation of their diversity close to their natural ecosystem conditions and development of their territorially integrated system built to ensure possibility of using ecocorridors of the migration and distribution of plant and animal species which would ensure preservation of natural ecosystems, species and population of the flora and fauna. One of the main tasks of the Program is to agree upon the issues related to the transboundary (TB) integration of econet elements (first of all, protected Areas, PAs) of the neighboring countries in order to develop the PEEN.

The Ministry of Environmental Protection of Ukraine (MEP) arranged the elaboration of maps (schemas) in line of econet development, on national and regional levels, as stage of implementation of the ideology of econet. For the Carpathian region such map (scale 1: 200 000) was designed in 2005-2006 by the team of experts (Alla Bezus'ko, Vitalij Brusak, Yurij Masikevych, Serhij Matvieiev, Iaroslav Movchan, Serhij Popovych, Mykola Prykhod'ko, Liubov Fel'baba-Klushyna, Yurij Zin'ko), accompanied by extended note. The report and scheme were accepted by the MEP (2007). That map was used for the further development of regional and local maps on oblast' (an administrative unit at the level of province) and district level (2007-2008 years). The conceptual aspects of maps are discussing by the econet' coordination councils (nationally and regionally), established according the Program and after that, agreed by respective state insitutions (land and spatial planning organs, local authorities) should be incorporated in appropriate documents of different level. The basic programs of econet formation adopted already by all oblast's of the Carpathian region and the process of elaboration of detailed maps and inclusion them in plans of spatial development takes place nowadays. The conceptual justification on scheme of ecocorridors of Ukrainian Carpathian, tentatively harmonized in sense of TBPAs, is presented.

Composition and contents of the ecocorridors schemes and structure, information about the region, general plan and map materials, criteria of selection of connected territories were prepared on national level in cooperation with territorial boards of the MEP as well as with scientists. Composition, contents and rules of getting up of each kind of respectfull documents is regulated by correspondent normative and technical document, i.a. set on realization of land exploitation organization and taking into account the features of biogeocoenoces of regions. The facilitation of coordination and cooperation between all relevant stakeholders, so as to enhance conservation and sustainable management in the areas outside of protected areas in the Carpathians, in particular with the objective of improving and ensuring connectivity between existing protected areas and other areas and habitats significant for biological and landscape diversity of the Carpathians was arranged by econet councils on national and regional levels.

Steps, undertaken in the area aimed at achieving objectives of Carpathian Convention and its first Protocol, created some basic platform, but it will be necessary to implement and develop adequate legal, financial, organizational, scientific, educational and informational measures, i.a., development, harmonization and implementation of relevant management plans aimed at achieving the aims of protection and sustainable use of habitats and species.

MACROFUNGI INVESTIGATIONS IN SZEKLERLAND, TRANSYLVANIA, ROMANIA

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Keywords: East Carpathians, macrofungi, taxonomical, ecological investigations

According to recent summarisation 1032 macrofungi taxa were documented from Szeklerland up to 1997. The author and his colleagues started systematic field surveys from 1998 in order to investigate the macrofungi of this territory. The species recorded were documented with fungaria and/or photo, in many cases with description, too.
The investigations were grouped around 5 main points of view: 1/ making the inventory of the macrofungi species from Szeklerland; 2/ detailed survey of macrofungi of particular areas; 3/ review of particular macrofungi groups from taxonomical, systematical and ecological point of view; 4/ making the database of the species recorded; 5/making the possibility to publish these results.
1/ As a result of the field surveys a number of 504 macrofungi taxa were documented and in majority published by the author and his colleagues with more than 2 000 occurrence data from 24 localities and 22 habitat types.
2/ Eight particular areas were investigated in details: Reci environs, Bodocului Mts., Baraoltului Mts., Vrancei Mts., Ghimeş-Făget environs, Oituz environs, Gurghiului Mts., Sfînta Ana Lake environs. In the case of these areas the habitat characterisation, macrofungi communities characterisation and the situation of rare and endangered macrofungi was also investigated.
3/ Taxonomic revision, data compilation, description, macroscopic key and habitat characterisation of 15 macrofungi groups were made: genera Amanita, Lactarius, Boletus, Leccinum, Chalciporus, Gyroporus, Porphyrellus, Strobilomyces; families Auriscalpiaceae, Bankeraceae, Cantharellaceae, Gomphaceae, Hydnaceae, Polyporaceae, Albatrellaceae.
4/ An MsAccess database was made by the author, containing all collected and documented macrofungi occurrence data. Each record contains the species name, time and place of occurrence, habitat and, in many cases other additional information, too. This database is updated in every year.
5/ A regular mycological-ethnomycological yearly periodical “Moeszia” have started to be published from 2003 under the auspices of the “Kálmán László” Mycological Society. The main aim of Moeszia is to provide a forum for mycological publications connected to Transylvania. The periodical publishes scientific papers, as well as society news parallel in Hungarian and English.
The poster contains the list of all available publications referring to the territory, published by the author and his colleagues, not presented here because of the text length limit.

VICARIANCE: MYTH OR REALITY IN THE DIANTHUS SECTION PLUMARIA

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Keywords: Dianthus, microsatellite, AFLP, section Plumaria, vicariance

Neither morphological, nor previous molecular taxonomic analyses prove fully the vicariance theory of the Central-European carnations in the Plumaria complex. Moreover our former AFLP (amplified fragment length polymorphism) studies suggest that considerably less species exist than we thought or previous authors mentioned. The AFLP analysis supported just three major species groups: the Plumaria aggregate which contains all subspecies of the Dianthus plumarius inclusively the endemic pannonian D. serotinus. The later originates from calcicole sandy localities of the forest steppe area. The second is the Petraeus aggregate that contains all taxa from the East- and South Carpathians as well as the Balcans. Subspecies of D. superbus belong to the third group, forming the Superbus aggregate.
On the other hand even the existence of the Plumaria section is doubtful, namely this group based on sequence data (ITS sequence data not published, as well as ITS and plastid sequence consensus data by Valente et al. 2010). appears to be not monophyletic.
To reinforce our former results we tested 3 microsatellite markers (DCA221; DCD010; MS-DINCARACC; by Smulders et al. 2000, 2003) developed for cultivated carnations, on wild specimens originated from different localities of the Carpathian Mountains and surroundings. The investigated populations were: 1-3.) Dianthus plumarius, Hungary, Pilisszentlélek, Kisszénás and Sas-hegy; 4.) D. serotinus, from the Hungarian lowland; 5-6.) D. petraeus subsp. orbelicus (syn. D. simonkaianus), from Romania, Runk (Runc) and Torockó (Trascău); 7-14.) D. petraeus subsp. petraeus, Romania, collected from more localities of the South Carpathians’; 15-17.) D. superbus, Hungary, Botanic Garden of Soroksár; Nyírbárány; Vámospércs; 18-19.) D. superbus subsp. alpestris Romania, Munții-Rodnei; Munții-Ciucaş;

The aims were to test variability of the microsatellites on the wild Dianthus species, and to find the best resolution to evaluate microsatellite data set of the polyploid species. Finally, to confirm or debate our former results.
Vicariant species of the different geographical sites should diverge significantly and in consequence populations should have possessed different allele configurations. On the other hand, as we presumed, no large geographical barrier existed among the sites. Hereby the gene flow between these carnation species was almost continuous along Central- and Southeast Europe. Based on the recent palynological records submediteranean migration corridor from the Balcan was also confirmed by Magyari et al 2008, preserving in the postglacial the gene lineages among the regions.
The polyploidy of this complex probably was not the consequence of a single time hybridizations event but, the organization of populations owning tetra-, hexa- and mixed ploidy level (Weiss et al. 2002) has been a permanently repetitive process. Due to the above-mentioned reasons, the number of taxon- or population-specific allele variability of the three microsatellite markers investigated was lower than we expected in case of vicariance. We did not find any unambiguous and distinct differentiation between the populations analysed. As microsatellite data support our former AFLP-results it seems that the present distribution of the wild carnations, complex Plumaria, is a consequence of a series of recent expansion events from the southern refugia. In this approach we believe that the taxonomic status of some species as well as the vicariance scenario should be reconsidered. However taking into the consideration that the majority of the investigated taxa are polyploids, our establishments need further investigations.

THREATENED FISHES AND LAMPREYS OF THE UPPER AND MIDDLE SAN RIVER DRAINAGE BASIN (S-E POLAND)

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Keywords: fish, lampreys, threatened species

Introduction
The San River is the largest right-bank tributary of the upper Vistula River with a length of 433 km and a basin area of 16,861 km2 . There are the largest artificial lake in Poland, Lake Solina, created by a dam on the San River.
Material and methods
Sampling was undertaken in 2008-2009 period. Fish were caught by upstream electrofishing, anaesthetised, identified, measured for total length and weighed. After that they were released to water. When it was possible, one active electrode (anode) was applied for every 5-6 m of the river width. In sites localised in the middle San, which were of over 100 m width, as many as 5 anodes were used simultaneously.
Results and discussion
A total number of 25 fish and 1 lamprey species were recorded in the upper and middle San drainage. Among them 18 are regarded seriously threatened (according to Witkowski et al., 2009). 1 species, Vimba vimba, is considered critically endangered (CR, partially CD); 3 are endangered (EN): Salmo trutta “lacustris”, Chondrostoma nasus and Alburnoides bipunctatus; 7 are vulnerable (VU): Lampetra planeri, Sabanejewia baltica/balcanica, Rhodeus amarus, Lota lota, Cottus gobio, Cottus poecilopus and Barbus barbus; 5 are near threatened (NT): Barbus carpathicus, Romanogobio kesslerii, Phoxinus phoxinus, Leuciscus leuciscus and Cobitis elongatoides; 4 species, Salmo trutta “fario”, Thymallus thymallus, Salmo salar and Hucho hucho (the 2 latter extinct in the wild, EW), depend on conservation actions (CD); 1 fish, namely Barbus waleckii, is of rather unclear taxonomic validity and there is a lack of sufficient data on its distribution in Poland (DD); all other species are of least concern (LC).
Anadromous fish, S. salar and V. vimba, as well as potamodromous S. trutta “lacustris”, were recorded only in a very few specimens. R. kesslerii, however relatively common in the lower parts of the middle San, is known in Poland only from that single river and thus it seems to be extraordinary suspected to threat. Riverine species, as Ch. nasus and B. barbus, were relatively abundant, in some localities prevailing in the total fish biomass, often together with Squalius cephalus.

Thematic session: Ecosystem Services and Human Well-being

Chairs:
Pavel Cudlin (Academy of Sciences of the Czech Republic, Czech Republic),
Marine Elbakidze (Ivan Franko National University of Lviv, Ukriane / Swedish University of Agricultural Sciences, Sweden),
Maria Nijnik (Macaulay Land Use Research Institute, United Kingdom)

The session intends to join forces of natural, social and human scientists as well as practitioners to explore the potential for an applied interdisciplinary research and knowledge exchange. Due to the ongoing radical changes in the political, social, and ecological environments in the Carpathian countries, there is an urgent need to develop an integrated ecosystems approach which would consider an entire range of ecosystem services and possible trade.

ORAL PRESENTATIONS

CULTURAL LANDSCAPES, ECOSYSTEM SERVICES, AND THE LOCAL ECONOMY IN MARAMURES MOUNTAINS NATURAL PARK, ROMANIA

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Keywords: Cultural landscapes, ecosystem services, Maramures Mountains, Romania

Ecosystems that offer pleasant views, a diverse fauna and vegetation, clean water bodies and streams, silence, enjoyable climatic conditions, and architectural landmarks are likely to provide recreational services to locals and visitors. Recreation opportunities are the result of multiple services being provided at the landscape scale. Our presentation addresses the assessment of the recreational values of cultural landscapes and the economic benefits of protection in Maramures Mountains Natural Park (MMNP), a 15,000 hectare park in northeastern Romania. The study was the first economic assessment of the benefits of protecting public land in Romania.
A total of eleven ecosystem services were assessed in the economic valuation across the three different land cover types of forest, hayfields, and alpine pastures. Eighty percent of the study was based on primary data provided by park personnel or gathered in the area of interest. A tourist survey was then used to assess aesthetic and cultural values of rural cultural landscapes in relation to other values provided by forests.
Altogether, MMNP provided a total of 142,961,070.19 RON in ecosystem goods and services in 2007. Ecosystem services such as annual carbon sequestration, watershed protection, wildlife habitat provisioning, recreation, cultural heritage, and traditional landscapes altogether contributed roughly a half of that value. Different visitor groups held different experiences regarding what contributed the most to the enjoyment of their visits. Romanians showed the highest appreciation for the last remaining steam train in the region and wildlife. Western Europeans appreciated the rural way of life and hayfields, while Eastern Europeans didn't show clear preferences with possibly more enjoyment of the large expanses of forests.

APPROACHES TO VALUATION OF ECOSYSTEM SERVICES IN MOUNTAIN AREAS

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Keywords: ecosystem function measurement, ecosystem services valuation, biodiversity, nature protection, sustainable development

Ecosystem services (ESS) are the benefits human receive, directly or indirectly, from ecosystems (Costanza et al. 1997). Links between human well-being and ESS are complex and need consideration of different spatial and temporal scales to assess them properly. ESS include provisioning services such as food, water, timber, fuel, biochemicals, natural medicines; regulating services, e.g. regulation of the climate and natural hazards, purification of air and water, and flood protection; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services, e.g. soil formation,

photosynthesis, and nutrient cycling (MEA 2005). Over the past 50 years, rapid and extensive environmental changes in land use, climate and the atmosphere have resulted in a substantial loss or degradation of ecosystem services, while demands for services have been increasing. Ecologically oriented scientists and politicians call for a new integrated resource management policy toward greener sustainable landscape that will cover needs of current generation while optimizing land use to provide sustainable ecosystem services.

The role of mountain forests in the provision of forest products, as well as many other supporting and regulating services, is well known. Rapidly changing temperatures, precipitation amounts and patterns or increasing atmospheric CO2 concentration are all likely to affect forest growth and health, species composition and alter the functioning of forest ecosystems. From this point of view the mountain ecosystems belong to the most endangered ecosystems all over the world.

Though our well-being is dependent upon the continued flow of the ESS, many ESS, such as air-conditioning service, are public goods with no markets and no prices. As a result, biodiversity is declining, ecosystems are continuously degraded and society, in turn, is suffering the consequences, which are partly irreversible. In the Czech Republic two interdisciplinary expert methods, estimating non-market value of biodiversity and ecosystem services, were proposed.

Biotope valuation method (BVM) identifies the carrying capacity of individual biotope types as specific environments for plant and animal species and reflects mainly biodiversity aspects of biotopes (point assessing of species and biotope type diversity, their rareness and vulnerability). Biotope classification goes out of Natura 2000 mapping and more developing man-influenced biotopes (Cudlín et al. 2005). Biotope monetary values reflect the average restoration costs necessary for maintaining and improving the landscape quality and are mainly aimed at quantifying environmental damages from land cover changes. The monetary value of one point (€0.56) is derived from a set of representative restoration projects as average national cost needed for one point improving of 1m2 of the biotope (Sejak, Dejmal et al. 2003, summary see: http://fzp.ujep.cz/projekty/bvm/bvm.pdf).

Energy-water-vegetation valuation method (EWVM) is based on monitored energy and water flows, described by the Energy-Transport-Reaction model (Ripl 1995), that produce the main life supporting services - benefits - for humans and other species within autotrophic ecosystems (e.g. air-conditioning, water retention, CO2 sequestration services). Monetary values of those benefits are estimated by the replacement cost method, i.e. through the cost of providing a substitute good that would perform a similar function to an environmental service.

By utilizing these two methods (EWVM, BVM), two scales of ecological values of landscape (both as flows and stocks) have been derived. Subsequently, these environmental values may be compared with market prices of standard land uses. Biotope stock values range from zero (chemically contaminated land, impermeable surfaces) to about €40 per one square metre. Similarly, the scale of ecosystem services stock values starts at levels near to zero in cases of completely anthropogenic biotopes, however, in cases of natural and semi-natural biotopes the values moved at the levels €100-150 per m2, highly surpassing the standard economic values from traditional land uses (Seják, Pokorný 2009). The scale of ecosystem service values reflects variety of benefits that society enjoys mostly free of charge, but without which cannot live. While the biotope valuation method is showing how costly society is in maintaining biotopes as environments for healthy ecosystem, ecosystem service valuation method shows how costly society is in substituting (replacing) the ecosystem services by unnatural, technological way. Based on the real data on biotopes and their monitored energy, water and material flows, the presented accounting methods may provide land conservation managers, public land stewards and environmentally aware land developers a means to optimize land uses properly among ecological and economic purposes in natural resource management.

The construction of the indicator set, capable to inform us about the human pressure on mountain landscape can enable us to inform about the present situation in ecosystem services provisioning. Indicator set quantifies pattern and rate of human driving forces, pressures, impacts on ecosystems and agro-ecosystems and human society responses to decreasing ability of forest-agriculture landscape to supply multiple ecosystem services (DeGrot et al. 2006). Indicator sets were proposed to quantify effect of increased demand of ecosystem service use on ecosystem functioning in middle sized watershed (upper part of the Stropnice River, South Bohemia).

Based on the real data on biotopes and their monitored energy, water and material flows and synergies, the biodiversity and ecosystem goods and services will be identified and evaluated. The presented accounting and valuation methods may provide touched public, land conservation managers, public land stewards and environmentally aware land developers a means to optimize land uses properly among ecological and economic purposes in natural resource management (Seják, Pokorný 2009). There is an urgent need to valuate the ecosystem services in the Carpathian ecoregion due to many radical changes in political, social and ecological environments in all countries in the ecoregion at present time, which could bring unexpected changes in ecosystem services, and affect the human well-being in a long term perspective. Therefore, the multi-scale assessment of the ecosystem services should be conducted and supported by scientific communities and governmental organizations.

ANALYSING THE ECONOMICS OF CARBON UPTAKE AND ASSESSING POLICY OPTIONS FOR FORESTRY IN THE UKRAINE'S CARPATHIANS TO MITIGATE CLIMATE CHANGE

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Keywords: climate change, carbon sequestration, forest, ecosystem services, scenario analysis

Since the Kyoto Protocol, climate change has become among the most important environmental policy issues. The Conference of the Parties to the UN FCCC (1997) necessitated agreement on the designation of funding from industries and governments for creating forest plantations, and to assess the economics of climate change mitigation via the expansion of forest cover is becoming a motivating topic. Studies on carbon mitigation options have been initiated in a number of countries, including Ukraine (Lakida et al., 1995; Nijnik, 2005), and an important research question that arises is to discover whether the establishment of new forests offers a low-cost opportunity for carbon sequestration.

Our purpose in this study is to assess, in economic terms, the capacities of woodland development in the Ukrainian Carpathians. Four policy scenarios are considered: (1) carbon storage in forests, (2) carbon storage and additional wood-for-fuel substitution (3) carbon storage and additional sink policy for wood products, and (4) woodlands development for multiple purposes.

Forests store carbon by photosynthesis and carbon sequestration positively correlates with the growth rates of the trees. Given that benefits of carbon uptake estimated in physical terms depend on tree growth, the functional forms for stand growth of tree species considered for planting were estimated. The data were based on the continuous records of the forest state accounts. The equations for the estimates of the stand growth related to the age of trees of the first site classes (the most productive and fast growing in particular conditions) were used later in carbon budget calculations. Carbon uptake benefits are computed for different discount rates. Following the IPCC (2000), in the majority of cases, the estimates of carbon savings are calculated in permanent tons.

The study explores the potential of afforestation (and reforestation) of waste and unwooded land within the State Forest Fund (inventory) and of marginal agricultural land. Initial cost-benefit analysis of afforestation was carried out. We have also computed the costs per ton of carbon uptake estimates to answer the question whether an expansion of tree-planting may be an economically efficient way of mitigating climate change. An initial analysis of whether carbon sequestration is compatible with the use of forests for provision of multiple ecosystem services was also carried out.

Firstly, by adapting the methodology developed by van Kooten and Bulte (2000), the paper presents an assessment of carbon uptake benefits, and the economics of carbon sink in trees: a storage option. We examine the case when trees are planted for a period of 40 years, without considering future use of wood and land after timber harvesting. In the following section, we discuss costs and benefits of carbon sequestration, when bio energy and wood products policy options are considered. This section examines the economics of substitution wood for fossil fuel and of storing carbon in wood products (after the trees are harvested). Finally, we analyse the costs and benefits of planting trees with the purpose of using new forests for timber production, erosion prevention and climate change mitigation. We also compute the estimates on costs per ton of sequestered carbon which provide benchmarks for possible future comparison of the proposed strategy (each of four scenarios under investigation) with other climate change mitigation policy alternatives (e.g. with those, going beyond the land use sector).

The results of the study provide evidence that tree-planting on bare and marginal agricultural land will further increase carbon uptake potential of the Carpathians. The results also show that while the carbon uptake estimates of the forests are comparable in the main with those, for example, in British Columbia, the social-economic costs per ton of carbon uptake in the Carpathians are comparatively low. The present value carbon uptake costs, for example, are just 8.7 €/ton for the storage scenario when benefits of carbon uptake are not discounted (and costs are discounted at 4%). The results of the cost-benefit analysis of the storage policy (scenario 1) are promising, at the discount rates for carbon uptake between 0% - 4%.

Under wood-for-fuel substitution (scenario 2) and sink policy option for wood products (scenario 3), and with the assumptions considered in our modules, afforestation for the sole purpose of carbon uptake is not recommended in the Carpathian Mountains. However, discount rate and time horizon considered in the models are important factors influencing the results. The effects of avoiding carbon release through the replacement of non-timber materials are repeatable, and social-economic benefits under the wood product sink scenario over the long run (over 100 years) are expected to be much higher than under the strategy of only carbon fixation.

The general conclusion of the current study is that the Carpathian forests may offer a low-cost opportunity for carbon sequestration and a promising alternative of emissions reduction. The region has the potential to contribute to global carbon uptake, primarily because of the availability of land suitable for tree planting, because of good forest-growing conditions and relatively low afforestation costs. The results of the research have shown that afforestation for the single objective of carbon uptake would not always be economically efficient. The individual scope for carbon sequestration is likely to be driven by the type of land in question. Despite high-cost estimates of carbon sink in some regions there is empirical evidence that large amounts of carbon may be sequestered by forest at low costs in other regions, particularly

where the opportunity costs of land are low. The choice of location for forestry development and of appropriate tree species and management regimes to be applied is imperative for saving economic costs. In future studies, we intend to employ a dynamic optimization model (an optimal control tool) to indicate optimal expansion of mountain forests in the Carpathians (under different scenarios).

To date, we highly recommend expanding the wooded area in this region for multiple purposes, including the soil protection forest benefits. When multi-functional forestry is considered at discount rates lower than 2%, the costs will be covered by the returns, in the majority of cases. Together with the contribution to climate stability, afforestation in the Carpathians would substantially enhance the environmental role of forests. To ensure multiple objectives of forestry, the region could capture the opportunity of bringing together its rural development and forest policy priorities, targeting both climate change and sustainable development goals. Moreover, in view of the Kyoto Protocol and the decisions that follow, Ukraine could potentially play a role in climate change negotiations under the emissions credit-trading scheme (or voluntary marketing), involving carbon offset credits from forestry.

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STAKEHOLDER ATTITUDES TOWARDS SUSTAINABLE FOREST MANAGEMENT PRINCIPLES AND IMPLEMENTATION IN THE UKRAINIAN CARPATHIANS

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Keywords: Sustainable forest management, forest policy instruments, forest sector stakeholders, mountain communities well-being, Ukrainian Carpathians

Consideration of forest stakeholder attitudes is important in the context of the forest sector's transition to a democratic, decentralized system of governance. Understanding the motivational context for forest sector decision making is not a sufficiently developed research field. Only a few studies have focused directly on forest sector stakeholder attitudes, perceptions, and values. Most of these studies have been carried out in the United States, Canada, Sweden, Finland, Germany, Great Britain, and Austria. These studies focused mainly on forest landowner motivations, and less on the values, attitudes and perceptions that influence forestry professional behavior.

Based on a survey of all forest stakeholders in the rural mountain areas of Ukrainian Carpathians, initiated by the atelier entitled "Ecological Economics and Sustainable Forest Management" (Lviv, 2007), we can sketch a generalized picture of attitudes towards Sustainable Forest Management (SFM) principles. The survey encompassed 735 respondents, 74 % of whom were in the public sector, 10 % in the private sector, 8 % of respondents were private entrepreneurs specializing in harvesting, wood processing or non-wood forest products processing, 4 % were temporarily unemployed, and 1 % were students. The results of study identified the low level of awareness with the SFM ideas. Only 12.7 % answered that they know precisely what the term "sustainable forest management" means. The main share of respondents (63.5 %) were generally familiar with this term, and 23.8 % of respondents were not familiar with SFM. These data suggest that forest managers are not aware of contemporary SFM paradigms. The lack of specific knowledge is a serious obstacle for new forest policy implementation.

More than half of respondents recognized an economic (57.3 %) and an ecological role (60.7 %) of forests as important drivers of regional development. A considerable portion of respondents recognized both the economic and ecological role of forests as important (33.2 % and 38.1 % correspondingly). 81 % of respondents stressed the need for further reforms in the forest sector, the rest of respondents was satisfied with the present state of forestry and current model of its development. The high percent of respondents with positive attitudes towards forest sector reform confirmed the favourable preconditions for further reforms and its potential support. First of all, respondents would like to reform the system of financing (45 % of respondents that answered), the system of governance (33 % of respondents), and economic relations (20 % of respondents). 13 % of respondents emphasized a need to reform human resource policy, 18 % of respondents stressed the expediency of regulatory and legal framework reform. The respondents stressed the importance of the following activities to guide reform: improvement of felling systems, tree-planting system, decision making in forest management, harvesting techniques, development of forest roads network, and improvement of nature protected areas. For an opinion of 29 % of respondents, an improvement of economic situation in Ukraine is a precondition for successful development of forestry.

Forest certification is one of the most successful instruments of forest policy, but only 48.4 % of respondents have positive attitudes towards forest certification, 45.9 % have a neutral attitude, and 5.7 % are rather afraid of negative consequences of certification. The results showed that positive attitudes towards reform in the forest sector is determined by the cumulative influence (totally by 48.7 %) of such factors as level of knowledge about SFM, level of knowledge about the Forest Act and educational level. Increased knowledge about SFM and the Forest Act leads to the respondents having more positive attitudes towards reform.
The results point to the need for enrichment and diversification of the national forest policy instruments set, first of all for diversification of the informational instruments aimed for efficient communication, learning and trust building among the forestry professionals, local communities, authorities, and business.
It is planned to continue these studies within the framework of the program "Improving Forest Law Enforcement and Governance in the European Neighbourhood Policy East Countries and Russia" (FLEG) in cooperation with the experts from the IUCN, World Bank, and WWF. In particular, implementation of the program will include an analytical study of the economic and social impacts of inefficient and unsustainable forest practices and illegal logging. It will also analyze legal access to timber and other forest resources by local populations and small businesses and development of recommendations for simplification and streamlining of these procedures in Ukraine.

STAKEHOLDERS' PERCEPTIONS OF FOREST ECOSYSTEM SERVICES: UKRAINIAN CARPATHIANS CASE STUDY

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Keywords: forest ecosystem services, stakeholders, Conceptual Content Cognitive Mapping technique, non-parametric statistical analysis, cognitive map, Ukrainian Carpathians

Forest management paradigm alteration has driven scientific attention to stakeholders' perception of forest ecosystem services (FES). Most FES in contradistinction to forest goods is non-excludable and non-rival. Hence markets fail to measure their value, to signal their scarcity, or even to provide incentives to supply them (Costanza et al., 1997, Farley et al., 2009). Despite scientists have identified FES (Costanza et. al., 1997, Millennium Ecosystem Assessment, 2005), stakeholders' attitudes toward FES remain a bit different and these peculiarities are very important for understanding behavior trends in forest resource use and forest management.
We will present a forest values universe developed using Conceptual Content Cognitive Mapping technique (Kant and Lee, 2004), which belong to social choice mainstream. Further we examined identified stakeholders' preferences regarding FES applying non-parametric statistic methods to obtain cognitive maps of preferences. Set of cognitive maps which reflect perceptions of individuals and groups' values associated with FES (both of the own group and other groups) provide us with a comprehensive information for comparison of values systems identified by respondents both from an individual and a group point of view.
Statistically significant maps generated for Ukrainian Carpathians case study highlight behavioral and value reasons for particular decisions lobbying in conditions of weak markets and ill-defined property rights, and can be used as a background for predicting possible and understanding real-world conflicts and for their mitigation.

POSTER PRESENTATIONS

ROLE OF NON-WOOD FOREST PRODUCTS FOR RURAL COMMUNITIES IN A TRANSITION ECONOMY: A CASE STUDY IN UKRAINE

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Keywords: non-wood forest products, rural development, sustainable use, Ukrainian Carpathians

Sustainable use of non-wood forest products (NWFPs) is a component of sustainable forest management. In the light of a challenging social and economic development in countries in transition from planned to market economy, forest functions other than wood production have re-gained international importance and recognition. NWFPs provide important use and non-use values to many stakeholders in rural landscapes in forest dependent communities. The aim of this study was to define the importance of NWFPs for different local stakeholders in the Ukrainian Carpathians. We analysed national and international forest policy documents, national and regional management regulations concerning the use of forest

resources, including NWFPs. Using literature review, open-ended interviews with local forest stakeholders we studied the reasons for and methods of harvesting, amount of harvested NWFPs by different groups of forest users, traditional practices of NWFP utilization, and how these have changed during the past decade of economic transition. The results showed that NWFPs provide important livelihood resources for many communities in traditional village systems in the Ukrainian Carpathians. We discuss the need to develop a strategy for multi-level governance and sustainable management of NWFPs in countries in transition from socialistic planned to market economy, like Ukraine.

BUSINESS AND NATURE OPPORTUNITIES ON THE TISZA FLOODPLAINS

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Keywords: floodplain, invasive species, grazing, renewable energy, biomass

WWF initiated and developed a series of pilot projects at different sites in Europe to prove that local business can help effectively nature conservation. By identifying and supporting the shared motivations of communities, landowners and local businesses based on nature, the projects have now started to provide jobs, income and business opportunities whilst at the same time conserving or restoring natural habitats. One of these project sites can be found on the Tisza floodplains in north-eastern Hungary.

The floodplain grasslands, wetlands and forests used to be maintained through traditional land use, such as extensive grazing, hay and reed harvesting, sustainable fishing, floodplain orchards and handicraft production. After the abandonment of the traditional land use and intensive water management, most of the landscape is degraded, however many elements still remained. A large part of the area became protected, as a national park (Bükk National Park), and internationally protected, as a Ramsar wetland site. The area is home to globally significant species such as the black (Ciconia nigra) stork, whitetailed eagle (Haliaeetus albicilla) and numerous water birds that migrate to the area in the spring, including herons and geese. In the past couple of decades, this complex traditional management has almost completely vanished. Nowadays, seemingly irradicable, non-native, invasive plants have come to dominate the floodplain.

WWF Hungary has initiated an innovative pilot project in Tiszatarján village, next to the Tisza River in North-Eastern Hungary. The goal of the project is to restore and diversify the 3.000 ha of natural floodplain and produce local renewable energy while increasing and diversifying local income streams. A new company, set up within the frame of the project by the Tiszatarján municipality, a group of local farmers and local employees to harvest of the highly invasive indigo-bush (Amorpha fruticosa) stands, which was shipped to, and burnt at a large nearby energy plant to produce “green energy”. Large areas of land formerly covered by the indigo-bush, together with less productive arable lands, are now being given back to nature, to restore the floodplain’s natural habitats. Some of the area is being replanted with native willow (Salix alba), which will serve as a long-term, sustainable supply of “biomass” for the power plant. Additional project “mechanisms” include the introduction of grazing animals such as Hungarian grey cattle and water buffalo to prevent the return of invasive species, and to assist with grassland management. Finally, these changes provide an attractive landscape for eco-tourism, which will bring in additional revenues to economically diversify and better sustain this Hungarian rural community along rivers originated from the Carpathians.

Thematic session: Forests, their Management and Resources

Chairs:
Ovidiu Badea (Forest Research and Management Institute, Romania),
Andrzej Bytnerowicz (USDA Forest Service, USA),
Ferenc Horvath (Hungarian Academy of Sciences, Hungary),
Stanisław Niemtur (Forest Research Institute, Poland),
Maciej Skorupski (Poznań Agricultural University, Poland),
Jarosław Socha (University of Agriculture in Kraków, Poland)

Forests are a dynamic component of the Carpathian mountain ecosystems: they are important not only as a source of timber, but also for soil formation and slope stability, water retention and quality, biodiversity, carbon sequestration, habitats and corridors for many wildlife species, and recreational usage. The session is focused on forest ecosystems at various scales, specifically on their state and functioning under influences of changing climate, air pollution and different socio-economic scenarios. The session compares and analyzes a variety of forest use and management practices optimal for sustainability of forest resources and ecosystem services.

ORAL PRESENTATIONS

CHANGES IN THE THREAT OF SPRUCE STAND DISINTEGRATION IN THE BESKID ŚLĄSKI AND ŻYWIECKI MTS IN THE YEARS 2007-2009

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Keywords: spruce stands, degrees of reconstruction urgency, stock-taking, plant and climatic zones, the Beskid Śląski and Żywiecki Mts

The present paper describes the dynamics of changes in spruce stand disintegration in the Beskid Śląski and Żywiecki Mts on the basis of the results of stock-taking performed in 2009 as compared to those in 2007. The research was done in 6 forest districts in the Beskidy Mts, belonging to the Regional Directorate of the State Forests in Katowice. The area of spruce stands in degrees of disintegration threat on the day of 30th September in the research period was determined by all forest districts, namely: Bielsko, Ustroń, Wisła, Węgierska Górka, Jeleśnia and Ujsoły, on the basis of data in the State Forests Electronic Database (SILP) in degrees of stand disintegration threat and in plant and climatic zones, according to the algorithm proposed by the present Authors (Barszcz et al. 2009).
Rules of classification of the stands to be reconstructed in degrees of reconstruction urgency:
1 – very urgent reconstruction within a very short period (up to a few years), which should include the following stands: dying ones, where the harvesting of sanitary deadwood (NPS) is above 50 m3/1ha, which corresponds to the active deadwood increase index (NPC) over 16, tree coverage in the stand of 0.1-0.3 and degree of coverage with a young generation of 0.1-0.3;
2 – urgent reconstruction within a relatively short period (up to several years), which should include the following stands: weakened ones, where the harvesting of sanitary deadwood (NPS) is 30-50 m3/1ha, which corresponds to the active deadwood increase index (NPC) of 10-16, stand tree coverage of 0.4-0.5 and degree of coverage with a young generation of 0.4-0.5;
3 – relatively urgent reconstruction within a longer period (within 20-30 years), which should include the following stands: weakened ones, where the harvesting of sanitary deadwood (NPS) is below 30 m3/1ha, which corresponds to the active deadwood increase index (NPC) below 10, stand tree coverage of 0.5-0.7 and degree of coverage with a young generation above 0.5;
Data analysis showed that it was necessary to distinguish the 4th degree of stand reconstruction urgency in order to include the remaining spruce stands, mostly cultures, with tree coverage above 0.7, as well as the few spruce stands which should undergo reconstruction within a long period (over 30 years).
The data obtained from SILP allowed for an attempt at visualization of the results of the current stock-taking in the form of digital maps showing different degrees of stand reconstruction urgency in accordance with the divisions within each of the 6 forest districts under analysis.
Comparison of the results of stock-taking of the stands threatened with disintegration in 6 forest districts of the Beskidy Mts, namely: Bielsko, Ustroń, Wisła, Węgierska Górka, Jeleśnia and Ujsoły in 2007 (altogether 24 446 ha) and in 2009 (altogether 20 983 ha) indicate a decrease in the rate of spruce stand disintegration. A decrease in the area of such stands in the period under analysis amounted to 3 463 ha (i.e. about 14%) altogether. This may point to the slowing down of the rate of spruce stand disintegration as well as to considerable intensification of reconstruction work.

The spruce stands still currently facing the highest threat of disintegration are located in the forest districts of Ujsoły and Wisła, those under medium threat are in Węgierska Górka and Jeleśnia while those under the lowest threat are in Bielsko and Ustroń. This points to the fact that the rate of the disintegration remains constant in the same, southern and south-eastern part of the research area.
There are a total of about 22 650 ha to be reconstructed in the 6 forest districts, most of which are located in the lower forest zone. At higher altitudes, there are fewer stands to undergo reconstruction but they are likely to cause problems due to the small area of the seed producing spruce and beech stands and a lack of such a base for fir and admixture species, and particularly due to a deficient amount of natural regeneration.
The highest percentage of spruce stands to be reconstructed (in the degrees of urgency 1-3) is still situated in the lower forest zone (a decrease in the area by about 30%). Spruce stand reconstruction in this zone as well as in the foothills (an increase by over 2.3 times) will be relatively easy thanks to favourable site conditions, a possibility to use a wide range of species as well as a large number and large area of the existing seed producing stands containing the main forest creating species. What may become an obstacle is the amount of effort resulting from the size of the area to undergo reconstruction.
Threatened spruce stands in the middle forest zone are a smaller but still considerable group in terms of area (area decrease by about 23%). This zone contains fewer seed producing spruce stands, little beech and no seed base for fir and admixture species; for this reason the reconstruction of these stands will be more problematic.
In the upper forest zone, the reconstruction of spruce stands, which are almost entirely in the course of dying and disintegration will, despite their small area, cause the largest problems because there are no recognized seed producing stands in this zone, few species for potential use and unfavourable site conditions, especially in the mountain top and range locations.
According to the present Authors (cf. also Barszcz et al. 2009), the reconstruction should also include the remaining spruce stands, i.e. cultures (about 18 000 ha), classified as the 4th degree of threat, and revealing the least visible symptoms of damage.

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NORWAY SPRUCE DECLINE IN THE SILESIAN AND ŻYWIEC BESKIDS IN RELATION TO FOREST SITE CONDITIONS.

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Keywords: Norway spruce, forest decline, the Western Beskidy, forest site conditions

Spruce stands in Polish Beskids have shown symptoms of decreased vitality and resistance for over a dozen years, resulting in large-scale forest decline. This situation refers particularly to older stands, which cover a large part of the Silesian and Żywiec Beskids, playing the protective function as a superior role. This dangerous situation leads not only to serious ecological consequences, but also to other problems regarding forest use and restoration. The Spruce stands decline in Beskids can neither be perceived as a new occurrence, nor as an area-specific one. European forest studies indicate this as a major problem. Thus, deriving scientific principles for alleviating the negative impacts as well as deliberating the new management plans requires rather local approach. Furthermore, all forecasts should be included in the active planning, in frames of forest foresight.
The most harmful events in Polish Mountains in recent period took place in 1980's in Western Sudeten, where 160 km2 was deforested by acid rains as a main reason. From beginning of 1980 we have observed significant air pollution decrease in Poland, as well as in whole Europe, but heavy deposition during last decades and reinforced climatic anomalies contribute to serious damages also in polish Carpathian forests.
Additional reason for poor vitality of Beskids spruce stands was introduction of foreign spruce genotypes, namely spruce monocultures, not adapted to the local sites and soil, instead of mixed stands with beech and fir in a major share.
Impaired trees are especially vulnerable to fungal infections, but most of all to bark beetles attacks, which are usually the last agent in the mountain spruce stands dieback process. Therefore trees exposed to these organisms are currently under special treatment, to slow down stand decline process and to sustain their existence in order to provide successful regeneration.
The aim of this paper is to evaluate the influence of forest site conditions on the stand decline dynamics in the selected forest inspectorates of Beskids. The second important goal is to propose the optimum share of spruce in current and future stands in Beskids, depending on spatial variety of forest sites and climate change forecasts.
The bases for all research were geomatics materials, mainly as digital layers together with database, integrated with digital map (Polish abbrev. LMN - Leśna Mapa Numeryczna) and IT Forest State Systems (Polish abbrev. SILP - System Informatyczny Lasów Państwowych). Software used in the analytical process includes: GIS ArcView, ArcGIS and extensions for spatial analysis – Spatial Analyst and 3D Analyst. The influence of forecasted climate changes on stand development in the Silesian and Żywiec Beskids was determined on the basis of Digital Elevation Model (DEM), including the physiographic

conditions. An exposure and slope inclination map was derived from data provided with SILP and DEM tables. The forecast for optimum spruce share in the species composition in Beskids forest stands was done by means of comparative analysis of geomatics materials, taking in consideration forest site variations, in terms of microclimatic conditions presented in basic silviculture principles.

The spatial analysis of forest sites and spruce stands in Beskids indicates that Norway spruce is the dominant species regardless of site type in vertical and horizontal gradient. The largest areas in the research are fertile sites - mixed mountain forests (Polish abbrev. LMG), amounting to 51.38% of the whole region. They reach up to 1,000 m above sea level, where they shift to poor site - mixed mountain coniferous forest (Polish abbrev. BMG, 10%). On lower elevation (700 m above sea level) mixed mountain forests (LMG) neighbours with mountain forests (Polish abbrev. LG) - 24%. Hence, the tree habitats which are suitable for mixed forest development exceed 75% of the whole area. Habitats suitable for spruce stands in the region amount to 25%. The current percentage of spruce trees in some forest divisions of the Żywiec Beskids exceeds even 90%.

Greatest share of spruce trees in stands can be found in BMG and LMG sites. Furthermore, these stands are usually classified as the oldest ones, growing mostly on intermediate ridges and slopes located in the highest areas. The average age of spruce stand in the given area is quite high (70 years old), and is related to the fact of large areas covered by of seed stands or protection forests.

The current situation in the Beskids triggered by the bark beetles (Ips typographus) outbreak and fungi pathogens, makes ca. 43% of the area covered by spruce stands endangered by decline. This, in turn, constitutes 61% of the standing volume in the investigated forest inspectorates.

The spatial analysis of spruce stands dieback in the most endangered forest inspectorates (Węgierska Górka) has shown, that the largest decline was observed in the southern and western exposures. This fact is related to high soil and air humidity demands of spruce trees. It can be mostly seen in stands located up to 1,000 m above sea level, which may be traced back to higher annual precipitation. In forest divisions with lower percentage of declining spruce trees, the most of standing deadwood emerges on southern, western and northern slopes. This information should be taken into account when planning the spruce share for new stands (Fig.1).

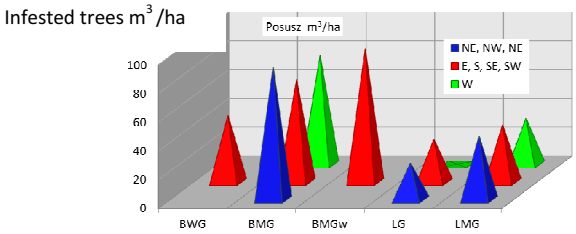

Figure 1. Infested trees in Węgierska Górka forest inspectorate (2007) depending on site type conditions and exposures

According to the conducted analyses, a new stand composition was created with keeping the spruce as a relevant tree species. Those stands however will correspond to the altering climatic situation in Silesian and Żywiec Beskids. Percentage of spruce trees in poor sites - BWG (high mountain coniferous forest) should not exceed more than 60-70%, in BG (mountain forest) – 40-50%, in BMG (mixed mountain coniferous forest) – 50-60%, and in mountain forests (fertile site) - 10-20%.

In the long run, stand conversion in the lower subalpine forest in fertile site conditions should aim for decrease on the spruce share up to 10-20%, depending on site conditions and microclimate. This is related only to fertile sites (LG, LMG), which constitute 80% of all site types in some of forest divisions. Stands with spruce as the dominant species should remain in the higher subalpine forest and higher parts of the lower subalpine forests for BWG, BG and BMG poor site conditions.

The uncontrolled large-scale decline of spruce stands may only be stopped by a revision and shortening the regeneration period for the main forest tree species in Beskids, i.e. fir, beech and spruce. There is also a need to reduce the cutting age of spruce trees, in order to facilitate controlled logging. Introduction of new tree species into the stands should be preceded by a proper recognition of microsite conditions, especially in the diversified areas such as Beskids.

MODELLING ABOVEGROUND FOREST BIOMASS IN THE WESTERN CARPATHIANS

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Keywords: biomass, random forests, forest inventory, Carpathian Mountains, Landsat

Maintaining long-term forest productivity is critical for both regional and global climate, as forests provide carbon sequestration potential. Forest biomass is hence an important parameter for studies of forest productivity and carbon cycling dynamics (Bonan, 2008; Eggers et al., 2008; Schulp et al., 2008). Modelling biomass using forest inventory and remote sensing data allows up-scaling from field measurements to continuous broad-scale forest information. Our

objective thus was to evaluate the relative contribution of inventory data, spectral information and derivatives from topographic data to predict aboveground tree biomass, exemplified for spruce forests in the Western Carpathians.
The Carpathians are Europe's largest continuous mountain forest ecosystem and an important carbon pool due to the high forest productivity. However, regional productivity varies and depends on previous forest management, regional climate and environmental conditions.
Spruce plantations provide homogeneous species composition and stand structure in large parts of the Western Carpathians since the 19th and 20th century (Fabijanowski and Jaworski, 1995). This led to lower tree resistance to stress factors such as air pollution, insect pests, diseases, and extreme weather events, ultimately resulting in the heavy spruce dieback now experienced throughout the region (Ditmarová et al., 2007; Grodzki, 2007; Šrámek et al., 2008).
To predict biomass, we used three groups of predictors and a random forest regression approach (Breiman, 2001; Prasad et al., 2006). Predictive variables were derived from Polish forest inventory data, field measurements, Landsat Thematic Mapper data and a digital elevation model. While inventory data would be the ideal source of information, these are not yet available in digital formats everywhere or become easily outdated when a lack of personnel resources prohibits regular updates. Satellite data therefore enable creation of independent, up-to-date and spatially continuous information layers.
Generally, models combining the stand-based inventory data, spectral and topography data did not result in higher accuracy of biomass predictions than the inventory-based model alone. Correlation coefficients of the most accurate models range from 0.52 for Landsat TM- and topography-based biomass estimates to 0.98 for the inventory based models. Using spectral and topography data alone, we could explain 27% of biomass variation. Evaluation of variable rankings for spectral and topography-based predictors revealed that inclusion of elevation was crucial for predicting biomass.
It is hence not a surprise that inventory data, where available, are an excellent source of spatial information about biomass of spruce forests and related productivity. Where such data is not available, combined satellite and DEM data have potential for predicting aboveground biomass with reasonable accuracy in regions comparable to the Western Carpathians.

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COMPUTER TOMOGRAPHY IN WOOD-DECAY ASSESSMENT OF SILVER FIR (ABIES ALBA MILL.) STANDS IN POLISH PART OF CARPATHIANS

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Keywords: fir stands, wood-decay, computed tomography, Picus Sonic, Carpathians

Silver fir (Abies alba Mill.) is one of the major tree species in the Carpathians, being natural component of mixed stands with beech and spruce, mostly in the lower mountain zone. It is considered as ecological stabilizer of Carpathians forests, being the perfect species to form multigenerational stands with diversified structure, resulting in forest biodiversity increase. After a period of fir stands area reduction, and replacing them with spruce and beech, recently this species come into prominence again. Revitalization of existing fir stands and relatively good regeneration development enables to wider usage of this species in silviculture and restoring fir for its natural range and sites.
Increase of interest in Silver fir is connected, first of all, with the large-scale dying back of spruce stands in Beskids Mountain and conversion of these artificial spruce monocultures to mixed stands with numerous participation of fir. One of the reasons for spruce stands vitality reductions are fungi diseases, causing root and stem rot of trees. The most widespread agents of root rot are fungi from the genus Heterobasidion, confirmed as the most devastating disease of conifers in the northern hemisphere. It is also widespread in forests in the United States, being responsible for the loss of one billion U.S. dollars annually.

Silver fir is one of the most productive European woody species but it has high requirements for air moisture. Exception to this is relatively xerophilic relict in alpine ecotype from Wallis canton (southwest Switzerland). This area has very low precipitation between 400–550 mm per year – from that is during summer only about 270 mm (Bernicchia at al 2007). A usually high requirement of fir for air moisture is favorable for spreading of fungi diseases.

There are numerous fungi able to cause the rot of fir trees, but meantime there is lack of information about size of these damages, particularly in seed stands where we carried out investigations of rot damages in fir stands of advanced age.

Our investigations were carried out in three fir seed stands, representing different parts of firs range in the Polish Carpathians. In Silesian Beskids were chosen spruce and fir stand in Węgierska Gorka forest inspectorate, in Island Beskids fir seed stand in forest inspectorate Limanowa and in Bieszczady fir stand with the admixture of beech in forest inspectorate Baligród. These stands were located in the lower mountain zone (from 610 for 833 m a.s.l.), in age from 120 to 150 years. In each stand 30 trees were chosen at random for investigations of rot presence into the lower part of stem. In Węgierska Gorka forest inspectorate also 30 spruce trees were examined for comparison, and 10 beeches in Baligrod forest inspectorate.

Investigations were conducted with computer tomography method, with use of Picus Sonic tomograph, a non-invasive tool for trees diagnosis. It is the only method that enables estimation of wood damages inside the trunk, without cutting or boring the selected trees. This is important in growing seed stands and all the more in national parks and reserves.

Our computer tomography investigation revealed large participation of stems with decay in chosen stands. All diagnosed fir trees in W. Gorka forest inspectorate showed wood damages in stem, and in Limanowa and Baligrod close to 90%. Average size of damaged wood zone on cross section was also the biggest in W. Gorka, amounting to over 22% of the tomogram area, whereas it was 14% in Limanowa and 13% in Baligrod.

In case of diagnosed spruce trees, percentage of stems with decay was even lesser than in fir trees, amounting to 90%, whereas examination of the group of ten beeches in Baligród revealed the extensive decay only in one case.

Intensification of wood decay occurrence is related to stand age. It was extensively described for spruce stands, also on the basis of our research with the Picus Sonic tomograph. It was suggested by some authors, that silver fir is not so rot susceptible species as Norway spruce; however there is still lack of detailed information about this phenomenon extent in fir stands. Meantime, examinations we carried out in fir seed stands in the Carpathians do not confirm this statement.

Participation of fir trees with damaged wood in stem was similar or even bigger than of spruce trees in advanced age. However, we found also healthy individuals among inspected fir trees. They should be mother trees for future regenerations and stands in the first order. For this reason is planned wider usage of the computer tomography method in selection for forest tree breeding program.

However, to determine potential dissimilarities in damage character between Silver fir and Norway spruce, further researches are required. Especially since both of them are the most important forest tree species in Carpathians, often forming mixed stands. Frequent wood damages caused by fungi found in butts of fir trees from various parts of the Carpathians in Poland, force to further observation of this species health condition.

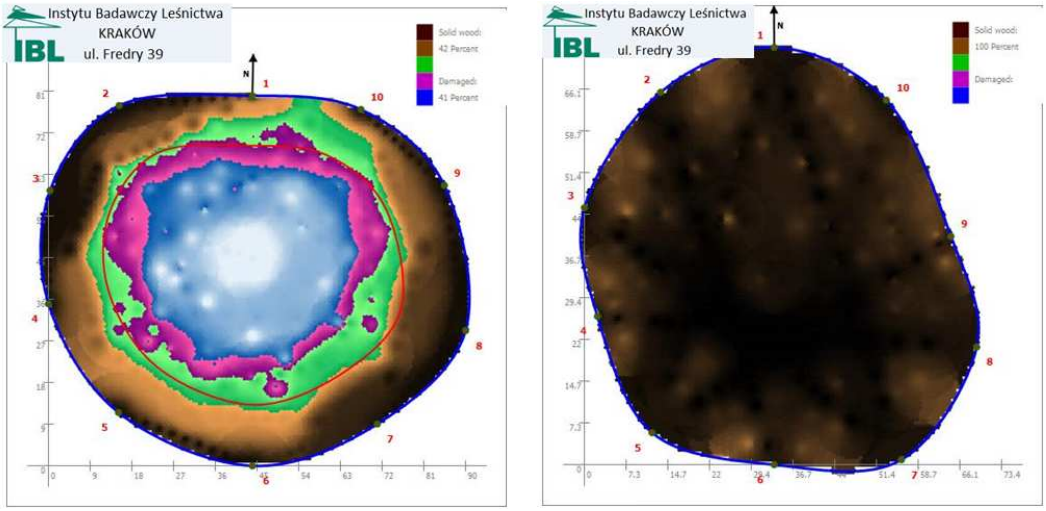

Figure 1. Tomogram (cross section of tree stem) of the tree with the wood-decay and the healthy tree

TILIA CORDATA MILL., ACER PSEUDOPLATANUS L. AND PINUS SYLVESTRIS L. AS VALUABLE ADMIXTURES IN THE CARPATHIAN FORESTS

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Keywords: productivity, nurse stand, protection tasks, natural forest, primeval forest, Bieszczady Mts., Obrożyska reserve

Polish Carpathian forests (territory of the Carpathian Province) are dominated mainly by Abies alba Mill., Fagus sylvativa L. and Picea abies L. (almost 71% of the state forests). Each of this main species occupies suitable sites in terms of altitude, fertility and climatic conditions. Besides them there are many other tree species, which can serve as a valuable admixture or even co-dominant species in the Carpathian region.

One of the main admixtures species in silver fir, beech or spruce stands growing on rich and medium rich sites is Acer pseudoplatanus L. Sycamore maple with beech very often constitute unique Aceri-Fagetum and common Dentario glandulosae-Fagetum forest associations. In such primeval forests, occurring in Bieszczady Mts., four permanent sample plots were established in 1993, where periodic stand measurements have been accomplished. On the basis of this studies it can be concluded that sycamore maple can be a high productive co-dominant or even dominant species (from 65 m3/ha on the highest elevation to 261 m3/ha on lower altitude) in mixed sycamore-beech stands growing on altitude between 930 and 1160 m a.s.l. Furthermore these stands in Bieszczady Mts., especially in the vicinity of upper forest limit, constitute permanent and stable forest communities, which are able to fulfill protection tasks. Similar natural stands consisted of beech and sycamore maple can be found in Stužica reserve in Slovakia (near Polish and Ukrainian border), which have been studied since thirties of 20th century.

On the lower elevation (up to 600 m a.s.l.) forest association Tilio-Carpinetum can be found, where Tilia cordata Mill. is one of the dominant tree species. Such forests are in “Las Lipowy Obrożyska” reserve, which is situated near Poprad river (Beskid Sądecki Mts) in vicinity of Muszyna town. That little-leaf linden forest is a relict of linden stands abundantly occurring in this part of the Carpathians in the postglacial climatic optimum. In this unique stand, considered as a natural forest, three sample plots were established in 1990, where detailed stand measurements have been performed every 10 years. On the basis of the measurements it has been found that the linden forest in Obrożyska reserve have one of the greatest volumes (760 – 860 m3/ha) among primeval and natural stands in Polish part of the Carpathians. So large volume occurred owing to the high share of little-leaf linden, thus it can be concluded that Tilia cordata Mill. appeared to be a valuable productive admixture or co-dominant species on favourable site conditions.

Scotch pine (Pinus sylvestris L.) dominated stands, which share in the Carpathian forests is about 17,5%, can be found mostly in the uplands (up to 600-700 m a.s.l.), where they are of artificial origin and on higher elevation as patches of admixture, often of natural origin, in silver fir or beech stands. In such, mostly autochthonous, 39 stands of Pinus sylvestris L. the investigations on occurrence and differentiation of the main tree species were done. In each selected stand the detailed measurements of 20 mean sample trees (80 to 170 years of mean age) from the upper stand stratum were carried out. The investigated stands were in most cases characterized by normal vitality, long crowns, low quality of the trunk and high volume (up to 675 m . In each of the analyzed stands a high stability of Scotch pines was observed (the ratio of height to breast high diameter of trees was below 80). Pine tree as an admixture species can play a stabilizing role in stands prone to wind damages, and can be a productive admixture or co-dominant species in silver fir or beech stands. Additionally the site condition created by Scotch pine are conducive to the abundant appearance of the main and admixtures climax species, mostly Abies alba Mill. This role of pine stands as a nurse crop stands enables the prolongation of the transformation period and attainment of multi-storey, uneven-aged silver fir stands.

MANAGEMENT OF NORWAY SPRUCE STANDS IN WESTERN CARPATHIANS

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Keywords: Norway spruce, thinning, static stability, abiotic hazard factors, Western Carpathians

Introduction

In the Czech Republic, the Moravsko-slezské Beskydy Mts., the Hostýnsko-Vsetínské vrchy Mts. and the Javorníky Mts. create an important part of the Western Carpathians. This region is characterized by high percentage of forest cover. Although broadleaves dominated in natural species composition, Norway spruce stands cover more than one half of present forest area. Higher portion of spruce is a historical result of wide using and utilization of spruce wood.

Norway spruce stands, which were established in the last century, grew relatively well in the last decades. But forest decline (drying, yellowing) has been observing here last several years. Massive dying is observed now in spruce stands

cultivated in zones with elevation 400 – 600 m, mean temperature 6,0 – 7,5 ˚C and precipitation 650 – 800 mm, i.e. in the zones where spruce is not the original species, at least not in monocultures.

The health condition of the forest in the Western Carpathians must be reflected in forestry management. The main principles of the new forestry concept in the region consist in conversion of current spruce monocultures to stand with close-to-nature species composition. This process should be continual and current spruce stands must be stabilized before it because canopy opening, as a starting operation of conversion, is usually connected with following stand disintegration in the unstable spruce monocultures.

The possibilities of preparing spruce stand for conversion can be evaluated using the long-term results of thinning experiments which were established in the Czech part of the Western Carpathians in 1960 by Forestry and Game Management Research Institute Strnady.

Therefore, the main objective of presented study is focused on long-term effect of silviculture measures (high thinning and low thinning) on stability of mature Norway spruce monocultures in the Western Carpathians. We specified hypothesis that silvicultural measures (thinning) can support spruce stand stability and conversion of these stands is consequently less risky.

Methods

Forestry and Game Management Research Institute Strnady has created a new experimental basis for thinning research since 1956. A total of 46 experimental series were founded in Norway spruce (Picea abies /L./ Karst.); 24 series are still being maintained. This contribution focuses on the group of series established in young Norway spruce stands in 1960 in the Western Carpathians (Tab. 1).

Table 1. List of experimental series in Norway spruce stands established in 1960 in the Western Carpathians

	Name	Age[1]	Comparative plots[2]	Coordinates in WGS-84 system	Elevation (m)	Forest type group according to Viewegh et al. (2003)
1	Frýdek - Místek	49	C, H	49°31´22´´	730	*Piceeto-Fagetum acidophilum*
2	Ostravice	43	C, H, L	49°27´32´´	570	*Piceeto-Abietum variohumidum acidophylum*
3	Velké Karlovice I.	48	H, L1, L2	49°21´22´´	794	*Piceeto-Fagetum eutrophicum*
4	Velké Karlovice II.	48	C, H	49°21´22´´	794	*Piceeto-Fagetum eutrophicum*
5	Velké Karlovice III.	41	C, H	49°20´34´´	734	*Piceeto-Fagetum acerosum humidum*

[1]Age in 1960, [2]C – control without thinning, H – high thinning (positive selection from above), L (1,2) – Low thinning (negative selection from below)

The subjective of thinning experiment was to compare two basic methods of thinning: positive selection from above (H) and negative selection from below (L). Each experimental series has one control plot (C) where no thinning was conducted. It was expected that thinning started at 40 – 50 years will result in: (1) Deeper differentiation of diameter structure, e.g. better survival of smaller trees and (2) Higher diameter increment of all trees left after thinning and consequently in their better static stability.

The methods for founding and evaluation of long-tem thinning experiments is based on the standardized techniques and methods used in forestry research. This methodology was established by the Forestry and Game Management Research Institute in 1956 – 1957 (Pařez 1958).

The basic area of partial comparative plot is square of 0.25 hectare. The experimental series are surveyed as a rule in five-year periods off-vegetation-season and all trees are measured by callipers in mm over bark. The height of the stands is measured by telescopic poles or Blume-Leisse altimeter on representative groups of trees (30 individuals of all tree classes) and height curves are calculated to assess the mean and top height.

In the frame of the presented study we used mentioned experiments for analyses of diameter structure and diameter growth development of observed spruce stands. Differences between variants were tested using Kruskal-Wallis one-way ANOVA in statistical software package UNISTAT® (version 5.1). Unless otherwise indicated, test levels of $p < 0.05$ were used throughout.

Results and discussion

At the end of observation period (2005), the diameter distributions were partly different on comparative variants (fig. 1). We found significantly lower amount of thinner trees (diameter degrees -20 cm and 21-30 cm) on plots with low thinning compare to control plots. Number of thicker trees was not affected by thinning – differences between variants were insignificant.

Values of h/d ratio continually decreased with diameter degrees on comparative plots (fig. 1). Our study confirmed that Norway spruce stands without thinning or thinned by positive selection from above (high thinning) are unstable as a large portion of individuals exceeds the h/d ratio of 100 (diameter degrees up to 30 cm) probably due to mutual competition for light, water and nutrients and consequent diameter growth depression.

Generally, h/d ratio values higher than 100 imply low stability of stands (Lekes and Dandul 2000). Some studies (e.g. Mildner 1967) set the critical value to 90, especially in connection with snow damage in young stands. Lower values were recommended by Vicena et al. (1979) who mentioned an optimal h/d ratio of 79 or maximal (acceptable) one of 83. A very detailed study on the basis of results from 85 research plots was done in Slovakia (Konopka 1999). This study determined the degrees of static stability of spruce stands on the basis of h/d ratio values as: excellent ≤ 82, good 83-92, satisfactory 93-101 and dissatisfactory ≥102.

In our study we found significantly higher h/d ratio for thicker trees (diameter degrees over 40 cm) on plots with low thinning compared to unthinned stands or stands with high thinning. But these differences are numerically small and the values of h/d ratio were 82 and lower on all variants. It means excellent degree of static stability according to Konopka (1999) mentioned above.
Although we recognized some significant differences between unthinned stands and stands with low thinning, observed effects were relatively small. Similar low effect of thinning in Norway spruce stands was reported by Eriksson (2006), Makinen et al. (2006) and Pelletier, Pitt (2008). On the other hand higher positive effect of early thinning or wide spacing on stand stability is supported by many other studies (e. g. Pollanschütz, 1974, MacCurrach, 1991, Nielsen, 1995, Brüchert et al., 2000, Slodicak, Novak 2006).

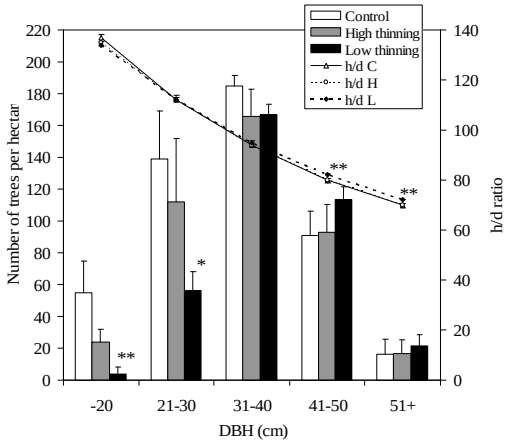

Figure 1: Diameter distribution and h/d ratio on comparative plots with different thinning regime of thinning series founded in 1960 in the Western Carpathians (means with SE). C – Control, H – high thinning, L – Low thinning. Statistically significant differences between variants: *p<0.10, **p<0.05

Conclusion

On the basis of the presented analyses, we drew following conclusions:
On the experiments started with thinning at the age of 40 – 50 years, diameter distribution of stands was influenced by treatment based on low thinning only. We found significantly lower amount of thinner unstable trees (diameter degrees -20 cm and 21-30 cm) on plots with low thinning compare to control plots.
Although we found significantly higher h/d ratio for thicker trees (diameter degrees over 40 cm) on plots with low thinning compared to unthinned stands or stands with high thinning, observed differences were numerically small and the h/d ratio showed excellent values (82 and lower) in these diameter degrees on all variants.
In the Western Carpathian area we can recommend low thinning as a major silvicultural measure for stabilising of Norway spruce stands before conversion. On the basis of results from literature early (compared to our experiments) start of thinning in young spruce stands is suggested.

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VARIOUS PATHWAYS OF SECONDARY SUCCESSION AFTER LARGE-SCALE DESTRUCTION OF SPRUCE MONOCULTURES IN THE WESTERN BESKIDY MOUNTAINS

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After the large-scale windthrows, which had occurred in November 2004, the disintegration of Norway spruce (Picea abies) monocultures in various parts of Western Carpathians accelerated significantly. It was especially pronounced in the Western Part of the Beskidy Mountains, where the outbreak of bark beetles was accelerated by the high summer temperatures in 2006 and 2007. As a result, thousand of hectares of spruce stands have been clear-cut and large part of the area – especially in higher elevations – appeared almost bare. Following the cuts, a broad-scale tree planting program has been applied, and the species most commonly planted were European beech Fagus sylvatica and silver fir Abies alba. Some seedlings in the clear-cut areas had been planted earlier, underneath the spruce canopy, before the stands were attacked by bark beetle. There is also ample natural regeneration – partly established before the stand destruction, partly after cuttings. In our study we focused upon the density, species composition and distribution of the young generation of trees –

natural regeneration along with planted seedlings – in the areas strongly affected by the bark beetle outbreak and largely clear-cut during the last few years. Throughout the study area we established a network of hundreds of small, circular sample plots. Within those plots we counted seedlings of in various size and age classes, and we identified all vascular plants and estimated the percentage of cover for each species. According to our survey, the density of the young generation of trees was strongly variable, although there are no areas completely deprived of regeneration. Norway spruce was the dominant species among seedlings, especially in the Beskid Śląski range. Regeneration of beech and silver fir – two species believed to be the most important components of future forest stands – made up only a small percentage of the total number of seedlings and saplings; in Beskid Śląski it was represented almost exclusively by planted seedlings, while in Beskid Żywiecki there was also quite numerous natural regeneration of beech. In Beskid Żywiecki we found also a substantial admixture of sycamore Acer pseudoplatanus among the natural regeneration in moist and fertile habitats. The typical pioneer species – like birches (especially Betula pendula), willows (especially Salix caprea) and aspen Populus tremula – were present in the area under study, but usually occurred in low densities. This is in a sharp contrast with forest of lower elevations, where the larger opening created after spruce removal had been filled with dense thickets of silver birch. The lack of mature birches, willows and aspens in the tree stands in higher elevations is the likely explanation for the low numbers of seedlings of those light-demanding species, appearing in the clear cut areas. Investigations of species composition and cover of the ground vegetation revealed, that plants typical for the forest understory – especially bilberry Vaccinium myrtillus – still dominated in the open areas, especially in the Beskid Śląski range. In Beskid Żywiecki, where the soils are generally riches, the species composition of the ground vegetation in clear-cut areas was more diverse. The share of grasses – which are considered strong competitors for tree seedlings - was still restricted to the places, where the stand canopy have been partly opened before the massive bark beetle outbreak. The dominant species among grasses was Deschampsia flexuosa, while the more aggressive competitors – like Calamagrostis arundinacea or C. epigeios – were definitely less frequent, although locally abundant. Leaving large part of the clear-cut area for natural succession seems a viable option; the seedlings of beech and fir can be planted under the cover of pioneer tree species for many years, creating opportunity for development of mixed, uneven-aged forests, hopefully not only more natural, but also more resilient than the spruce monocultures

PATTERNS OF TREE SPECIES COMPOSITION AND THEIR RELATION WITH CLIMATE AND PAST FOREST MANAGEMENT IN HARAGISTYA-LÓFEJ FOREST RESERVE (AGGTELEK KARST, HUNGARY)

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Keywords: Aggtelek Karst, climate change, tree species composition

Introduction

In 2007 the United Nations intergovernmental scientific panel studying climate change declared that the evidence of a warming trend is 'unequivocal', and that human activity has 'very likely' been the driving force behind that change over the last 50 years (IPCC report 2007). Consequently the debate now seems centred less over whether there is a change or whether human activity is the cause, rather over how to deal with its effects. As Kramer and Mohren (2001) state forests are especially vulnerable to climate change, due to the longevity of trees. Gálhidy et al. (2006) studied the relationship between a range of climatic indices and the distribution of zonal forests in Hungary. Sessile oak (Quercus petraea) and beech (Fagus sylvatica) are among the most frequent and economically significant tree species in the region. According to their findings the presence of beech, formerly associated with the mean air humidity at 14:00 in July, was best explained with Ellenberg's Climate Quotient (July temperature/annual precipitation) whereas in the case of sessile oak annual mean temperature was the main predictor, followed by either mean annual precipitation or mean summer temperature. Karstic habitats are in many cases quite extreme and therefore especially sensitive to change. Our research and monitoring activity in Haragistya-Lófej forest reserve (Aggtelek National Park, N-Hungary) has started in 2006. Part of the foothills of the Carpathians at 400-500 m asl, the area bears all the hallmarks of a typical karst plateau, with a dry and highly varied surface, covered by series of dolines and dry valleys. According to the local value of Ellenberg's Climate Quotient (31.2 based on climate data from the years 1958-2008) it is situated at the climatic boundary where beech's competitiveness decreases. In such circumstances even minor changes in the climate can be expected to significantly modify species composition. There are indeed signs of recent change in the reserve and the reasons could be anthropogenic as well as natural. The aim of this study is to summarize what is known about the climate of this area and to interpret recent changes in the tree species composition of the sample area with relation to the climate and the anthropogenic impact of the last 50 years. Since there are no detailed data available from the past we attempt to track changes based on the species composition of living trees, deadwood and young trees within the different forest types.

Methods

In order to gain information about present and past climate we used the monthly temperature and precipitation data of Jósvafő and Silica meteorological stations from the period 1958-2008. We calculated the Standard Precipitation Index (McKee et al. 1993) and analysed the frequency, duration and strength of drought events for the last 50 years. We have

analysed the spatial distribution of different forest types in a 90 ha part of Haragistya-Lófej Forest Reserve and examined the species composition of living and dead trees within each type. Data from measurements carried out in 2006-2007 in permanent circle plots served as a basis for the analysis. We defined deadwood types based on the species composition for each sampling point and examined the connection between forest type and deadwood type, looking for anomalies as signs of possible change. In order to gain some information on recruitment tendencies, the species composition of young trees was taken into account.

Results

Compared to the relatively cool period lasting from the middle of the 1970's until the beginning of the 1990's the last 20 years brought an increase in the annual mean temperature. However there has been no definite change in the annual precipitation sums. The 3-and 6-months SPI values show that the number of dry spells decreased in the last decade but their average length and intensity increased. The average length and intensity of wet periods have gradually decreased since the beginning of the 1970's but show a bit of increase in the last decade.

As for changes in the species composition the same species were dominant among the living trees as among the dead ones in most forest types. However in the different beech (Fagus sylvatica)-dominated stands the snags and fallen dead trees are mainly hornbeams (Carpinus betulus) and sessile oaks (Quercus petraea) or there are no dead trees at all. Dead junipers (Juniperus communis) are frequent in any kind of open oak forests around the hilltops and ridges, and the remains of a few individuals can still be found even in some of the mesophilous forest types. Our dataset allows only limited information on recruitment processes due to the size limit applied, however the different oak species represent only 9% of the recorded young trees whereas young beech trees appear throughout the study area.

Discussion

Present patterns of tree species composition in the area are most likely the result of 3 different processes. The first one of these is natural succession following the last clear-cuts; a general lack of funding in the late 1940's led to the forest regenerating in a natural way, mainly from coppice stools. Its most visible effects nowadays are the slow reforestation of the remaining meadows and the closing of the canopy layer accompanied by the gradual disappearance of pioneer species like birch (Betula pendula) or juniper (Juniperus communis). Some of the stands were later subject to thinnings as part of the classical forest management procedure. Forestry practices at this time included suppressing some species (e.g. hornbeam – Carpinus betulus and lime – Tilia spp) in favour of others (especially oak species) although economical considerations sometimes led to alterations from these rules. Since the area was designated a forest reserve in 1993 and placed under strict protection forest management activities have ceased entirely in the core area and are very limited in the buffer zone. Therefore the second important driver of the present processes is related to a 'correction' of earlier human-induced changes; the retreat of oak (especially Quercus petraea) could be a sign of this. The effect of climate change will be added to those previously mentioned which makes it considerably more difficult to predict. Despite the fact that the amount of annual precipitation does not seem to be changing, long and intensive droughts can easily result in the shifting of habitats. In the case of beech, which currently seems to be gaining dominance, an increase in the strength and duration of drought events may become a seriously limiting factor.

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INTEGRATION OF LIDAR AND GIS FOR DIGITAL FOREST MAP REVISION AND DESCRIPTIVE DATA BASE UPDATE - CASE STUDY ON TATRA NATIONAL PARK

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Keywords: Tatra National Park, Norway spruce stands, ALS, Digital Forest Map, SILP database, GIS.

Protected areas are one of the most important targets of UE Directives and Conventions. Some of them concern saving habitats and birds species biodiversity, other allow public access to spatial information (like INSPIRE). For many years the administration of Polish National Parks is trying to establish standards and structure of GIS data and exchange schemas. For more than 10 years Polish State Forests National Forest Holding (PGL LP), which owns approx. 25% of Poland, introduced a standard - Informatics System (called SILP), which is a pure descriptive database. At the same time, other standardized GIS product was introduced in 420 Forest Districts - Digital Forest Map (LMN), which contains polygons (borders of forest compartments with unique ID), lines (e.g. roads) and points. Together, SILP and LMN, create a topologically correct, geometric layer with many attributes from forest inventory, which can be managed with GIS software. Due to the direct neighborhood of Polish State Forests and National Parks and arising necessity of information exchange between those

institutions, some NP consider the idea of using SILP database standard and accepting geometric structure of LMN. Tatra National Park, one of the first GIS and geo-technologies users, is using those two products of PGL LP (SILP + LMN). National Parks protection plans performers are used to work with these standards. It is obvious that this solution is not able to describe all richness of information describing the protected areas, but is a good starting point for proper modifications. Remote sensing technologies, including LiDAR (Airborne Laser Scanning; ALS), are able to provide accurate spatial data, for large and hard accessible areas. This data (3-D point cloud) can be used to derive information about terrain topography or some forest stand parameters which are needed for construction of forest management (McGaughey et all. 2004; Hyyppä et all. 2004).

The aim of presented study was an elaboration of automatic methodology of ALS point cloud data processing for Digital Forest Map revision (geometric errors) and update of attribute values stored in the descriptive SILP relational database. Such elements like: forest gaps, clearings, bio-groups, beetle bark-dead trees, wind damaged trees, areas of low canopy closure, are usually not taken into account using standardized Digital Forest Map (LMN). It seems that methods based on normalized ALS point cloud and GIS spatial analyses performed on interpolated canopy surfaces (nDSM) as well, bring instant compartment borders correction and can introduce new important objects (geometry with attributes) inside them. Such updated spatial information is important for determining the real forest area, the stage of stand development phase (gaps are the natural beginning of forest regeneration), the complexity of tree line and the vertical range of mountain dwarf pine (spatial indexes).

Selected attributes of SILP database, such as forest stand height, collected during forest inventory work, are possible to be updated using ALS data (e.g. the 95th percentile). Usually height of stand is not accurate, due to many factors, mainly canopy closure or used hypsometers. Some parts of forest stands, e.g. growing on extremely steep slopes or isolated ledges, will never be measured using traditional methods, while ALS technology allows determining chosen parameters very accurately. In high mountain areas additional problems may occur in deriving proper 95th percentile of ALS point cloud. Correct normalization of ALS data is dependent on effects of filtration and classification algorithms. Such terrain objects as: rocks, boulders, clefts, lying dead wood, often are causing inaccurate DTM, and, as a consequence, inaccurate nDSM.

The study area located in Tatra National Park (South Poland) cover 388 compartments with total area of 1854.9ha, from which the target of the study was 1107.9ha of forest stands and 772ha of dwarf mountain pine (Pinus mugo Turra; 102 compartments). The main tree species in the study area is Norway spruce (Picea abies (L.) Karst.), growing on 1002.8ha (167 compartments), which is 54.1% of study area. The age diversity of Norway spruce is large, which implicates existence of natural stands, but there are also large areas of relative young stands, due to strong wind damage in 1965 and 1968. The effect can be observed in number of stands within 2nd (21÷40 years) and 3rd (41÷60 years) age class (11.1% and 15.3% of Norway spruce area respectively). Two other numerous age classes are 7th (121÷140 years), covering 10.9%, and 9th (161÷180), covering almost 14.5% of Norway Spruce area. The oldest natural spruce stands, with age estimated between 240-260 years, cover 2.8% (26.6ha). Stands over 100 years old, cover over 55% of all Norway spruce stands area and are the biomass richest stands (the largest wood volume per hectare). Proper age and spatial structure are the most important factors deciding of forest stand sustainability in extreme high mountain environment.

The results of automatically performed analysis of forest stand heights based on ALS point clouds (McGaughey 2007) where divided into subgroups within age categories. They showed that stands younger than 80 years are on average higher using ALS data, when compared to heights stored in current SILP database. The differences turn out to be highest for youngest stands. Spruce stands in 1st age group (0÷20 years) showed mean difference +10.7m (min. +6.0; max. +14.4m; std. dev. = 4.3m), and only +0.3m (min. -6.3m ; max. + 5.9m; std. dev. = 3.0m) in the 5th age class (81÷100 years). The differences concerning stand height for older stands (over 100 years) have values below zero, which means that height in SILP database was higher than derived through ALS point cloud analysis (95th percentile). This effect was described many times in literature (i.e. Andersen et al. 2006). On average these differences were between -0.7m (min. -3.3m ; max 2.2m; std.dev. = 1.9m) in 9th age class to -2.3m (min. -3.8m; max. -0.8m; std. dev. = 2.1m) for 11th age class. The mean difference for all analysed spruce compartments was +1.3m. However the absolute error (mean value from absolute differences) for all Norway spruce stands was +3.3m. Derived results were also weighted with the compartment area for each age class. This weighted means were equal to +0.49m and +2.92m for absolute differences. The values were influenced mostly by high differences for young stands for which database information, based on terrain measurements, could be not accurate. Dense canopy in such forests makes it often not possible to determine proper position of tree top. The errors could be caused also by not accurate DTM, due to rocks or dead wood on terrain. Errors in DTM affect accuracy of ALS point cloud analysis (normalization process). Besides basic forest stand taxation values, such as: tree/stand height, or canopy closure, ALS technology can be used to derive other parameters like precise information about terrain slopes, aspects or insolation on certain area. ALS data can be also used to calculate length of crown or analysis of tree height diversity (std. dev, skewness, kurtosis, etc.) within one compartment. LiDAR data can be also used to detect and describe: tree groups (e.g. over the tree line), gaps, dead tree groups which are very important for monitoring of sustainable forest ecosystem. Such information has to be added to the structure of SILP database used in Tatra NP. Periodic stand monitoring based on ALS technology, powered with multispectral digital aerial photos, can guarantee keeping both databases: SILP (descriptive) and LMN (geometrical) up to date, without the necessity of time and cost consuming forest inventory fieldwork.

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POSTER PRESENTATIONS

BIODIVERSITY AND CLIMATE CHANGE, A RISK ANALYSIS (BACCARA). CARPATHIAN CASE - GOALS AND ASSUMPTIONS

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Keywords: Carpathian forests, biodiversity, climate change, risk assessment

BACCARA is a research project supported by the European Community's Seventh Framework Programme, planned for four years (2009-2012). The main goal of BACCARA is to build the tools that will enable forest managers and policy makers to evaluate the risk of European forest biodiversity and productivity loss under climate change. The poster is aimed to present the goals and approach of this project, with special regard to the Carpathian Case.
BACCARA will construct a 3-dimensional risk assessment model linking climate change, functional diversity and forest productivity. The approach will be applied to the main European forest categories. Sixteen partners from 9 European countries and China are involved; the Forest Research Institute is the only partner from Poland. One of the study areas is located in the Polish part of the Carpathians.
Investigations in Carpathian Case will focus on mixed Picea abies, Fagus sylvatica and Abies alba stands. Study site location is Beskid Sądecki (Radziejowa Massif) with altitudinal transect of four measurement blocks on elevations 500 – 1100 m a.s.l. This transect is expected to cover a local climatic variability and spectrum of local forest types and species.
The effect of climate change on forest biodiversity will be evaluated through a better understanding of the ecological processes that shape species composition and that are particularly sensitive to climate conditions. The field investigations will cover three trophic levels: plants, plant-associated organisms (insects, fungi), and natural enemies of insect herbivores. The comparisons between pure and mixed stands is the main research goal.
The relationships between forest biodiversity and forest productivity will be deciphered through a better understanding of the respective roles of tree species richness and composition in the studied trophic levels.
The information will eventually be aggregated to predict the effect of climate change on forest productivity through changes in tree species composition.
The main outreach from project BACCARA will be the Guidelines “What-to-Grow” and “What-to-Combat”, addressed to the forest managers and policy makers.

NATURALNESS OF FORESTS AND NATURE BASED FORESTRY IN CENTRAL HUNGARY

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Keywords: forest naturalness, forest management, selection system

During the centuries, different methods of forest management and other human activity led to substantial decrease of forest naturalness in Hungary. Besides, regional differences as results of environmental and historical dissimilarity are remarkable. Previous data indicated that in the Buda-hills, Pilis and Börzsöny - all situated in Central Hungary - the naturalness of forests is generally higher than the Hungarian average, partly due to nature-based management systems. From 2004, selection system as a novel method of forest management is applied on both sides of the river Danube, on 5-5000 hectares, respectively.
In our study, we aimed to determine the naturalness of 7 forest compartments on Hárshegy (454 m asl.) of Buda-hills, situated in the Gerecse-Pilis-Budai hegyek forestry region. As a method, we used a standard forest naturalness protocol, used formerly in a national survey covering the whole country. Basic data collection on 25 sites included canopy, shrub and herbaceous layer composition and structure, soil disturbance and game effect.

Our preliminary result showed, that the stands were on calcareous soil, dominated mostly by sessile oak (Quercus petraea), turkey oak (Quercus cerris) and hornbeam (Carpinus betulus). Pine (Pinus nigra) and other non-native tree species were occurred sporadically. Most of the compartments differed significantly in their stand- and herb layer structure, and in amount of dead wood ($p<0.05$). As a conclusion, the naturalness of the stands on Hárs-hill overwhelm not only the average forest naturalness of the country, but also of the forestry region in which it is situated. The switch in management method e.g. the introduction of selection method may increase the forest naturalness via uneven thinning and removal of non-native tree specimen.

ASSESSMENT OF NATURAL REGENERATION AND VEGETATION ON TATRA NATIONAL PARK

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Keywords: calamity, permanent research plots, succession, natural regeneration, High Tatra Mts.

The papers deals about evaluation of data from the permanent plots established in 500x500 meters grids for observation of natural regeneration and from permanent plot from monitoring postcalamity development of vegetation.
The research sites have been established in natural or seminatural relatively undisturbed ecosystems. Outputs were processed from the permanent monitoring plots, which were established by field workers from National Forest Centre in Zvolen during summer 2007 and 2008. 924 monitoring plots were established in a 500x500 meters grid. During the autumn 2009 the workers of Research station by the State forests of TANAP, decide re-overview permanent plots. In spring 2010 we are planning to boil the grid with permanent plots in a 250x250 meters for detail analyses. The succession of vegetation is studied on permanent plots which were established and analysed in 2005 and repeatedly they are being analysed every year. The size of every plot is 400 m2, the corners are fixed by GPS. Phytocoenological relevés covering the whole plot areas were done. Three 1m x 1m permanent quadrats for detail analyses inside each permanent plot are positioned. In each 1m x 1m quadrate in 1dm x 1dm vascular plants are counted. The data of frequency squares are stored in the database written in VBA MS EXCEL. Goal of monitoring is to monitor the vegetation development on damaged area in the sense of Revitalization project. It is focused on monitoring of the natural development and the management regulations as well. The information from the 4 plots, which were established and have been marked by the are presented separately, as well (the plots NEX, EXT, REF a FIR). Forest stand damaged by wind disaster without the intervention of the forests, no processing of windfall trees without forestation. We can observe natural evolution. The designation "NEX". Forest stand affected by the calamity, processed the traditional way, the wood removed, then wooded areas, the designation "EXT". Stand unaffected calamity, so. reference areas, the 'REF'. Crops affected by the fire, marked "FIR". The results from statistical analyses were processed in software CANOCO for Windows (ter Braak &Šmilauer 1998). CCA was applied to data using the CANOCO.

MULTIFUNCTIONAL FOREST MANAGEMENT AS A BASIS FOR SUSTAINABLE FORESTRY ON THE PRINCIPLES OF CLOSE TO NATURE SILVICULTURE IN UKRAINIAN CARPATHIANS (BASED ON THE EXAMPLE OF THE SWISS-UKRAINIAN FOREST DEVELOPMENT PROJECT IN TRANSCARPATHIA "FORZA" ACTIVITIES).

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Keywords: Ukrainian Carpathians, multifunctional forest management, GIS in forest management, close-to-nature forestry, participatory planning.

In the last 100 years Western Ukraine has undergone drastic changes in its history from being part of the Austrian Hungarian Empire, through Soviet Union to an independent state. This history has significantly influenced the development of not only political, but also economical aspects.
After the creation of the Ukrainian state the economic system changed, having significant effect over land use. Collective farming was abandoned and the ground distributed to individual farmers. Part of these areas were not used for a long period. Use of pastures, grazing meadows, hay making areas was reduced, and also cattle, sheep livestock decreased. The forest naturally takes over the agricultural lands on the forest boundaries and this leads to the growth of the areas of natural forest associations.
Natural native forests are significantly influenced by clear cuts and by development of secondary forests over the places of clear cuts, and these forests do not always follow the natural conditions. Volumes of valuable timber collection also decreased significantly, as well as usage of other useful forest features. All these factors caused negative processes in forest sector, such as spruce die back, windfalls, wind breaks, land slides, floods that happen frequently in the Carpathians.

It is very important to understand and prevent causes that lead to forest damages for the proper management of forest and to avoid significant economic, ecologic and social loses.
Major objective of the FORZA project is implementation of a multifunctional forest management in the Ukrainian Carpathians with special emphasis over sustainable environment management and livelihood improvement. This objective is achieved through:
forest management and planning on the basis of close to nature silviculture
wide implementation of the GIS-technologies in the forest management planning and forest use;
monitoring of the forest stands state;
wide involving of a local community for the forest management planning, forest management for enhancing the social and ecological responsibility of forest sector;
improving of economic sustainability and market orientation of forest sector through the usage of cluster analyze recommendations;
improving of syllabi for higher education institutions;
capacity building of forest specialists;
Improving of the forest law regulations.
These main tasks were approved and are implemented in the framework of FORZA project activities in the Carpathian region of Ukraine, mainly in Transcarpathia, in particular due to the experimental status of state forest enterprises (Rahiv and Khust lishosps).
Conclusions and recommendations, which are obtained by the FORZA project, can be successfully and widely implemented for the forest management of whole Ukrainian Carpathians.

REGIONALIZATION OF FORESTS IN SLOVAKIA ACCORDING TO NATURAL POTENTIAL

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Keywords: forest regions, forest sites, naturalness, site index, strategic forest planning

Poster presents a proposal of new forest regionalization in Slovakia for purposes of strategic forest management planning. Spatial variability of main factors expressing natural potential, as geology, climate, particularities of tree species natural spread and relative growth rates were used as a basis for stratification. Various combinations of site units and regional units were examined in term of explained variability of both naturalness and productivity of oak, beech and spruce, as main tree species in Slovakia. Forest management data were utilized about the presence and the site indexes of referenced tree species in forest compartments. For the naturalness analysis, as a measure of variability quantile range 25–75% of tree species presence in unmanaged forest reserves was used. For productivity, standard deviation of site index expressed by potential tree height in the age of 100 years was used for the same purpose. Consequently, the best stratification design was selected with regard to maximization of explained variability and minimization of potential number of cases. Results show, that site units itself are not able explain variability of followed parameters satisfactorily, and involving of a regional unit is desirable and provides an acquisition. Generally, combinations of site and regional units are able explain about 50–70% of overall tree species natural presence variability, but only about 15–25% of overall tree species production variability. This finding complies with existing knowledge about weak correlation of tree growth with site quality expressed by site unit. As the best alternative, stratification design consisting of 8 regional units (forest regions) and 80 aggregated site units (management groups of sites) is designed. Proposed design reduces the number of potential site-regional combinations by 96%, with the loss of information only 0–10% in the case of tree species natural presence and 2–4% in the case of tree species production when compared to the current system of 81 forest regions and 187 applied site units.

CALICIOID LICHENIZED AND NON-LICHENIZED FUNGI OF TATRA NATIONAL PARK

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Almost all calicioid lichenized and non-lichenized species are rather rare in Slovakia due to the antropogenis pressure on forest biotopes. The research within the Tatra National Park has made it possilble to enhance knowledge on calicioid species. Field research and revision of the herbarium material have shown new species and facts.
In the Tatra National Park were found 40 species of 8 calicioid genera. A detailed field research has led to discovery of Calicium parvum, a new species not only for the lichenoflora of the Tatra Mts. but also for the whole Slovakia. Chaenotheca brachypoda, C. gracilenta and Microcalicium arenarium are new for Tatra Mts. (slovak part).
Rare and critically endangered species occur in the supramontane zone in natural and semi-natural forests in the back part of valleys. Based on the analysis of the species frequency and occurrence, a group of potential indication species of natural

and semi-natural forests of the Tatra National Park has been identified: Calicium adspersum, C. glaucellum, C. lenticulare, C. salicinum, Chaenotheca brachypoda, C. brunneola, C. stemonea, C. subroscida, Chaenothecopsis consociata, C. epithallina, C. viridialba, Cyphelium inquinans, Microcalicium ahlneri a Microcalicium disseminatum. Favourable state of the epixylic kalicioid lichenoflora has been found and possibilities of its further development in the region hit by the wind calamity in November 2004 have been evaluated.
The species Calicium parvum, Chaenothecopsis consociata, C. epithallina, C. savonica, C. tasmanica, C. viridialba and Microcalicium ahlneri are known only from the Tatra Mts. Forests of the Tatra Mts. represent a refugium for the species which occurred in the past also in other parts of Slovakia: Calicium adspersum, C. lenticulare, Chaenotheca phaeocephala, C. subroscida, Cyphelium karelicum and Stenocybe major.
Sustainability of the present state of natural and semi-natural forests of the Tatra Mts. is important for the survival of calicioid species, known at present only from the Tatra National Park and are very rare in Slovakia.

RADIAL GROWTH PATTERNS IN NORWAY SPRUCE COHORTS: SOUTHERN TATRA MOUNTAINS CASE STUDY

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Keywords: forest growth, disturbance events, Norway spruce

Mixed Lariceto – Piceetum community is a quite common forest type on the southern Tatra Mountains slopes. Its continuous appearance is related to the disturbance regime that causes periodical fluctuations of light conditions and seed-beds accessibility within tree-stands. In turn, in time the regeneration success and growth rates in both main tree-species vary. Nevertheless, while the above disturbances are of crucial importance for a successful regeneration of a pioneer, light-demanding tree species, such as European larch (Larix decidua Mill.), the regeneration of shadow-resistant Norway spruce (Picea abies (L.) Karst) is a continuous process, much less depending on both light conditions and seed-beds accessibility. Spruce regenerates and grows quite well even under canopy of alder trees. Thus, it is mainly because of the spruce behavior, the mixed Lariceto – Piceetum communities are uneven-aged.
In this study, the dendrochronological methods were used in order to determine the age structure and radial growth patterns in Norway spruce in such a community during the last 200 years. Windstorms are among the most severe disturbances that appear and affect forests on southern slopes of the Tatra Mountains. Thus, this research was carried out on circle sample plot of 1,13 ha established on a large, open area resulting from the windstorm that took place there in November 2004. The year-ring widths were measured in 519 cross sections of the Norway spruce stumps left after wind-fallen and wind-broken trees have been released from the area.
As expected, the un-even age structure of the Norway spruce population has been confirmed. The age of individual spruce trees varied from 30 to 235 years. After division of the whole number of spruce stump samples analyzed with respect to their age into 20-year age intervals, some 10 subsequent cohorts were identified. The number of stumps in each cohort varied from 2 to 137. The curves showing patterns of the radial growth in individual cohorts substantially varied, truly expressing the fluctuations of light conditions in course of each cohort life-time, while the effect of light conditions on the radial growth patterns' differentiation was of highest importance. In general, the cohorts that appeared just after disturbance, expressed fast radial growth rate in their early age, then decreasing, while in these regenerated under a dense canopy the radial growth in a course of time was much more even.

POTENTIAL ABIOTIC DRIVERS AND CONSTRAINTS AFFECTING THE STRUCTURE AND SERVICES OF A BROADLEAVED FOREST ECOSYSTEM. RESULTS OF SÍKFŐKÚT PROJECT LTER AND ENVEUROPE (LIFE08 ENV/IT/000399) SITE, HUNGARY

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Keywords: ecophysiology, litter production, oak forest, sessile oak, Turkey oak

Introduction
The climate projections for Hungary predict reduction in total area of natural climate-zonal forests and gradual shift of transition between forest-steppe and forest zones. The analyses revealing the close relationships between the decline of health condition of zonal forest trees and the summer water shortage of their habitats have strengthen such predictions. Longer drought periods are expected to affect very seriously the forests occurring in transitional habitats in Hungarian Central Range, especially the mixed stands of turkey oak (Quercus cerris) and sessile oak (Quercus petraea). The most

massive decline of oak (mostly sessile oak) has also been reported for forests of transitional habitats. In Hungary most of the data on ecological conditions of this forest type are from the Sikfőkút Project LTER (Long-term Ecological Research) site (http://sikfokutproject.hu/)which has a transitional location between forest-steppe and forest zones. Due to the transitional character, this forest site offers an ideal area to investigate how interannual variability of climate and long-term climate change may alter the dynamics and functional processes of a European climate-zonal forest ecosystem.

The site description

Sikfőkút Project site is situated in the foothill part of Bükk Mountains (North Hungary), 6 km NE of town Eger (47o90'N, 20o46'E, 320-340 m a.s.l.), in a stand of a 90-95 year-old sessile oak (Quercus petraea) - Turkey oak (Quercus cerris) climate-zonal plant community. The site was established in 1972 within the framework of MAB Programme and was devoted to reveal the structural and functional traits of the climate-zonal forest ecosytem. Long-term monitoring has started and involved repeated surveys on the composition and structure of tree-, shrub-, and herb layers of the oak forest.

The bedrock of Sikfőkút Project Site is miocenic pebble, the soil is deep brown forest soil. Based on the average of 50 years records the mean annual temperature is 10 oC, and the mean annual precipitation is 553 mm. The whole area of the site (64 ha) is protected and belongs to Bükk National Park. From the start of research (1973), forest management has been excluded from the forest, so it provides a good place to study the long term effects of global changes. Meteorological data show that the climatic conditions of Síkfőkút research site have become warmer and dryer. The annual mean temperature increased with 1,1 oC and the annual precipitation averagely decreased with 98 mm between 1973 and 1995. The increase of temperature was higher in the site than the Hungarian average value. The extraordinary sessile oak decline appeared at the site during this period could contribute to the appearance of extreme temperature increase within the forest.

Results and discussion

Forest structure and litter production

At the start of research of Síkfőkút Project practically only two oak species constituted the canopy layer of the forest: Quercus petraea by 84,46%, and Quercus cerris by 15,42 %. Extreme decline of canopy trees has occurred in the forest stand since the 1980s which approached sessile oak more seriously than Turkey oak. As a result the present number of Q. petraea trees is lower by 68,4 %. Q. cerris has also suffered from reduction of number trees but only by 15,9 %. The relative abundance of Q. petraea decreased to 46,9 % in the canopy layer while that of Q. cerris increased up to 22,8 %. Due to the thinning of forest canopy there has been an increase in the basal area of individual trees of both oak species as compared to the period before decline. The increase of basal area was larger in case of Q. cerris. However, the present basal area of trees calculated for 1 ha decreased for Q. petraea by 57%, while Q. cerris exhibited a moderate increase. Decline of canopy trees has also resulted in a gradual alteration of vertical and horizontal stuctural traits of the forest stand. Species diversity and abundance relations of forest canopy has increased significantly. A pioneer tree species (Acer campestre) has grown up from the shrub layer and it forms a second tree canopy level in the present state of the forest.

Since both oak species can be characterized by shade-intolerant character their rapid regeneration would be expected under the changed light climate after the canopy opening. However, no new individuals of oak species could grow up to the canopy layer. Furthermore, the number of saplings of both species is rather low in the forest understory. An important consequence of the tree decline is the lowering of cover and density of herb layer under the dense shrub layer. These observations also suggest that the community is now in a transitional state toward the xerothermic sessile oak-Turkey oak forest of Great Hungarian Plan.

Changes in tree species composition have affected the quantity and quality of litter production of forest since 70ies. The present composition and production of litter more or less reflects the changes in the tree species composition. Between the two oak species, the leaf litter of Quercus petraea decreased by 55 % of the value from 70ies, but that of Quercus cerris increased slightly. Current leaf litter production of Acer campestre also indicated its accelarated growth and new position in the forest canopy layer. In the present condition, the forest stand can be described by a slightly higher total leaf litter production than in 70ies before the start of oak decline.

Ecophysiology and drought tolerance of canopy tree species

Climatic change and prolonged summer drought stress have been suggested as a main contributing factor to oak forest decline in Hungary and also in Síkfőkút Project Site started in the middle of 80ies. Ecophysiological traits reflected different tolerance of two oak species to drought events. Leaf growth and photosynthesis characteristics suggested higher sensitivity of Quercus petraea to summer drought than that of Quercus cerris.

Results of sapflow and dendrometer measurements suggested that the two species differ in their water budget. Larger drought tolerance of Quercus cerris to drought was observed that might be attributed to the larger water storage capacity in the trunk than that of sessile oak. Both oak species are isohydric species and maintain their water balance with transitional reduction of stomatal opening around midday. Between the two oak species sessile oak reduces stomatal conductance more efficiently during the day than Turkey oak. However, the avoidance of leaf dehydration by stomatal clusure occurs at the cost of carbon balance and in long-term may induce severe carbon starvation in the trees since the carbohydrate store reserve are depleted due to continued demand for carbohydrates to maintain metabolism. This results finally in reduction of vitality and in turn the growth. Measurements in dry and humid growing seasons revealed that the water availability thresfolds of stomatal response for the two co-existing species are different.

Lasting effects of drought on leaf photochemical activity of both oak tree species was observed when chlorophyll flurescence parameters were measured in dry growing season of 2003 and the subsequent humid year, 2004. Both species showed lower Fv/Fm indicating impairment of maximal photochemical efficiency in the wetter year (2004) than in 2003, but Q. petraea was more affected than Q. cerris. This may be a consequence of reduced amount of carbohydrates, lipid and

protein reserves formed in the end of 2003 and also the damage to roots and irreversible xylem embolism. These together might weaken the trees for long period and accelerate their susceptibility to stresses including the large scale gradation of phytophagous insects particularly. This phenomenon was observed at Sikfőkút Project site during the massive gradation of gypsy moss (Limanthria dispar) starting one year after the drought in 2004 and reaching its maximum in 2005 with a drastic reduction of assimilating leaf surface of trees in the middle of growing season.

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TIMBER QUALITY ANALYSIS OF NORWAY SPRUCE FROM CARPATHIAN MTS. IN RELATION TO ALTITUDE

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The aim of the study was to determine the Norway spruce timber quality and frequency of wood defects, as well as its type structure, depending on altitude.
The investigations were conducted on twelve 1 hectare sample plots, located in Carpathians. Measuring the diameter at breast height of each tree (at least 7 cm thick), and tree height, as well as determining timber quality on standing trees and the types and variety of wood defects were conducted. In the next stage of studies the sample plots were divided into lower and upper forest zone. First the average volume (m3/ha) was set for quality classes and groups of timber and then its percentage was calculated. Moreover the type of wood defects structure were taken into consideration. In the next stage the statistical analyses were conducted with use $\chi 2$ test, to find out statistically significant differences between quality structure of timber, originated from lower and upper forest zone.
The results show, that the volume of better quality classes of timber (WA, WB, WB1) and total volume per hectare was statistically significant higher in lower forest zone than in upper one. In the lower forest zone there was noted smaller volume per hectare of classes WC and WD and also less middle-sized-wood groups (S1, S2, S3, S4) in comparison with upper forest zone. The $\chi 2$ test proved statistically significant differences in the assortment structure between compared forest zones. Decrease of tree share with injuries and knobs, and increase with curvatures and rots along with increase altitude were also observed.
Spruce stands from lower forest zone which aren't seriously threatened from wind or biotic factors, can create a possibility to get high quality timber.

CHANGES IN LONGEVITY OF NORWAY SPRUCE NEEDLES AS AN ASSESSMENT OF STANDS VITALITY IN THE CARPATHIANS, SUDETEN AND NORTH RANGE

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Keywords: Norway spruce, needles longevity, Carpathians, Sudeten

Norway Spruce (Picea abies. (L.) Karst) is a species that occurs naturally in Poland in two different ranges. It can be found as a mountain tree, which creates stands or has a relevant share in stand composition in Carpathians and Sudeten but also as a lowland tree, which has its natural range within the north-eastern part of Poland. Throughout the years, the share of spruce in stands has decreased. In 1954 it was covering 8,8% of the forested area as a dominant species and currently it occupies 6% of forests in total as dominant. Due to the human activity in the mountains, the quantitative relations for spruce has altered, namely as in the East Carpathians his share was reduced, in the Western Carpathians and in Sudeten his relevance was increased by creation of numerous homogenous stands covering the vastness of mountain areas. However, those monocultures did not adhere to the existing site conditions. In Sudeten, the share of the sites adequate for coniferous forests equals to 55% whereas spruce stands cover 72% of this area. In Carpathians from the 25% area covered by spruce stands, solely 3% of sites are appropriate (Bonkowski et al. 2004). Establishment of the mountain spruce monocultures in contradiction with site conditions resulted in enhanced susceptibility for biotic and abiotic factors and thus also in major tree impairment. One of the most pronounced and actual example for how did the forest threats affect those ecosystems, were the outcomes of the acid rains. Those are visible in the considerable area of deforested land which was an explicit repercussion of forest dieback. In the 1980's, 160 square kilometers of Sudeten forests, vanished ultimately from acid rains as a main reason.
Many authors claim that the spruce needles vitality is related mainly to the environmental conditions. According to H. Wacher (1985), in the lowlands, spruce needles are able to outlast for 4,2 years as an average, whilst in the mountains, needles longevity is 5,5 years. The altering number of the living spruce needles on the tree, informs us about the environmental disturbances and indirectly about the species vitality.

In this paper, all the data related to the number of the living groups of needles on spruce trees from 3 year period (2007-2009) were analysed. Data obtained, was collected in frames of monitoring program, from the permanent observation plots of total number of 140, located in different parts of Poland. In the mountains, we had 51 observation plots in Carpathians, 23 plots in Sudeten and in the North Range 66 plots respectively. Each plot comprises the group of 20 consecutively numbered trees forming a dominant stand. Each year a quantitative control of the living number of needle groups (emerging annually) is conducted for the individual trees within the plot. All the data collected was sorted and set together separately for Carpathians, Sudeten and North Range also in compliance with the distinction for a different natural forest districts. Data set from the recent 3 years were compared with the earlier measurements starting from 1997 (Niemtur, Wawrzoniak 2005).

Basing on the results, a distinct decrease for the average value of the living needles on the respective trees has been denoted, both for Carpathians and Sudeten. However, locally, considerable fluctuations of this value were observed, sometimes reaching the extent of 5 years difference. Further on, we can also see a clear difference between the tendencies in Sudeten and Carpathians. An obvious sharp increase of the value has been stated at the beginning of the investigated period and in the following years it is stable and maintains relatively constant value. In the recent three years however, a significant drop has been observed. The situation develops utterly in Carpathians, with two subareas of a distinct difference in needles vitality, can be distinguished, namely West Carpathians represented by Silesian Beskids & Żywiec Beskids and East Carpathians represented by Bieszczady Mts. In Bieszczady Mts, the needles longevity is shorter and we can observe more or less constant interval between the number of living needles in East and West Carpathians which equals 1,5 years. This interval maintains for the whole period. Both in West and East Carpathians however, there is a decreasing tendency consequently ongoing throughout the years with a short term fluctuations. The North Range, which is likely set as a comparison to mountainous conditions do not reveal any major shifts in the needles dynamics however it can serve as a reference point for rapidly changing conditions in mountain stands.

Longevity of needles expresses the overall vital condition of spruce trees. Apparently there is a set of factors which have a multifaceted way of interaction with the environment and needles longevity as well. The superiority of pollution factor among others has recently become less relevant and the other influences have been taking the advantage. In terms of spruce vitality, it is important to mention, that rapidly changing situation in mountain forests can also have a significant influence for needles longevity. This explicitly refers to the issue of stand conversion, however very abrupt process triggered by external factors like major windthrows and pests outbreaks for a mass scale hamper this process and makes it difficult to execute in a desirable way. The bulk of spruce is touched by this issue. Therefore it is envisaged that the future stands will comprise relevantly less spruce in their composition. Thus, further investigation of spruce needles longevity should be fostered together with finding an optimal treatment for spruce stands that could fulfill all the premises for sustainable forest management with needles longevity as one of the criteria.

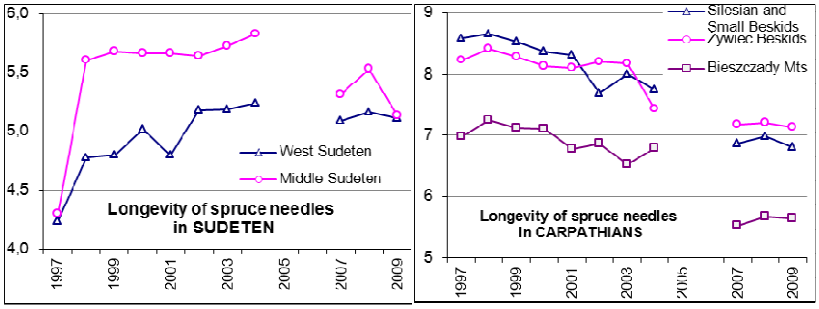

Fig. 1 Changes in the longevity of spruce needles in 13 years period.

A POSSIBLE CAUSES OF SPRUCE DECLINE IN SLOVAK CARPATIAN REGIONS – ECOPHYSIOLOGICAL OVERVIEW

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Keywords: spruce decline, stress factors, drought, stress markers

Introduction

Physiology of Norway spruce (Picea abies L. Karst) in mountain localities is influenced and limited by a number of ecological factors, both natural and anthropogenic, in general acting interactively. The result is a multiple stress that may induce weakening, diseases and dieback of individual trees until decomposition of the whole stands. The spectre of stress factors and their impacts vary in space and with time. In mountain spruce forests, the driving factor enhancing oxidation stress on the stands is a complex of climatic conditions, high ground-level ozone concentrations, and periods of excessive solar radiation. Towards the end of winter and in early spring, occurrence of water stress caused by so called winter desiccation

is typical. The today impact of atmospheric pollution in mountain conditions is mostly indirect – through wet and hidden deposition. Input of acids results in acidification stress in rhizosphere, what, together with damage to needles and leaching of nutrients, can induce more pronounced nutritional stress (Kmeť et al. 2004).

The regions of Orava, Kysuce, Tatry and Spiš are well known due to intensive spruce decline grading over the recent years. Similarly damaged spruce stands are in the southern border areas of Poland and in the Czech Republic, Germany and Italia. Originally secondary harmful agents turn to primary and commercially important on trees with weakened in physiology. The influence of these agents on Slovak forests is constantly increasing, despite an enormous effort to liquidate them. This contribution is focussed on more comprehensive description of the problem (primarily from the viewpoint of tree physiology).

Material and Methods

Dieback of spruce forest stands was studied in selected Slovak regions, mainly Kysuce and Spiš region. Research on eco-physiological aspects backing up the dieback of spruce forest stands in the area of the Kysucké Beskydy Mts, was pursued in frame of the project „Conversion of allochtonous forest communities endangered due to environmental changes (primarily climate change) to ecologically more stable ecosystems“, covering a wider range of the related issues.

The aim was to obtain sufficient analytical information about spruce decline at levels of individual trees, stands and over larger areas; and based of synthesis of these data to explain the processes underlying the dieback (with accent on the role of drought stress).

Possible causes of spruce decline were analysed through observations of the following characteristics: genetic background, provenience, influence of root system, physiological processes (photosynthesis, chlorophyll fluorescence, content of pigments), water stress, climatic conditions, soil condition, imission load, diameter increment, defoliation, and influence of fungal pathogens and insects.

A special interest was put on monitoring possible influence of drought stress, because we suppose that importance of this factor will grade, especially in areas relatively rich in precipitation.

Results

The main results obtained in solving projects:

high contents of manganese and aluminium, low contents of calcium and especially potassium in spruce assimilatory organs totally disturbed mineral nutrition Spiš region

low potassium amounts in spruce needles indicating impaired water regime in trees

weakened anti-oxidative mechanism of spruce needles (very low concentrations of carotenoids), higher sensitivity to „photo-chilling“ – ground-level ozone, low temperature and intensive solar radiation

low photosynthetic rate in needles kept on adult spruce trees, insufficient supply of assimilates for individual trees

soils evidently exhausted by several generations of allochtonous spruce stands

Conclusions

All of the reported facts and the research results obtained in the selected regions (but we can generalize across the whole Slovakia) show that the issue is really complex. There are neither both biologically and economically effective agents nor methods of classic forest protection able to suppress totally the modern (unspecific) spruce decline.

As for silviculture, the most suitable strategy for forest regeneration in conditions of the anticipated climate change is: 1. maintaining genetic diversity, 2. breeding for resistance, 3. selection of material with fast growth and good adaptation across the wide range of ecological conditions, 4. introduction from areas with warmer climate. However, eco-physiological research and new knowledge of processes underlying the dieback of woody plants maintain equally important and irreplaceable.

Acknowledgement

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THE ROLE OF TREE UPROOTING IN CAMBISOL DEVELOPMENT IN THE OUTER WESTERN CARPATHIANS

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Keywords: disturbance, pit-mound, Cambisols development, natural forest, managed forest

The role of tree uprooting in soil formation was studied in a natural forest in the Cambisol soil zone on both the fine pit-mound spatial scale and on the coarse entire-forest ecosystem scale. The effect of a lack of pit-mound dynamics in managed forests was also assessed.
Properties of pit-mounds were studied in a 10.8 ha plot. From a total number of 1562 pit-mounds, a representative sample of 51 pit-mounds was chosen for dendrochronological dating. Ages were determined to be between 9 – 191 years. The development of soils was studied for 14 pit-mounds of all ages. A total of 210 samples were taken from microsites at mounds, pits, and currently non-disturbed ground, from the depths 0-10, 15, 30, 50 and 100 cm. In addition, samples were taken from 9 profiles in managed forests in which tree uprooting dynamics have been prevented for at least 200 years (45 samples). Each sample was analyzed for 38 chemical and physical soil characteristics. Multidimensional statistical methods were used to evaluate the significance of (i) sampling depth, (ii) microsite, and (iii) age since the last disturbance on soil properties in the natural forest. Depth explained 12.1% of the variability in soil characteristics ($p<0.001$), while microsite and age explained 7.5% ($p<0.001$) and 1.8% ($p=0.048$) of the variability, respectively. The highest values of Ca, Mg, C and CEC were found in pits, whereas mounds had the highest values of labile Al and exchangeable acidity. Currently non-disturbed soils had values close to the average between mound and pit values. Despite generally higher values of sorption complex characteristics, pits showed leaching of the sorption complex, leaching of C and mild clay illuviation up to about 100 years of age. Mounds showed increasing CEC values over time, as well as an increasing proportion of humic acids, with significant changes in the proportions of Fe (and Al, Si) forms. Some soil characteristics had a unimodal time course.
Unlike the natural forest, the managed forest soils had considerably higher contents of namely the crystalline forms of Fe, Al and Mn, reflecting a more advanced stage of soil formation. However, the different disturbance regimes did not affect the course of clay illuviation, sorption complex leaching, or the content of organic matter.

Acknowledgements
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WHAT IS THE CONNECTION BETWEEN AN OAK FOREST HERB LAYER AND THE HERBACEOUS EDGE ZONE? VEGETATION AND SEED BANK STUDIES

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Keywords: edge zone, herb vegetation, soil seed bank

Secondary forest edges joining agricultural areas either form barriers or can serve as buffer zones towards forest. At the same time they can be potential seed sources considering the forest herbaceous vegetation development. In the framework of Síkfőkút Project (N-Hungary) we studied the herbaceous vegetation of a NW forest edge which continues toward the forest with a narrow and dense woody inner edge. The herbaceous outer zone connects to an abandoned vineyard. The averagely 15-30 m wide zone was studied in permanent plots of two transects parallel to the woody inner edge. In each transect 25-25 4×4 m plots were sampled in 2008. The percentage cover of the herbs was estimated in each plot. To study the seed bank the seedling emergence method was used. The seeds of the drilled soil samples were concentrated and germinated in glasshouse. Two vertical segments (0–5, 5–10 cm) were separated. The same methods were used inside the forest in 2006.
In the edge zone 141 vascular plant species were registered with 94% cover. Dominant species were Elymus repens, Dactylis spp. and Poa pratensis. From the 37,680 cm3 soil sample 6,332 seeds germinated which equals ca. 17,000 seeds/m2. The number of seeds was 13 times larger here then in the forest. Almost half of the seeds belong to the annual adventive Erigeron annuus followed by Urtica dioica and Hypericum perforatum. The seeds concentrated in the upper soil level. Altogether 182 species occurred in the studied zone. Considering the seed bank as part of the vegetation the species number is increased by 22% with the seed bank study.

Inside the forest as a consequence of climate change – drying and warming –, the woody layers rearranged by the end of 1990s. One third of sessile oaks died and the shrub layer had become extremely dense. Under them the herbaceous vegetation lost its former cover. Vegetation data from 2006 show only 41 species with less then 10% cover. The seed bank can not serve as a sufficient source for recruitment because almost half of the 491 forest seeds is in the lower soil layer and they are long term persistent ones.
The similarity between the two habitats is low in all respects as that of between the above ground and vegetation and soil seed bank. The dominant grasses have transient seed bank type on both sites. The upper soil layer of the edge involved the most short term persistent and transient seeds.
The dense woody forest edge separates the forest so much, that the connecting herbaceous vegetation has a different species spectrum both aboveground and belowground. It is rather a seed trap and buffer zone then a transitional zone inward the forest. We can not expect the recruitment the forest herbs from that zone, while any disturbance in the forest can result in the appearance of ruderals from the persistent seeds of lower soil layer.

CLIMATE AND TIMBERLINE DYNAMICS IN THE CARPATHIAN MOUNTAINS DURING THE XX CENTURY

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Keywords: Forest cover change, timberline dynamics, Carpathian mountains, climate change, XX century

The forest-tundra mountain ecotone, associated with the timberline and treeline, is reported to have risen in elevation in many parts of the world as a result of global warming. The main goal of this study was to analyze the changes in timberline position over the Carpathian mountain range and to relate these changes with observed climate change and other global change issues, such as land use change. Timberline changes were analyzed on elevation over 1000 m between 1880 and 2000 by comparing military maps of the Austro-Hungarian Empire and Landsat imagery. The whole region had a forest cover ration of 73,2%, by 2000 it decreased to 70,6%. The forest cover increased in the West Carpathians considerably (by 6,9%), by 0,5% –in the Ukrainian Carpathians, and decreased in the North and South Romanian Carpathians (-6,3% and -1,9%, respectively). In all the regionsthere is a peak of afforestation at a specific height: 1450 m in the West and Ukrainian Carpathians, 1600 and 1700 m in the North and South Romanian Carpathians, respectively. A third of all afforestation occurred at timberline, more than half – on abandoned pastures, the rest – because of other factors. 12,5% of all deforestation happened at timberline, 68% was caused by pasture expansion, the rest – by other factors. Deforestation exceeds afforestation at the highest elevations in all the four regions, which is a consequence of artificial pasture expansion and increased avalanches and debris flows. Overall, there has been much afforestation at the timberline in areas with different degrees of human influence.

GROWTH AND WATER BALANCE PARAMETERS OF SPRUCE – LARCH FOREST IN THE TATRA NATIONAL PARK

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Keywords: transpiration rate, stem radius changes, meteorological and soil parameters, Tatra National Park

Longer drought periods and abnormal amounts of precipitation in short time are expected due to the increase of air temperatures and assumed changes in the distribution of precipitation. Transpiration and sap flow rate of trees and their circumference changes are strongly influenced by climate and weather conditions. The transpiration of spruce (Picea abies /L./ Karst.) and larch (Larix decidua Mill.) sample trees and stem circumference changes were investigated during vegetation period 2009 at research plot Smrekovec, located in the Tatra National Park in Slovakia. The research plot is situated in untouched forest at an altitude 1249 m asl., the southern – east oriented slope. The forest is mixed with 80% of spruce trees and 20% of larch trees, 123 years old, 7th forest vegetation rank. Sap flow was measured continually in 5 sample trees of each of both trees species using the tree-trunk heat balance method (THB) with internal heating of xylem tissues and sensing of temperature. Changes of stem circumference were measured in the same trees using digital dendrometers, DRL 26 (EMS Brno, Cz). Soil characteristics (soil temperature [°C], soil water potential [Pa]) were measured at two depths 15 and 50 cm using the Microlog SP with gypsum blocks. Simultaneously the microclimate characteristics were measured: air temperature [°C], air humidity [%], global radiation [kW.h-1.m-2] and precipitation [mm]. We found relationship between stem circumference changes and monitored meteorological factors. The stem circumference of the sample trees started to create at the end of May after relatively warmer period. Temperature determines the starting day of cambium initiation. The temperatures in May determine the latewood portion for northern provenances of trees.

Precipitation during vegetation period positively influences stem growth also. We observed the second marked growth of stem circumference at the beginning of October when it was observed the uncommon increase of air temperature and sums of precipitation were low. The sap flow of sample trees is depending on global radiation, precipitation and soil water potential. We investigate seasonal and diurnal sap flow changes. At the end of May and at the beginning of June it was observed the decrease of tree transpiration due to higher sums of precipitation and low global radiation. Typically, leaf transpiration rate changes substantially during the day. As a result, stem water potential changes constantly. Diurnal fluctuations in stem diameter reflect decreasing stem water potential caused by high transpiration during the day and increasing stem water potential during the night, when transpiration ceases.

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ECOPHYSIOLOGICAL RESPONSES OF SESSILE OAK (QUERCUS PETRAEA L.) TO EXTRAORDINARY DROUGHT OF 2003

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Introduction
Climatic change and prolonged summer drought stress have been suggested as major contributing factors to the decline of central European forests in recent decades. Severe summer drought such as that which occurred in 2003 may have long-term consequences for the forest condition by making the trees susceptible to other abiotic and biotic stresses appearing simultaneously or in subsequent growing seasons.
The aim of this study was to characterize the physiological responses of sessile oak (Quercus petraea) to drought by monitoring the changes in the quantum yield of PSII and photosynthetic pigment in the canopy of adult trees in two subsequent dry (2003) and humid year (2004).

Materials and methods
The investigations were performed in the Sikfőkút Research site in the Bükk Mountains, North Hungarian Central Range at 320-340 m a.s.l. and is covered by a 90-95 year-old stand of sessile oak-turkey oak forest community.
Climatic factors were monitored by means of automatic sensors with dataloggers (Onset Co., USA) at the top of a tower above the tree canopy. For describing the stress connditions of trees we calculated the Gaussen-Bagnouls' xerotherm index on the basis of monthly rainfall and temperature. The values of this index reflected serious drought (0.21-0.78) during the whole growing season in 2003. However, in growing season of 2004 the values ranged between 1,1-2.3. Field measurements and leaf samplings were performed from the canopy of four trees growing close to the meteorological tower.

Results and discussion
At the same stage of leaf area development (< 30 %, and 100 %) in the two years, the persisting drought in 2003 resulted in a large reduction of leaf mass in both canopy layers of Q. petraea. The specific leaf mass (SLM) proved a sensitive parameter to drought. SLM of expanded sun and shade leaves of Q. petraea was 15-20 % lower in 2003. Chlorophyll content was less influenced by different climatic conditions of the two growing seasons than the leaf growth characteristics but strongly varied with the light gradient in the tree canopy. Fully developed leaves of sessile oak in summer contained higher concentrations of chlorophylls and carotenoids per dry mass in both canopy layers in 2003 than in 2004.
The total content of carotenoids both for chlorophyll and dry mass basis was high in spring which reflects the role of these components in the protection of developing photosynthetic apparatus of very young leaves against photo-damages. Leaves of sessile oak contained higher carotenoid pool per chlorophyll basis in sun leaves than in shade leaves. Total carotenoids per unit chlorophyll (a+b) basis correlated negatively with the maximum quantum yield of photochemistry (Fv/Fm) during the growing seasons. The variation of carotenoid pool in the early and late growing seasons appeared to be closely correlated with the changes in the total content of pigments taking place in the photoprotective VAZ cycle pool (Violaxanthin, Antheraxanthin, Zeaxanthin). Our results show that sun leaves were always characterized by more depressed Fv/Fm and larger VAZ cycle pool than shade leaves during the whole growing season of both years.
Values of Fv/Fm were lower in 2004 than 2003 which indicated lasting drought effects on the photochemical activity of leaves of sessile oak.

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EFFECT OF CLIMATE CHANGE ON ELEMENT CONTENT AND SOIL PH (SÍKFŐKÚT DIRT PROJECT, NORTH-HUNGARY)

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In the Quercetum petraeae-cerris forest of Síkfőkút (ILTER site in North-Hungary), we examined how the litter input effects the soil total C, NO3--N, NH4+-N, organic-N, total-N, P, K+, Mg2+, Ca2+contents and pH in long-term field litter manipulation experiment (Detritus Input and Removal Treatment, DIRT Project).
Our research indicates that if the climate change reduces the litter production (input) on long-term scale, the total-C, total-N, Ca2+- and Mg2+ content of the soil would decrease, which could result in the degradation of the soil.
Our long-term litter manipulation experiment has an other important conclusion. If the litter production decreases on long-term scale it would result in the decrease of soil pH, because the decreasing Ca2+- and Mg2+ content of litter input can not buffer the soil acidic intermediates and humus materials. It is supported by the fact, that there is positive significant correlation between the soil Ca2+- and Mg2+ contents and the pH.
If the litter production increases as a consequence of climate change, the pH would increase. However, our long-term research on the Síkfőkút Project shows that the litter production decreases, and it can has negative effect on the soil.

DESCRIBING THE SELECTED INVENTORY PARAMETERS OF MOUNTAIN VEGETATION USING THE AIRBORNE LASER SCANNIG (ALS) TECHNOLOGY IN POLISH TATRA

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Keywords: Airborne Laser Scanning (ALS), forest inventory, mountain forests structure, protected areas

Mountain Carpathians forests, especially under protection such in the Tatra National Park (TPN), have a very important role not only for the local society (landscape value, tourism attraction, preservation against soil erosion and snow avalanches) but for the biodiversity and understanding of ecological processes ongoing in the changing environment. The knowledge of mountain vegetation spatial distribution, like their: age, height or vertical structure, especially of the oldest forest stand, may give very important information for silviculture methods used in difficult mountain terrain. Updated and precision spatial information is the most important for the vegetation mapping (inventory) which is a base for the decision chain made in process of management of protected areas like national parks or Natura 2000 as well. The ground truth data collected during filed campaign are very expensive and usually only focused on small areas like plots located on regular inventory grids. In the high mountain environment those plots are very often not accessible or the grid is not regular. In such case, the remote sensing technologies like: photogrammetry (airborne photos) or VHRS images used as source of GIS data, are very helpful. Airborne laser scanning (ALS) technology, in the last years has become a recognized and reliable geomatics tool, providing precision data of the spatial forest structure (horizontal and vertical) which can be retrieved for describing of selected taxation parameters, important for the forest inventory and monitoring.
The aim of the presented study was to determine the possibility of using airborne laser scanning technology to describe selected characteristics (taxation and others ecological parameters) of the Norway spruce (Picea abies K.) forest stands and dwarf mountain pine (Pinus mugo Turra) communities (patches). The study area cover about 12 sqkm of the Polish Tatra mountains in the region of Sucha Stawianska Valley. The study vertical transect started from mixed forest stands (approx. 1.000 m a.s.l. – Kuźnice; Zakopane) trough the mountain Norway spruce stands to the mountain dwarf pine and alpine vegetation (meadows), reaching the peaks in the region of Kasprowy Peak (approx. 2.000 m a.s.l.). The airborne laser scanning data were collected by two full waveform scanners (Riegl Q-560) in August 2007 The mean density of cloud point was approx. 20 points\sqm (Wężyk et all. 2008). Also the digital aerial photographs (CIR) collected with Vexcel camera in the same period, were used for the study as digital orthomosaic. In July 2008, during the ground truth data collection, the 30 inventory areas (400 sq m each) in the different age stands and 30 other reference objects (e.g. individual trees or dwarf mountain pine patches) were established. The height of trees was measured using the Vertex III (Haglöf) hypsometer. The location of every inventory plot was confirmed using the dGPS Pro XRS (Trimble) receiver and the reference station in the Zakopane (TPN). Finally approximately 1100 trees were measured: diameter at the breast height (DBH), height of the tree and base of living crown. Those values were treated later as a reference to the results obtained from the automatically analysis of the ALS point clouds. The results has shown slight underestimation (-0.4m) of the height of Norway spruce stand using the ALS method as 95 percentile of the cloud point comparing to the reference value. The biggest differences ay the height refers to the stands with a low value of canopy closure at the upper tree line (forest border), for which an

underestimation of the ALS method arrive up to -1.7 m (problems with the verification of the DTM model due to rocks and a layer of dense blueberries vegetation). At the same time the occurrence of high correlation (R = 0.82) between the reference height and ALS values were confirmed. The analysis done for the two taxation parameters: tree height and DBH, shown also the high correlation (R=0.80). No significant effect of attitude (a.s.l.) was confirmed, regarding to the accuracy of tree height measurement using the ALS technology.

Further research will compare the ALS method to the results gathered using photogrammetry work-out of archival aerial photos (Wężyk et al. 2005) and focus on full or semi-automatically process of describing the crown base height and determination of the land cover forms (Pinus mugo patches) and the complexity of the tree line.

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Thematic session: Integrated Land Resource Management and Regional Development Policy

Chairs:
Olaf Bastian (Leibniz Institute for Ecological and Regional Development, Germany)
Ivan Kruhlov (Ivan Franko National University of Lviv, Ukraine)
Bohdan Prots (National Academy of Sciences of Ukraine, Ukraine)

The session aims to discuss the approaches, techniques, data sources, and regional examples of landscape management and sustainable regional development. It also incorporates discussions on comprehensive (cross-sector) physical planning which protects the environment, improves socio-economic standards and is based on cooperation between a wide set of stakeholders. Following the Carpathian Convention, it focuses on, but is not limited to, the current state and prospects of sustainable development and spatial planning, particularly in border areas and integrated planning of land resources, using ecosystem approach. Further, it expects to discuss the following points: the role of the protected areas as examples of environmentally sensitive landscape development model, the methods of identification and the layouts of ecological networks in the region, and the opportunities for green development in all fields of human activities in the Carpathians.

ORAL PRESENTATIONS

LANDSCAPE GOVERNANCE AND PRODUCT DYNAMICS IN THE UKRAINIAN CARPATHIAN MOUNTAINS 1772-2010: LESSONS FOR SUSTAINABLE LANDSCAPE PLANNING AND MANAGEMENT

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Keywords: sustainable development, sustainability, spatial planning, traditional village system, biodiversity, rural development, forest management, cultural landscape

The current international forest policy trend is to encourage a transition from the sustained yield paradigm of wood and fibre production to sustainable development based also on non-wood goods, ecosystem services and landscape values. To satisfy ecological, economic and socio-cultural dimensions of sustainable development implies important challenges for landscape governance. Multi-level governance systems that involve private, public and civil sector actors that match the spatial scale and requirements of actors involved with the development of products for different markets are thus needed.
Ukraine is currently in a rapid and complex transition from a socialist planned to market economy. The current Ukrainian nature resource policy issues include increasing the forest cover, introduction of sustainable forest management, forest certification, land privatisation, development of recreation infrastructure as well as securing ecosystem services, cultural heritage, and biodiversity conservation. Policy implementation at multiple levels must account for these issues, as well as legacies of past governance models within entire landscapes as integrated social-ecological systems.
Located in the very centre of Europe, the globally recognised Carpathian Mountain range with its diversity of forests and cultural landscapes has a complex geopolitical history. We employed a comparative study approach to study how different regions and countries have coped with new policy implementation challenges through different time periods. During the past century individual landscapes in the Ukrainian part of this ecoregion have been under the jurisdiction of several different states. We analyse the institutions and actors exercising forest landscape governance during four time periods from 1772 to 2010 (the Habsburg Empire, Poland/Czechoslovakia, the Soviet Union, and Ukraine). For each period we describe the contemporary system of governance and the products produced based on landscape's goods, ecosystem services and natural and cultural values.
During the Habsburg Empire and the Polish reign landscapes' spatial pattern was based on a traditional village system (TVS) with centre-periphery zoning from houses, gardens, fields, mowed and grazed grasslands to forests. This land use system thus integrated the use of forest and woodland ecosystems with agriculture. The TVS carried traditional knowledge, innovations and practices of local communities, gained over long time and adapted to the local environment. TVSs helped to sustain production of multiple goods and services providing livelihoods security and quality of life, as well as contributed to characteristic natural and cultural heritage. Thus, the traditional village system integrated economic, ecological and socio-cultural dimensions within local governance arrangements in space and time.
However, when the Polish and Czechoslovakian parts of today's Ukraine were accessed by the Soviet Union the governance system rapidly changed. During the Soviet time (1939-1991) private land property was expropriated, people were forced to emigrate, arable lands increased at the expense of wooded grasslands, and forestry became more intensive. The structure of land and forest properties was changed. Forests were owned by state, private plots of land were joined into collective farms. The use of natural resources in the Ukrainian Carpathians during this period was shifted towards industrial use of

forests with spruce reforestation, which was caused by the growing importance of industrial forestry in Ukraine. This was accompanied by an increase in both harvesting and reforestation.
The re-privatization of arable and forested land, with some restrictions, by local people began after the collapse of the socialist system since 1991. It has increased the social and cultural value of forests, which are becoming family's heritage for generations. This process has exceptional significance for people in the Ukrainian Carpathians where old generation still has feeling of ownership and memories about unjust political and social events. We discuss the degree to which different types and level of governances can deliver different sustainability dimensions now, and under scenarios of uncertainty and climate change.
We conclude that to implement visions about sustainable landscapes integrated holistic multi-level approaches are needed at the scale of regions. Implementation of policies prescribing sustainable development as a societal process, and sustainability as outcomes on the ground, requires both top-down planning and multi-level governance. To implement contemporary natural resource policies within the EU and in Ukraine there are lessons to be learned from all four phases in the geopolitical arrangement of states in the Carpathian ecoregion.

HISTORICAL LANDSCAPE ELEMENTS – PART OF OUR CULTURAL HERITAGE

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Keywords: cultural landscape, Saxony, landscape program

International and European agreements (e.g. the European Landscape Convention) and laws of many countries aim at maintaining valuable traditional cultural landscapes. Cultural landscape is the result of the long-term interactions between natural conditions and human influence. Man shaped nature according to his existential, economic, social, cultural and mental needs. Cultural landscapes are changing more or less permanently, directly correlated with the development of human societies and the changes in humans' needs.
Traditional landscapes (historical landscapes) are parts of the contemporary cultural landscape, where historical structures have not been removed or overshadowed by contemporary, modern methods of land utilization, and where many relics of the past outlived until today (Antrop 2000, Moss & Okey 2004).
Traditional landscapes are rich in historical landscape elements (HLE). To a certain but lower degree, such elements can be found also in ´normal´, modern cultural landscapes. HLE represent a specific, historically determined and recently diminishing sub-category of overall landscape structures. They are documents of the cultural and economic life of former human generations in the landscape. Landscape elements can be qualified as historical, if they are not originating any more under the present conditions. In contemporary landscapes they have been preserved thanks to special regulations or due to the slowness of landscape change. As relics they remind, for example, of memorable events (e.g. court lime-trees). They mark old trade routes (by avenues, narrow passes, mile-stones), but also borders (boundary stones, hedges, stone walls, castle-walls). They also document economic systems (e.g. settlement and field forms, edges of fields, meadow orchards, vineyards, pollarded willows, fish-ponds).
HLE are very important for our modern human society, because they meet many functions (landscape services). They:
reflect the historical development of the landscape, the co-existence and/or struggle between man and nature as well as reflection the cultural, social, political and economic transformations of the society
are a mirror of the technological development at that time. They enable insights into the needs and possibilities of our ancestors, and they give vivid examples of their history and culture
are important and expressive landscape-historical sources of knowledge
contribute to the individuality and the character of a landscape (together with the natural conditions and structures)
tell history and stories, and they are connected with symbols
carry collective memories and help that landscapes are highly regarded by people
essentially contribute to the regional identity (native region)
are habitats of plants and animals and sometimes the last sanctuary of rare and threatened species
enhance the attractiveness of an area for recreation. They are also useful for education (e.g. extracurricular learning place), and they inspire arts.
Due to the importance of traditional landscapes and HLE on the one side, their rapid decline on the other side, the German Nature Conservation Act postulates the protection of historical cultural landscapes. Hence, it is an evident task to identify the most characteristic and valuable historical structures and to secure their survival. Conservation, as well as effective management and utilization of at least a representative part of existing HLE is an important contribution to maintain our cultural heritage. For it, detailed information on the state of the cultural landscape and the stock of HLE is needed.
For several years, efforts to record and to inventory HLE have been increased. Various methodological approaches were developed, and in several German federal states, but also abroad, activities and programs were started, which are involving also voluntary work. The analysis of HLE can also contribute to delimit whole historical landscape areas (e.g. Burggraaf & Kleefeld 1998, Peters & Klinkhammer 2000).

Also in Saxony, the various natural conditions and long traditions in land use have been the preconditions for richness, diversity and culturally significant historical manifestations. In pursuit of regional planning goals concerning the preservation and development of the cultural landscape, the Free State of Saxony Sachsen pays attention to HLE in its landscape program presently under development. By order of the Saxon State Office for Environment, Agriculture and Geology a new multistage methodology was developed by Walz et al. (2007, 2010) for analyzing and evaluating HLE and whole landscapes. This approach combines methods of the spatial overlay of geodata, the descriptive statistics and the spatial and hierarchical clustering. The analysis of HLE and the deduction of historical landscape areas were realized basing on local sub-districts as smallest reference units, according to the scale 1:50,000. It was used a statistical approach to assure the comparability and repeatability of the method and to reduce the subjective factor.

To identify and to evaluate cultural landscape areas, in a first step the spatial distribution of cultural landscape elements (40 types) was processed with the aid of a GIS. The frequency of the single element types per local sub-district is the result of this procedure. Sets of maps (incl. a synthesis map) show the distribution and the main areas of occurrence of the 40 HLE types. In a second step, by aggregating similarly structured sub-districts, cultural landscape areas were established that differ in their diversity and character shaped by HLE. In a third step, the local sub-districts were assessed regarding the degree they are coined by individual HLE types and priority areas were deduced. In this way, 17 cultural landscape areas and 53 sub-units could be defined, which can be distinguished by their more or less rich and diverse stock of HLE.

As an additional project, for 16 selected types of HLE more precise information was collected and documented in detailed descriptions (Thiem & Bastian 2009): field-terraces, avenues, old dikes, extensively used arable fields, extensively used grassland, pits, hedges, heaths, historical forestry systems, narrow passes, relic peat-cutting sites, stone walls, meadow orchards, ponds, forest hide farmland, vineyards. The main focus was on such types that are also habitats for animals and plants. Therefore, they are important for landscape management on two counts.

The descriptions are structured as follows:

Definition / features (description of the main characteristics)
Typology: description of varieties, sub-types and their characteristics
Peculiarity / scenery: meaning for the landscape as a shaping element, landscape perception
Origin and history of the HLE (types): short draft of the cultural and land use history, also changes in functions
Occurrence and distribution in Saxony (and in Germany)
Classification as HLE
Resilience / risks: Which land use forms and other influences cause threats and losses?
State of protection: Is the element under preservation order (e.g. as biotope or historical monument) or not?
Significance for species, biocoenoses or habitats
Conservation and management: appropriate land use models and measures
Sources of information, references

A risk analysis, in which experts were questioned on current threats to the HLE, revealed where there is a need for further action (Walz et al. 2007). Many HLE are threatened by decay and loss. One of the main problems is the missing use. The problems with HLE that have no public awareness and no strong lobby, e.g. avenues and technical monuments, are especially seriously. An essential part of the industrial monuments in Saxony is threatened.

The future of (relics of) traditional landscapes and HLE will depend on the question, if the public can be sensitized for the maintenance of this important part of our cultural heritage, and if we will find ways to combine the conservation and management of these areas and elements with modern economic systems and lifestyles.

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MANAGEMENT AND DEVELOPMENT OF GAPS IN THE ECOLOGICAL NETWORK OF EUROPEAN BORDER REGIONS

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Keywords: Ecological networks, GIS, gap analysis, protected areas, Central Europe

Within the project TransEcoNet (Transnational Ecological Networks in Central Europe http://www.transeconet.eu/) the transnational network of ecological important areas in border regions within Central and Eastern Europe is analysed. The conservation and development of trans-boundary protected areas is an important step towards protecting natural heritage as well as biodiversity in Europe. In this study the ecological network is to be understood as the existing administrative network of protected areas.

The area under investigation stretches from the Baltic Sea to the Ukraine and to the Adriatic Sea covering the NUTS3 regions adjoining the selected inner Central European national boundaries.

The analyses are based on spatial data and are performed in a Geographical Information System (GIS). After collecting and harmonising national data as well as European data sets of protected areas all areas have been classified due to the international standard provided by the categories of IUCN (International Union for Conservation of Nature). In a second step all protected areas have been categorised as core and non-core areas according to their protection status and size. Following these basic data preparation steps different analyses have been performed. First, the connectivity of the network was analysed using the results of a nearest neighbour analysis combined with a buffer analysis. In general the result shows a good protection status of the area under investigation. Thus, also other border areas beside the Green Belt, the former Iron Curtain, are forming important ecological networks and supply important ecological functions and services for the society.

A gap analysis is a method to identify biodiversity (i.e. species, ecosystems and ecological processes) not adequately conserved within a protected area network. The gap analysis is usually applied to fairly large areas, because this allows decisions about conservation to be made with the best available information and on the basis of ecological rather than political boundaries (Dudley & Parish 2006). In our gap analysis we used easily accessible data on ecosystems (corine landcover data set classified through a hemeroby index classification) as well as worldwide accessible species data (IUCN database).

For the gap analysis the determination of potential wetland, mountainous and woodland habitat corridors as well as potential corridors of protected areas which have been designated and combined using different GIS methods (figure 1) has been carried out.

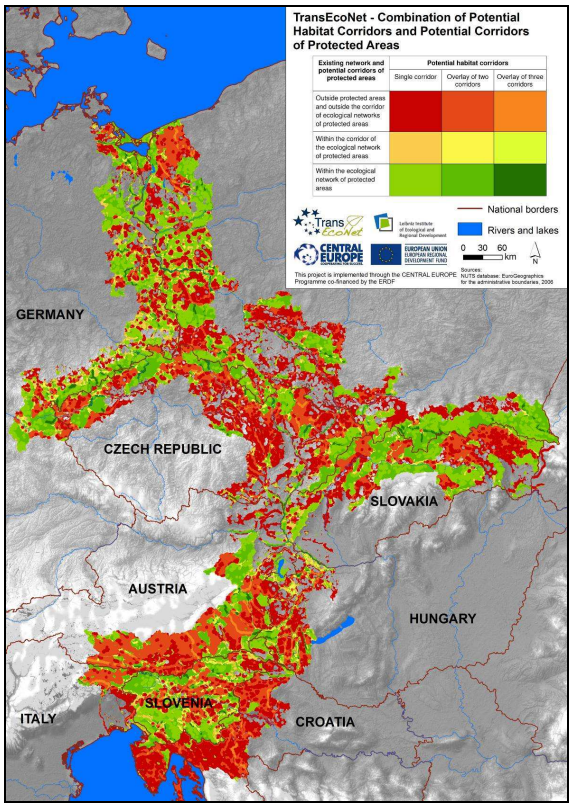

Figure 1. Combination of existing and potential habitat corridors and existing and potential corridors of protected areas

For the determination of gaps only land use classes from the CORINE land cover data set with an oligohemerobe hemeroby index (close to natural) according to Steinhardt et al. (1999) where chosen (Tab. 1).

The result of the gap analysis of is the definition, prioritisation and visualisation of gaps within the existing ecological and the potential ecological network. This analysis should lead directly to the development of one or more scenarios for expansion of the protected area network (Dudley & Parish 2006). Therefore results together with management and measurement strategies should be supplemented to target groups (policy makers and the public).
The linkage of already existing networks through the designated potential corridors of protected networks by means of the extension of already protected areas is our first priority. Furthermore, the existing protected areas should be preserved continually and their connectivity should be improved further by establishing near-natural or protected corridors between insular areas. Suitable specific actions and measures should be taken by nature conservation authorities to reach these aims and to conserve biodiversity.

Table 1. CORINE land cover codes with an oligohemerobe hemeroby index and description

CORINE land cover code	Description
321	Natural grasslands
322	Moors and heathland
331	Beaches, dunes, sands
332	Bare rocks
333	Sparsely vegetated areas
334	Burnt areas
335	Glaciers and perpetual snow
411	Inland marshes
412	Peat bogs
421	Salt marshes
422	Salines
423	Intertidal flats
511	Water courses
512	Water bodies
521	Coastal lagoons
522	Estuaries
324	Sclerophyllous vegetation
311	Transitional woodland-shrub
312	Broad-leaved forest
313	Coniferous forest
324	Mixed forest

An important step in the process of the gap analysis is the prioritisation of the gaps, table 2 shows this process.

Table 2. Prioritisation process of the gap analysis

Gaps	Class of threatened species occurrence		
	low	medium	high
Gap within single corridor outside protected areas and outside the corridor of ecological network of protected areas	Very low priority	Low priority	Low priority
Gap within the overlay of two corridors outside protected areas and outside the corridor of ecological network of protected areas	Low priority	Low priority	Medium priority
Gap within the overlay of three corridors outside protected areas and outside the corridor of ecological network of protected areas	Low priority	Medium priority	Medium priority
Gap within single corridor within the corridor of the ecological network of protected areas	Medium priority	Medium priority	High priority
Gap within the overlay of two corridors within the corridor of the ecological network of protected areas	Medium priority	High priority	High priority
Gap within the overlay of three corridors within the corridor of the ecological network of protected areas	High priority	High priority	Very high priority

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DIFFICULTIES IN RESTORING REQUIRED LAND MANAGEMENT PRACTISES AND REGIONAL DEVELOPMENT IN THE MOUNTAIN REGION OF NE SLOVAKIA

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Keywords: agriculture; decline; biodiversity; regional development; sustainable development;

The aim of this paper is to summarise processes of change in biodiversity over the last 60 years in selected mountain area of Slovakia, and to point out very recent trends and some of the growing conflicts of interest between the implementation of the Common Agricultural Policy (CAP) and sustainable regional development including biodiversity targets. The interdisciplinary approach includes identification of driving forces of land use change, implications for habitats and species, prediction of possible future trends and especially recommendations regarding appropriate management measures for the maintenance of biodiversity together with sustainable development of the region.
Well-preserved nature and geographical location at the border of the West-Carpathian and the East-Carpathian biogeographical regions the Poloniny National Park (NP) ranks among the most valuable areas for biodiversity in Slovakia. The landscape is dominated by forests with agriculture (predominantly grasslands) taking place in a mountainous setting. Forest resources represent valuable element in the territory, both from an economic and natural protection / biodiversity perspective. Currently forest areas occupy about 85% of the territory and original beech forests prevail (76.5%), which in several places are remnants of the primeval forest. Grasslands became source of traditional farming many years ago, when extensive agriculture was mainly focused on hay production and grazing, representing the lifestyle of local people. This kind of sensitive human management contributed to the maintenance of valuable grassland communities and their rich biodiversity. Especially the mountain "*poloniny*" meadows are characterised by large numbers of East-Carpathian rare and threatened species.
Major land cover changes recorded in the study area include increase in woodland area due to grassland abandonment and the conversion of woodland/shrubs due to forest management (Olah et al 2006). Forests have become an even more dominant landscape feature of the region in recent decades, the management of the forests has not changed, and follows precise forest-management plans. On the contrary intensification of agriculture from the 1970s and its decline after the massive political and socio-economic changes of 1989 have caused substantial damage to species-rich grasslands in the region. Economic crisis and remoteness of the area rapidly influenced land abandonment and depopulation. All villages in the study area have experienced population decreases, and in the majority of cases these declines are critical. As the housing function was stable in the 1950s, current depopulation trends represent a significant obstacle to the development of the region, and impact negatively on the maintenance of landscape structure.
The history of CAP implementation in CEE countries is relatively short compared to western European countries, but conflicts of CAP and biodiversity conservation were already predicted at the outset (Young et al 2007). Predicted obstacles to the maintenance of valuable mountain meadows in the Poloniny NP became visible after only 5 years of CAP reform. Implementation of the CAP is now being provided greater financial support to restart agricultural activities in the Poloniny NP. Regardless there is still concern about the maintenance of the biodiversity of mountain grassland communities with limited access and requiring specific extensive management. Land management of the surviving large farms is dependent on financial agricultural support and large scale mowing of the easily accessible grasslands, using large machinery, is dominant. The grasslands abandoned for many years are now managed again - especially at lower altitudes, the landscape has been cleared from shrubs on agricultural land, the secondary succession leading to forest has been interrupted and stopped. However small localities of greater biodiversity importance continue to be overlooked and forgotten. Large intensive meadows become even larger as the subsidy is determined by the managed area while the most valuable mountain grasslands are not included in the Land Parcel Information System and thus not eligible for financial support from the CAP. Individual farmers have not been integrated into the farming process and the number of inhabitants continues to decline rapidly. Lack of management of small narrow parcels in nearby settlements has resulted in their abandonment and overgrowing or transformation to intensive meadows.
Financial support has resulted in a larger area of agricultural land being managed by the two post-collective farms, but stakeholders believe that local individual farmers also need to be motivated and guided to join agri-environmental programmes. The inclusion of small farmers in agricultural programmes could provide a better fit to the local conditions of mountain agriculture. Therefore communication and co-operation between institutions and stakeholder groups is a crucial precondition in enabling the realisation of this landscape's potential, in ensuring better living conditions for the region's inhabitants and in delivering biodiversity conservation. Finally it must be stressed that decision making about agricultural

biodiversity must follow financially beneficial agri-environmental schemes but also the national biodiversity strategy and local strategic aims of nature protection.
Emerging from this analysis are several recommendations for future land management measures, as for example:
Widely implement measures of agro-environmental support (e.g. protection of biotopes, ecological farming, protection from erosion, measures that support water retention) and to include the most valuable grasslands in the support system.
To apply mosaic utilisation of larger areas and sequence of management practices on the same plot – to simulate the traditional use and support the species diversity.
To use controlled grazing or soil fertilisation for maintenance of grassland productivity because of naturally nutrient-poor substrate.
Involve local small and medium-sized enterprises and farmers into agricultural/environmental support schemes, with aim to manage small and inaccessible grassland localities and realise more environment friendly farming.
Establish close and permanent contacts between nature conservation institutions, like NP Administration, with other relevant institutions within the region and to clarify their interests, competences in the Poloniny NP.
Establish closer cooperation between farmers and NP Administration to specify sites and detail management for biodiversity maintenance.
Conduct public awareness activities in the region by mentioned institutions to understand issues of nature conservancy and biodiversity.
NP Administration should apply for grants and thus support local employment and achieve maintenance of the management on localities of biodiversity importance.
Support cross-border cooperation to facilitate rural development of the region.
Support the formation of local information centres as well as accommodation facilities and services for tourists.
Inform local people via the local government about possible support for tourism, which has great potential to make the region accessible for more visitors/tourists.

THE EAST CARPATHIAN BIOSPHERE RESERVE REVISITED: CHALLENGES AND OPPORTUNITIES IN TRANSBOUNDARY COOPERATION IN THE COMING DECADE

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Keywords: Transboundary Protected Areas (TBPA), conservation of biodiversity, cooperation, East Carpathian Biosphere Reserve (ECBR)

In late 1990s, transboundary biosphere reserves were hailed as a new framework for international cooperation for the conservation of biodiversity and protected area management. The UNESCO Man and Biosphere (MaB) concept had expanded rapidly in late 20th century and transboundary biospheres represented the increasing trend for protected area management in Europe and throughout the world. In 1997, The East Carpathian Biosphere Reserve (ECBR), as it is known today, was thrust in the spotlight as it became the world's first tri-lateral biosphere reserve, uniting protected areas from Poland, Slovakia, and Ukraine. A little more than a decade later, the ECBR has, once again, become the focus of international conservation attention. In 2007, the World Wildlife Fund-Danube Carpathian Programme Office (WWF-DCPO) initiated TBPA cooperation as part of its larger initiative on the "Protection and Sustainable Use of Natural Resources in the Ukrainian Carpathians" sponsored by the Norwegian government. The Carpathian region is a priority ecoregion for the WWF network in general and for WWF-DCPO in particular. The project is in line with national, regional and international priorities for biodiversity conservation and strengthening environmental governance in the region, as these are expressed in the Ukrainian biodiversity action plan, ecoregional conservation plan, the Kyiv Resolution on Biodiversity, the Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention), the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), and the Convention on Biological Diversity (CBD. The project area is broadly defined as the East Carpathian Mountains of western Ukraine, with specific activities focused around protected areas contained within two internationally recognized UNESCO-MaB Programme reserves in the Transcarpathian Region: the Ukrainian portion of the trilateral ECBR and the Carpathian Biosphere Reserve (CBR) located near the border with Romania. The transboundary component of the project stresses transfrontier cooperation and conservation activities across the borders of Ukraine and the adjoining countries. This paper evaluates past efforts and presents recommendations intended to improve the effectiveness of transboundary protected areas management in the ECBR region.
As a blueprint for large-scale conservation in the 21st century, transboundary biosphere reserves have their limitations. The accession of several Central and East European (CEE) countries to the European Union (EU) -- encompassing the other third of the Carpathians -- have provided benefits for the region and Western Europe. Ukraine, which is the only Carpathian country outside the EU, is now the point of demarcation between East and West. Nonetheless, Ukrainian protected areas

on the border with the EU have also reaped benefits from funding and contact with the West. The significant progress and momentum that transpired in the interim period has stalled, however, and formal TBPA cooperation in the ECBR has come to a virtual standstill. By nature, TBPAs attempt to disregard political boundaries and create a "shared spatial identity" and set up formal or informal institutional entities for making these operational. The ECBR has had no less than four distinct administrative bodies over the five years between the formation of the original bi-lateral biosphere between Poland and Slovakia (1992) and the eventual trilateral biosphere reserve that incorporated Ukraine (1997). There were: 1) a "Coordinating Council," 2) a Scientific Council, followed by a 3) a "Consultative Council," and finally 4) a tri-lateral non-profit foundation -- The Foundation for the Eastern Carpathians Biodiversity Conservation (ECBC). To date, there is no single administrative unit overseeing cooperation and there is no official agreement between the three governments acknowledging the existence of ECBR. Protected areas in the Carpathian ecoregion rely heavily on international donors and state support for maintenance of the park and long-term planning activities. Because there is no formal government ratification, administrators of the protected areas of the ECBR feel there cannot be progress in TBPA cooperation until there is ratification of the treaty by the individual countries.

The current WWF-DCPO project is preparing the groundwork for a number of measures contributing to the sustainable use and protection of the globally important natural values in the East Carpathians in Ukraine. It focuses on promoting cooperation between protected area authorities, NGOs and local communities and stakeholders to promote local sustainable development and nature protection as well as cross-border cooperation. These protected areas are increasingly threatened by natural and anthropogenic forces but continue to play an increasingly important role for carbon storage and climate change mitigation, water storage, and recreation as well as the protection biodiversity and wildlife habitat that guarantees life as we know it into the 21st century.

REALISING TRANS-BOUNDARY ECOLOGICAL CONNECTIVITY IN THE UKRAINIAN CARPATHIANS

STAKEHOLDER INVOLVEMENT AND ECOLOGICAL MODELLING WITH SELECTED MAMMAL SPECIES IN TWO PILOT STUDIES CONNECTING UKRAINIAN PROTECTED AREAS WITH PROTECTED AREAS IN POLAND AND ROMANIA

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Keywords: habitat fragmentation, connectivity, corridor, ecological modelling, large mammals,

In order to cope with increasing habitat fragmentation, biodiversity conservation in the Carpathians requires the establishment of connections between habitat fragments, i.e. protected areas, to enable migration and genetic exchange between wildlife populations for their long term survival. The Ukrainian government striving for harmonization with European policy and legislation such as the Pan-European Ecological Network, is aware of this need. During the last decade, the first moves for the development of a Ukrainian ecological network have been made, but actual realisation is hampered by lack of experience and inadequate policy and legislation. So far, development initiatives have mainly focused the design of networks at national and regional level, awareness and information exchange, but not yet on the establishment of ecological connections on the ground.

The project presented here is built on modelling methodology developed in earlier work in the project "Safeguarding the Romanian Carpathian Ecological Network, a vision for large carnivores and biodiversity in Eastern Europe", on its turn inspired by the "Southern Rockies Wildlands Network Vision" (USA). Both initiatives present a science-based blueprint, spelling out desirable, site-specific ecological goals aiming at the preservation and restoration of large, interconnected and relatively undisturbed ecosystems.

The presented work in the Ukrainian Carpathians, however, does not remain in the design phase, but goes a number of steps beyond, by shaping and formalising ecological corridors (eco-corridor) within the social and legal realities on the

ground. This pilot exercise involves the establishment at local level of eco-corridors between selected protected areas in Ukraine, Romania and Poland, to investigate best policies and practices for their development. The experiences of this pilot study are translated into directives for the development of policies, legislation and other useful instruments, transferred to the policy process at national and regional level through the Ministry of Environmental Protection of Ukraine, and the international network of the Carpathian Convention.

The process consists of five main steps: (1) modeling of eco-corridor options based on landscape and habitat requirements of so called "umbrella species", (2) legal analysis to pave the formal way for eco-corridor establishment, (3) consultations with authorities, land owners and land users to identify an optimal course for the eco-corridor supported by all, (4) participative elaboration of eco-corridor management plans, and (5) official approval of the eco-corridor by the competent authorities.

The process started with a meeting with experts on wildlife, protected areas and landuse planning for the delimitation of the study area and the elaboration of the workplan. Bear, Lynx, Wildcat and European bison were selected as "umbrella species" and their habitat requirement parameters were determined for the eco-corridor modeling. Subsequently, data were collected according to the model's requirements. Eco-corridor scenarios were elaborated using GIS with geo-data on habitat characteristics such as landcover, topography, proximity to settlements and roads as well as land status and ownership. Additional information was acquired from consultations with stakeholders. Eco-corridor scenarios established were reviewed, additional information needs determined, and the final course of eco-corridors agreed, during a stakeholder meeting. After agreement on the location, eco-corridor units were identified, each characterized by specific landuse and ownership issues requiring a specific management strategy. For each unit, the needs and conditions have been worked out in a management plan to achieve a sustainable "conductivity" regime for wildlife through measures such as the gazetting of new "stepping stone" protected areas, land swap, agreements with land users/owners, adapted infrastructure and compensation mechanisms. During a concluding session management options and other approaches were evaluated and a strategy determined to complete the eco-corridors. Policy recommendations and lessons learned were shared with the policymakers concerned.

Among the mayor achievements of this pilot study, the establishment of the first wildlife corridors in Ukraine is most striking. Moreover, all valuable experiences gained and annotated are compiled in a manual, which eliminates many gaps and obstacles hampering ecological network development in Ukraine, and which will be a useful tool for eco-corridor development in other countries.

The main lesson learned from this pilot study is that the establishment of eco-corridors on the ground can be a powerful driver for awareness creation among authorities and local populations. The population of seven villages expressed their support to eco-corridors at village council meetings and they started understanding and appreciating the ecological network concept. The study made also clear that even in the more populated areas of the western Ukrainian Carpathians, it is not (yet) too late to realise connections between protected areas, because landuse intensity is still low. GIS modelling can be very helpful to identify options for eco-corridor development, providing ecological substantiation and option maps to the consultation process. The actual realisation of the eco-corridors require, however, considerable fine-tuning with local authorities, land owners and land users. Final eco-corridor boundaries are therefore drawn with a pencil on a desk. A very basic constraint in the development of eco-corridors is the limited availability of thematic and topographic map information of an adequate scale. Another crucial issue is the absence of an accurate cadastre of the Carpathians, which would make spatial planning more effective. A key opportunity in Ukraine would be to improve collaboration between Government and research institutions, which would facilitate the extension of new approaches.

IMPLEMENTING SUSTAINABLE FOREST MANAGEMENT FROM POLICY TO ACTUAL LANDSCAPES AND BACK AGAIN: THE UKRAINIAN CARPATHIANS AS A CASE STUDY

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To implement sustainable forest management (SFM) in actual landscapes, forest stakeholders exercising governance on multiple levels and different spatial scales need to be provided with empirical information of how ecological, economic and socio-cultural dimensions of SFM are perceived and developed locally. This paper outlines the need of transdisciplinary research using multiple case studies to understand the role of forested landscapes for regional development. We reviewed the state and trends of SFM implementation in Ukraine, which represents one of the post-Soviet countries in transition from socialist planned to market economy. First we analysed the national forest legislation and laws relevant to management of forest and woodland landscapes, and described how the involved institutions implemented policies using a “top-down” approach. Using the Skole district in the Carpathian Mountains as a case study, we then described the status of ecological, economic and social-cultural dimensions of SFM in an actual landscape, and evaluated the implementation process of SFM from “bottom-up”.

The Ukrainian government was the primary forest actor and implemented policies through national, regional and local institutions as well as state forest enterprises. This multilevel system of policy implementation implied a “top-down”

approach to forest management. Thus, there was also a long way for any initiative from actual management units back to the policy-making level, and an absence of an efficient working mechanism for local forest stakeholders to influence the forest policy development.

Our study of ecological dimensions of SFM in the Skole district shown that forest landscapes have more than 200–yr management history. Intensive forest exploitation led to reduction of beech and beech-spruce-fir forests in the Skole area. Oak forests in the valleys were reduced to a minimum already in seventeen century. At present time, mono-cultural spruce plantations prevail. Middle-aged and young stands dominated. According to the interviews with state forest enterprise directors, more then a half of forests suffered from pest diseases and root rot, which cause death to Norway spruce stands. Natural reforestation of abandoned agricultural land in the valley bottoms was a widespread present phenomenon in the area. Marginal lands of former collective farms, which were not used any more for grazing and crop production, have been covered by forests due to natural succession dynamic.

The forests in the Skole district belong to the state. According to the interviews with forest stakeholders the volumes of harvested wood have been increasing during last ten years mainly due to increasing of timber amount from intermediate harvest operations. A low level of state investments in the forestry sector was the main reason for a low level of regeneration activities after harvesting during the last years. About 65-70% of wood harvested in the district was exported as round-wood, thus adding only limited value to local community economic development.

The Skole district has a rich history. The restoration and protection of historic sites of regional and national value have been increasing since 1991, and the area has been recognized as an integral part of Boyko's ethnographic area in the Carpathians. The support of traditional Boyko's land use, which is closely connected to forests, should be a milestone in a regional program of SFM.

The privatization of arable and forested land (with restrictions) by local people that began after the collapse of the socialist system, has increased the social and cultural value of forests, which are becoming family's heritage for generations. This process has exceptionally significance for people in the Western part of Ukraine where old generation still has feeling of owners and memories about unjust political and social events, which brought them to ruin.

Interviews with local and regional forest stakeholders and analyses of official statistics shown that: (1) Forest enterprises focused exclusively on the economic use of forest resources. (2) Local level forest managers did not understand fully ecological and socio-cultural dimensions of SFM. (3) Even if only 3.6% of the Skole population was employed by state forest enterprises, forests played a vital socio-cultural role and provided livelihood for many people. (4) The ecological functions of forests were being degraded and restoration was needed. (5) There was no mechanism for local forest stakeholders to influence forest practice in the area. For implementation of SFM in actual forest landscapes three types of gaps need to be bridged: (1) A policy implementation gap between the official definition of SFM, and how its different criteria and indicators are understood by forest actors. (2) A policy creation gap between ecological, economic and socio-cultural needs at the national, regional and local levels. (3) A knowledge gap between the need of a holistic transdisciplinary approach for SFM implementation and mostly disciplinary knowledge which are used by different stakeholders to deal with SFM issues. Ways of bridging these gaps are introducing a landscape approach for forest landscape governance and management, and applying a zoning approach at multiple spatial scales to satisfy economic, ecological and socio-cultural dimension of SFM.

SUSTAINABLE FOREST MANAGEMENT ALTERNATIVES FOR THE CARPATHIAN MOUNTAIN REGION, WITH A FOCUS ON UKRAINE

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Keywords: Sustainable Forest Management, Carpathian Mountains, Ecosystem Services, Forest Carbon, Old-growth Forests

Introduction

Implementing international criteria for sustainable forest management (SFM) has been challenging in the Carpathian Mountain region of Europe. In this paper we explore contemporary science, emerging models, and innovative practices that offer guidance on implementing SFM criteria, with a focus on three: 1) conservation of biological diversity, 2) maintenance of water resources,

and 3) contribution to global carbon cycles. The recommendations we present were developed through a problem solving workshop (or atelier) held in western Ukraine in fall 2007, involving over 100 participants from Carpathian nations, western Europe, and the United States. An initial set of challenges and opportunities for SFM were identified through technical presentations, brainstorming sessions, and literature review, conducted in preparation for and at the outset of the atelier. These were explored further through field visits to forestry operations and protected areas, and on-site meetings with forest managers and local stakeholders in the Ukrainian Carpathians. We used triangulation methods to identify cross-cutting themes, such as opportunities for SFM expressed by multiple experts and stakeholders. Our exploration of options for forest carbon management drew also on aboveground biomass data collected in mature and old-growth forests at the Uholka World Heritage Site and the Gorgany Nature Reserve in western Ukraine.

Results and Discussion

The results of our atelier are primarily qualitative, consisting of a series of recommendations. The contribution of SFM to biodiversity conservation depends first on the establishment of fully representative reserve systems. On managed forestlands surrounding reserves, shifting stand age class distributions closer to the historic range of variability and recently developed silvicultural practices, such as disturbance based forestry, will help maintain ecological connectivity, landscape heterogeneity, and stand structural complexity. Strategically placed restoration of native species composition in areas dominated by spruce plantations will both enhance forest health and play an important role in biodiversity conservation. Broader use of contemporary watershed management approaches is recommended, including delineation of riparian buffers, riparian forest restoration, and ecologically informed forest road management. Investment in the forest road system and up-graded harvesting machinery are essential elements of this strategy. Expanding forest sector participation in green certification and carbon markets offer new opportunities and challenges for SFM in the Carpathians. Certification of forestlands is expanding but has been limited by non-conformities involving illegal timber harvesting and other factors.

Ukrainian afforestation/reforestation goals have the potential to sequester large amounts of carbon and this has been well quantified by previous research. Afforestation/reforestation may have significant economic value as international carbon markets develop. The relatively long rotations currently required under Ukrainian forest code offer significant carbon storage benefits, but carry risks for diseased or genetically non-endemic stands. On-going research suggests that structurally complex, late-successional temperate forests store very large amounts of carbon. For example, our analysis of original field data shows that old-growth Carpathian beech and spruce-fir forests store 57 and 50 % more carbon, respectively, than mature con-specific forests. Conservation of these systems can contribute to climate change mitigation efforts by preventing the greenhouse gas emissions that would result if these forests were cleared or logged and converted to rotational plantations. Active silvicultural management for structurally complex, high biomass forests offers additional benefits. Our simulation modeling in similar North American forest types suggests that low intensity silvicultural practices can increase carbon sequestration by 39 to 118% compared to more intensive forestry.

Carpathian nations are thus positioned to benefit from all three forest sector options provided by rapidly expanding international carbon markets, including afforestation/reforestation, avoided deforestation, and improved forest management (IFM). Both Joint Implementation projects and participation in the Voluntary Carbon Standard could provide revenue that would incentivize related conservation and forest management activities. Afforestation/reforestation projects might include forest restoration, for instance along deforested floodplains, to improve watershed functioning. Avoided deforestation or REDD projects might help fund establishment of new protected areas, while ecologically-based silvicultural practices (IFM) on managed forestlands could help maintain connectivity among reserves while restoring under-represented late-successional habitats and associated biodiversity.

Conclusion

An adaptive approach to sustainable forest management will be essential due to the anticipated effects of climate change on Carpathian flora and fauna. Recent scientific advances in the fields of watershed management, riparian forest conservation, and logging road system design will help inform improved protections for aquatic ecosystems in the Carpathians. Market based approaches, such as green certification, carbon markets, and payments for ecosystem services, may help incentivize sustainable forestry for a broad array of ecosystem goods and services. These represent significant opportunities for the Carpathian region.

The challenge facing Carpathian nations is to merge these ideas into a holistic, ecosystem management approach that can be implemented within existing or reformed administrative frameworks. If this can be achieved, there will be enhanced prospects for sustainable forest management in the Carpathian region.

BIODIVERSITY RESEARCH OF HISTORICAL STRUCTURE OF AGRICULTURAL LANDSCAPE

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Keywords: agricultural landscape, biodiversity, management strategy, nature protection, Slovakia

Historical structures of agricultural landscape (HSAL) are main object of the project "Research and maintaining of biodiversity in historical structures of agricultural landscape of Slovakia", supported by Norwegian Financial Mechanism, EEA Financial Mechanism and Government of the Slovak Republic. HSAL represent a mosaic of small-scale arable fields and permanent agricultural cultivations (grasslands, vineyards, high-trunk orchards) and are significant as the unique islands of species-rich plant and animal communities, originated by continuous succession over centuries. The overall objective of the project is to protect the environment through protection of biodiversity in valuable biotopes of HSAL in accordance with sustainable development. The project aims to bring new knowledge about HSAL by carrying out a thorough inventory of HSAL over whole Slovakia territory, coupled with interdisciplinary research in 3 pilot territories and implementation of the project results.

The correct understanding of such a complex system as an agro ecosystem, with its close connection to human action, requires a complex and highly objective approach. The interdisciplinary research of biodiversity and ecological conditions has been set up in 3 pilot territories, representing main HSAL type on the territory of Slovakia:

Viticulture agricultural landscape – Svätý Jur locality (altitude 126 - 514 m, 40 km^2, 4972 inhabitants)

Agricultural landscape with scattered settlements – Hriňová cadastre (altitude 490 - 1458 m, 126 km^2; 7923 inhabitants)

Mountain grassland-arable landscape – Liptovská Teplička cadastre (altitude 846 - 1429 m; 98 km^2, 2340 inhabitants).

The research in the pilot territories consists of analyses of biotic, abiotic conditions, land use, socio-economic conditions, demographic and sociological conditions on cadastral level, synthesis and evaluations of biodiversity.

Land use (aimed at HSAL) *and vegetation field mapping* is focused on semi-natural non-forest habitats, as meadows, pastures, shrubs, riparian vegetation, and remnants of forest, which shape significant refugees for fauna. Special attention is given to vegetation connected to the forms of anthropogenic relief. Detailed *vegetation and zoological research* is being performed in selected representative HSAL plots of average area of 100 – 300 m^2/ plot. The phytosociological sampling of HSAL vegetation was carried out by using the methods of the Zürich-Montpellier school. Objects of zoological monitoring were selected groups of vertebrates and invertebrates (spiders, beetles, grasshoppers, butterflies, molluscs, diplopods, small mammals and birds). Zoological traps have been founded on productive parts of plots (arable land, meadows, pastures, fallows) and on the bounds. *The land use changes* are studied between 2 periods (before collectivization in 1950 and present state in 2009). The legend of land use has been processed in compliance with Corine land cover mapping (Bossard, Feranec, Otahel, 2000) with special attention to the classes of agricultural area (including HSAL with the forms of anthropogenic relief. *The land use history* of plots is studied on the basis of interview with present and previous plot owners. The detailed research of *forms of anthropogenic relief* is being performed as well.

From *the abiotic conditions* point of view geological substrate, soils, relief and climatic conditions are studied on the basis of existing actual maps. Soil conditions have been studied in details at selected plots, where detailed vegetation and zoological research is being performed. Research is focused on relief conditions and geological pad and laboratory analyses of soil samples.

S*ocio-economic research* was focused on positive (legislative protection of nature and natural resources, etc.) and negative phenomena (water and soil contamination, air pollution, noise load, etc.). Study of *the demographic and sociological conditions* has been realized in form of interviews among citizens and visitors and on the basis of actual statistical data.

Sociological research will support the need, to clarify the attitudes and expectations of inhabitants as a basis for the development of management strategies.

Syntheses

Landscape-ecological typologization on the cadastral level – it is based on synthetic evaluation (map overlapping) of research results - land use, forms of anthropogenic relief, vegetation, soils, geological pad, relief, climatic conditions, positive and negative socio-economic phenomena. The list of landscape-ecological HSAL types is outcome of it.

Evaluations

Biodiversity evaluation – it is based on vegetation and zoological survey and its ecological conditions at species level as well as ecosystem level. The assessment will be oriented to evaluation of favourable conservation status (FCS) of a natural and seminatural habitat and species and identification of driving forces, and threats to the biodiversity of HSAL.

Scenarios – The main threats of HSAL were determined on the basis of the comparison of conflicts between the present state of the ecosystems and the main potential and real drivers. The trends are dependent on the realization or non-realization of threats. They are the responses of the landscape to the pressure of human activities. Three main scenarios of the agricultural landscape have been developed for study areas:

disintegration trend of HSAL (gradual extinction of mosaic) when the threats will be transformed in real activities – pressures on the traditional agricultural landscape connected with economical development

maintenance of traditional management of HSAL (optimal land-use) when the threats are minimized abandonment of agricultural linked with depopulation of rural landscape.

Propositions

Elaboration of Strategy for protection and management – proposal of optimal multifunctional utilization and management of investigated landscapes in relation to sustainable development of traditional agricultural landscape and maintaining the biodiversity of landscape. Proposal will be oriented to application of agro-environmental scheme, consecutive revival of agricultural utilization of HSAL as well as development of tourism, which could increase number of job opportunities. The proposal of ecological management will bring about not only protection of valuable biotopes, but will also have positive impact on healthiness of local inhabitants as well as visitors by reduction of stress phenomena (pollution of water, air, soil etc.) and by the production of healthy bio-products.

Results of complex inventory and typologization of HSAL and interdisciplinary research in the pilot areas should raise significantly knowledge about HSAL in Slovakia and in the central Europe. The research results and new knowledge about HSAL, as well as improving environmental awareness of stakeholders in the pilot territories and of general public through implementation activities, will contribute significantly to the application of obligations for Slovak Republic following agreements as the Convention on Biological Diversity (1994) and the European Landscape Convention (No. 176, 2000).

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POSTER PRESENTATIONS

STAKEHOLDERS ENGAGEMENT IN NATURA 2000 MANAGEMENTS OF ALPINE BIOREGION SITES IN MALOPOLSKA, POLAND

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Keywords: stakeholders, consultations, Natura 2000

Development near and within protected areas has been always troublesome, as well as designation of new sites of conservation. The case of Natura 2000 ecological network is a well known example of such challenges. Both in Europe and Poland its implementation met numerous obstacles, raised conflicts and resistance, but also proved there are solution for overcoming such difficulties. Effective conservation and managing conflicts between development and protection in Natura 2000 areas often need to be based on participation of local stakeholders.

The following poster presents an example of developing stakeholder engagement in management of Natura 2000 protected areas of the Alpine bioregion in Małopolska, Poland. Initial conflicts and misunderstandings between local authorities and public institutions are described, evaluation of established consultation scheme is presented. Further development of cooperation between stakeholders and concepts for further studies are discussed.

Poster presents original research including: (1) qualitative and quantitative study of consultation documents – local authorities written remarks concerning Natura 2000 proposed areas, (2) qualitative interviews with participants of consultation meetings in Małopolska concerning site designation, (3) qualitative interviews with experts designing and conducting further consultations schemes concerning management of sites.

BIOMASS FOR BIO-ENERGY: SOME REGIONAL RESULTS OF THE CEUBIOM PROJECT

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Keywords: biomass, energy, forest, agriculture, terrestrial, EO combination

This paper summarizes the current status and findings of the CEUBIOM project (Classification of European Biomass Potential for Bio-Energy Using Terrestrial and Earth Observations) with special respect to the Carpathian region. The overall aim of CEUBIOM is to develop a harmonized method for the assessment of biomass for bio-energy applicable in whole Europe with a focus on Eastern Europe and Western Balkan area, which is mirrored in the geographical distribution of the consortium members.
The first part of this paper summarizes the terrestrial methods and the situation of biomass estimation assessed in the following Carpathian countries: Czech Republic, Slovakia, Austria, Hungary, Romania, Ukraine, and partly in Poland. One main outcome of this review is that there are potential assessments ongoing in all of the countries, but with very different boundary conditions and varying results, even if the basic data is the same (e.g. in Czech Republic). Thus there is a strong need for a harmonized biomass potential assessment to generate comparable figures. The main information sources currently are:
Agricultural production statistics (region, crops, quantity produced, quantity used)
Forestry production (region, species, quality, quantity, quantity used)
Industry statistics (feedstock used, quantity, by-products produced)
Import/export statistics (crops, quantity)
From the consortium members, four partners considered their country having significant amounts of land available for biomass fuel farming: Czech Republic, Romania, Ukraine and Poland.
In the second part of this project the user requirements for the design of a harmonized approach were assessed. Compared to the overall requirements (43 questionnaires from 15 countries), there are some particularities and specific requirements in the Carpathian region (18 interviews incl. the above mentioned countries and Poland). 22 % of the Carpathian users have experience with national biomass assessments compared to 33 % of all users. Regarding satisfaction with the current status, type of potential needed and the use of the assessment (e.g. for policy planning, reporting, etc), there are no large individualities in the Carpathians. Regarding the temporal resolution, the Carpathian countries need faster response: 42 % need annual updates (compared to 31 % of all users). Potential assessments with less than six years intervals are not considered useful at all any more, while in the whole study, 16 % consider updates only every seven years or less still important. Accuracy requirements are again pretty much the same, while the thematic differentiation in the Carpathian countries is more focused on the agricultural crop differentiation (33 % compared to 17 %) than the forest type differentiations (33 vs. 48 %). In terms of resolution, the requirements of the Carpathian countries are slightly less demanding than the ones of all countries. In contrast, in terms of processing speed they are more demanding: 60 % of the Carpathian users need the assessments within 6 – 9 months (compared to 37 % of all users).

THE DYNAMICS OF THE FOREST RESOURCES IN THE ROMANIAN CARPATHIANS FROM 1990 TO 2006. A GEOGRAPHICAL APPROACH

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Keywords: forest resources, Romanian Carpathians, sustainable exploitation, forest policies and strategies

Due to their renewable and non-polluting character, forest resources are primarily taken into consideration by all sustainable development strategies, especially when it comes to showing the mountainous environment to advantage. More and more perturbing influences have left marks upon the process of forests' growth and development, pointing out the necessity of preserving forests and acknowledging the determinant role they play in preserving climate conditions, in stabilizing lands and water resources, in providing biological diversity.
In the year 2006 the area occupied by forests in Romania was of 6, 273 thousand hectares, representing 26% of the country area. In relation to the population number, the forest quota per inhabitant was of 0.28 hectares/inhabitant (as opposed to 0.30 hectares/inhabitant in 1990). Compared to this average percentage of afforestation at the national level, the territorial

grouping of forests is very diverse mainly due to natural conditions and man's intervention along the centuries. Thus, plains possess 10% of the total forest area, hills - 30% and mountains - 60% of this surface.

The present article is intended to analyze *the recent dynamics of forest resources in the Romanian mountainous space,* where the particularities of the relationships between man and woods and their actuality make this issue even more interesting. During the socialist period the way of using forest resources was strictly directed by means of the state machinery. After the profound discontinuance in 1990 and especially after the adoption of the Forest Code in 1991 (stipulating that forests can be returned to former owners within the limit of a certain area) the problem of woods has been redefined in its nature and functionality.

After 1990 the rhythm of changes has been accelerated. The demand of volume of wood on foot has grown whereas afforested areas have become smaller and smaller. Degraded lands due to deforestations and overgrazing, columns of country men carrying wood for fire in their carts, omnipresent lorries loaded with logs, grazing animals and zigzag paths woven on the deforested versants around villages, all these represent common images in certain Carpathian areas nowadays. At greater distances from highroads the rhythm of changes can be slower and the traditional system of land management is viable as long as forests survive. Nevertheless in many Carpathian areas the human impact is strong enough to bring about major and destructive changes within the forest ecosystem.

Whereas in 2001 only 8% of the woods area in Romania was in private property, the value increased to 21% in 2005 and continues to rise.

Although the Forest Code indicates the method of administering private woods, the obligations and rights that forest owners have, the attributions and responsibilities of the public bodies and local administration, at the same time stipulating sanctions against those who bring prejudices to the woods, many times forests are regarded as *common property* and used in a subsistence purpose (most often cutting wood for fire), being in danger of overexploitation and jeopardizing the wider functions of the forest. This aspect is pointed out by the affected regions and wood volume losses as a first consequence of these actions that have got out of control.

The forests in the Romanian Carpathians have a complex structure. The lower mountainous part is characterized by the presence of hornbeam and beech forests and especially of beech forests (in many cases pure beech forests, from this point of view Romania standing out among the European countries); there follow the mixed beech – resinous forests, the upper part being made up of coniferous species (mainly spruces and fir trees). The intervention of the human factor has had significant consequences upon the woods at this level, in certain places the superior tree line decreasing with 200-300 metres in order to make room for secondary pastures; by being planted, the spruce has got down to smaller altitudes as compared to its natural area.

The vastest areas covered with resinous woods lie in the Oriental Carpathians (reaching up to more than 50% of its surface in Suceava county), but also in the Meridional Carpathians and Apuseni Mountains where they occupy smaller surfaces. Mixed beech – resinous forests occupy a vast strip on the Eastern versant of the Oriental and Meridional Carpathians up to the Olt river. Beech forests can be mainly found in the Meridional Carpathians.

A survey on the health condition of the woods in Romania (O. Badea, M. Tănase, 2004) underlines the fact that, at the individual level, the spruce and the beech are the least affected species, the fir tree lying at the opposite side. At the international level, the intensity of forest damage is estimated in terms of the values of the percentage of notably defoliated trees. On the basis of this hierarchy, in 2003 Romania was included in the category of moderately affected countries, with a proportion of 12.6%.

Neither re-afforestations nor new plantations can compete with the original forest as regards biological richness and sociological importance. However, forest regeneration is an absolutely necessary approach in order to preserve the natural patrimony regardless of the system of property over the respective lands. In Romania, afforested areas drastically decreased from more than 25, 000 hectares in 1990 to 15, 500 hectares in 2006, the most affected ones being the lands occupied by resinous species (that is the mountainous region).

Forests play an important role in the life of the local mountainous communities and that is why it is necessary to find alternative strategies of life standard improvement without endangering the existence of woods. Most of the time, the local people's income is small and, in addition to this, the local communities have few ideas on the possibilities of improving their situation. Forests that have come to maturity represent a source of living for a great number of families, sometimes being in fact the only financial source. Under these circumstances viable alternatives of using forest resources must be looked for.

At present, the financial cost of supporting a sustainable exploitation of woods and of implementing certain forest strategies and policies seems to be high. Instead, trying to realistically foresee the future, we will find that the expense of ecological reconstruction is even heavier and the negative effects on the environment can be irreversible to a great extent.

QUO VADIS PODHALE? REGIONAL CULTURE OF PODHALE REGION (TATRA MAUNTIANS) IN THE FACE OF DEVELOPMENT OF TOURIST INDUSTRY. PROBLEMS, HOPES AND THREATS.

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Keywords: cultural heritage, tourism industry, commercialization of tradition, regional identity, mode of life

Podhale is one of the most popular and attractive region in Poland, situated at the food of Polish Tatras. To this day this small area (24 km x36 km) perceived as the oasis of genuine Polish folk culture, where some elements of tradition are not only well preserved, but still practiced by inhabitants, called Górale. Górale themselves emphasize their old pastoral origin and tradition, which is believed to be implemented by Vallachians shepherds, who reached Podhale in 15 century. As Górale leaders claim this mountaineering shepherding was the dominant form of Górale economic activity and fundamental for their existence and culture. And even though pastoral system lost its economical importance, it is still perceived as a core value of Górale regional identity.

Since 1989 Podhale had been experienced rapid economic, social and cultural change. From the region where shepherding and agriculture were the main sources of income, it turned to be a typical touristic area. Nowadays, more than 3 000 000 tourists visit Podhale every year (comparing to 200 000 of inhabitants). Thousands of new pensions, hotels, regional restaurants were erected in this small area, including huge and modern apartments "for sell". Ski-lifting with winter sport stations, shops, pubs proliferated Podhale villages. All these things dramatically changed the image of the region, its landscape, cultural and natural environment, people's life and their culture, raising both positive and negative consequences. Some of these new phenomena, like the process of commercialization of folk tradition, devastation of cultural landscape, dissolution of traditional value system, including shepherding, perceived by Górale regional leaders as the threatens to the existence of their cultural identity and group cohesion. All these anxieties found an expression in the question: "Quo vadis Podhale? Where is a limit of selling ourselves, our land, our tradition?"

The aim of my talk is to present some of the problems mentioned above, with special regard to the contemporary Górale cultural heritage and their identity. While discussing these phenomena I will use the ethnographic materials and documents, which were collected during my field work research carried on since 1995 till now in the Podhale region. I will also present some results of scientific research project tilted "Carpathians traditions in the contemporary models of local identity. Examples of Poland (Podhale) and Romania (Maramures). Comparative studies", which was conducted by the Institute of Ethnology and Cultural Ethnology, Jagiellonian University, in the period 2002-2004.

Thematic session: Land Use and Land Cover Change

Chairs:
Patrick Hostert (Humboldt-Universität zu Berlin, Germany),
Katarzyna Ostapowicz (*Jagiellonian University, Poland),*
Marc Zebisch (European Academy Bolzano [EURAC], Italy)

The session focuses on assessing the rates and spatial patterns of Land Use and Cover Change (LUCC) over time and across scales. LUCC is widespread in the Carpathian region mainly due to transformations of land use systems after 1990 and land use legacies since Austro-Hungarian and socialist times. Therefore, this session aims at revealing how rapid political, socio-economic and institutional changes affected LUCC, estimating the relative importance of underlying drivers of LUCC, and quantifying the effects of LUCC on ecosystem services and biodiversity. Answering these questions, specifically based on remote sensing and geospatial analyses, shall allow insights in future scenarios of LUCC in the Carpathians.

ORAL PRESENTATIONS

A FINE-SCALE LAND-COVER MAP FOR THE UKRAINIAN CARPATHIANS BASED ON SATELLITE IMAGES

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Keywords: Ukrainian Carpathians, land-cover map, Landsat thematic Mapper, SVM-classification, forest cover

Fine-scale land cover maps are important for analyzing land use change, for planning and assessing forestry and farmland management practices, to quantify ecosystem services, and for nature protection. Unfortunately, while those Carpathian countries that are a member of the European Union are covered by the CORINE land cover no harmonized fine-scale land cover map exists for the Ukrainian Carpathians. Our goal here was to use satellite images from the Landsat thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) sensors at a spatial resolution of 30m to classify such a map. Five Landsat footprints cover the Ukrainian Carpathians and we used two images, one from spring and one from summer 2000 to consider phenological differences among forest types among seasons. To mitigate shadowing effects due to region's mountainous terrain, we also included a shaded topography model in the classification. As a classifier, we used Support Vector Machines and we derived the land cover classes: coniferous forest, broadleaved forest, mixed forest, unmanaged grasslands & shrublands, managed grassland, water, cropland, dense settlements (urban areas), open settlements, and bare rock. Post-processing based on image segmentation was used to eliminate small patches (< 0,5 ha, e.g., representing separate tree groups inside of the fields) and to include major rivers. Our results showed that the Ukrainian Carpathians had a forest cover of 56 % in 2000. Broadleaved, mixed and coniferous forests had proportions of 21 %, 19 %, and 16 % respectively. Farmland (managed grassland and cropland) covered 25 % of the study region. We also found much currently unused land (fallow fields, succession areas) – likely areas that were abandoned in response to the collapse of state farms after 1991. Our land cover map provides the first unified assessment of its kind for the Ukrainian Carpathians, and we hope our map will inform land use and conservation planning in the region.

ASSESSMENT OF RECENT LAND COVER CHANGES IN THE CARPATHIANS MOUNTAINS WITH MODIS DATA

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Keywords: MODIS NDVI, land cover change, the Carpathians

Land cover changes are widely recognized as an important factor leading to alterations of the Earth system (Lambin et al. 2001). Changes can be divided into land cover conversion (characterized by a complete replacement of one cover type by another) and land cover modification (defined as more elusive alterations which affect the character of land cover without changing its type) (Coppin et al. 2002).
Various approaches can be used to reveal land cover changes. However, until now, not many full-scale research, relating to the whole Carpathians, has been carried out. Moreover, little attention has been paid to use satellite-derived products characterized by high temporal resolution and medium spatial resolution, which are provided by e.g. MODIS sensor. Data

gathered by MODIS sensor are usually linked to atmospheric research. Nevertheless, some of these products may be successfully applied to qualify land cover changes (Cararo et al. 2007). Therefore the purpose of this paper is to determine the general directions of contemporary land cover changes in the Carpathians based on MODIS NDVI data.

Series of 10 MODIS NDVI data sets (MOD13Q1 product) covering the second half of July from 2000 to 2009 were used in this study. Land cover changes in the Carpathian Mountains were assessed using NDVI differencing as well as trend analysis for period 2001-2009 with respect to elevation. To determine unchanged areas, two thresholds were assumed. Area was recognized as unaltered when the NDVI differencing value belonged to range <-0,13; 0,13>.

Changes recorded between 2001 and 2009 were not widespread – almost 92% of the total Carpathians territory remained unaltered. As for observed changes, decreases in NDVI values were predominant (Fig. 1). The largest drops were registered in the western part of the Apuseni Mountains (especially Criş Mountains), central (Transylvanian Plain) and north-western part of the Transylvanian Plateau (Someş Plateau), or in the Northern Mountain (Cserhát, Mátra or Bükk Mountains) situated within the Inner Western Carpathians. Regions where the increase of NDVI was found are more dispersed and cover smaller areas. The most visible rises were in the south-eastern part of the Moldavian-Muntenian Carpathians (Outer Eastern Carpathians) and in the western part of the Western Carpathians.

Between 2001 and 2009 negative trend dominated in the Carpathian Mountains, although it varied with elevation. Positive trends were observed within three classes included areas above 1500 a.s.l. The average rate of change was negative for both the whole Carpathians and particular classes. Between 2001 and 2009 NDVI value diminished average 0,2% per year. The biggest decreases were recorded in regions below 200 m a.s.l. Territories located above 2000 m a.s.l experienced the slowest changes.

The most noticeable alterations were recorded in areas below 200 m a.s.l. This fact may be connected with change in either agricultural land structure, or crop structure within arable lands.

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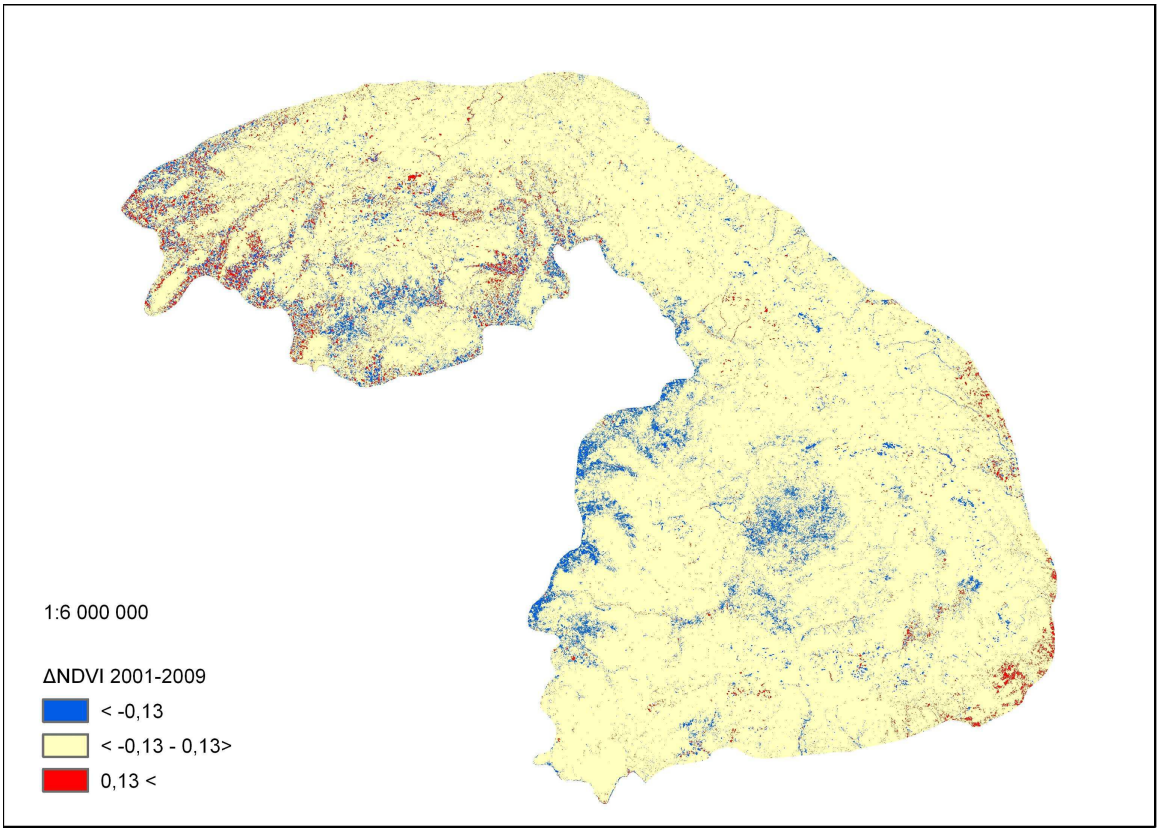

Figure 1. Changes in NDVI values between 2001 and 2009

EFFECTIVENESS OF PROTECTED AREAS IN ROMANIA – LAND USE CHANGES INSIDE AND OUTSIDE THE PROTECTED AREAS IN NORTHERN ROMANIA

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Keywords: protected areas, effectiveness, logging, forest ecosystems, land-use change, remote sensing, Romania

The Carpathians comprise Eastern Europe's largest contiguous forest ecosystem, provide habitat for many endangered species, and are a hotspot of biodiversity. Carpathian countries have undergone dramatic political and socio-economic changes after the collapse of socialism in 1989. The transition period was characterized by widespread land-use change, massive ownership changes and tenure insecurity, and weakened institutions, all of which presents considerable challenges for nature conservation. In Romania, the network of protected areas has been enlarged substantially since 1989, for example due to the Birds-, Habitat- and Water Framework directive, the NATURA 2000 network, as well as a national strategy and action plan for biodiversity conservation developed in 1996. Some 1.7 million ha, equalling 8% of Romania's territory, are now protected areas, including 13 national parks and 14 nature parks. However, the question is whether these directives are implemented and enforced and how effective Romania's protected areas are in safeguarding biodiversity and ecosystems. Here, our goal was to assess the effectiveness of two protected areas in the Romanian Carpathians: Maramures Nature Park (the largest protected area in Romania) and Rodnei National Park. We mapped changes in land cover, particularly forest disturbance, using a time-series of Landsat TM and ETM+ satellite images between 1985 and 2009 and a Support Vector Machine classifier. Our results suggest that forest cover remained fairly stable during the 1990s, whereas forest disturbance rates increased sharply after 2005. We also found substantial disturbances inside protected areas, even within the park's core areas. Most disturbances we mapped represented logging. We suggest that large-scale changes in forest ownership triggered by the restitution process, which where especially widespread after 2005, are a likely explanation for the increased logging rates we found. Park effectiveness appeared more effective before this period. Illegal logging and an eroding infrastructure for nature protection in Romania due to severe budget cuts of park administrations are possible explanations for these patters. Our results highlight how rapid ownership changes translated into high logging rates and emphasize the decreasing effectiveness of Romania's protected area network despite the recent accession of the country to the EU. Satellite images could be valuable tools to monitor forest change and thus to help safeguard biodiversity in the Carpathians.

LOGGING AND LAND ABANDONMENT IN WESTERN UKRAINE: EFFECTS ON CARBON FLUXES AND FUTURE CARBON STORAGE POTENTIAL

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Keywords: Post-socialist land use change, forest harvesting, cropland abandonment, carbon sequestration potential, carbon flux, forest transition, land use legacies, former Soviet Union; Carpathians

Land use is a critical factor in the global carbon cycle, but land use effects on carbon fluxes are poorly understood, particularly in areas where forests are regrowing. Land use intensity decreased substantially in Eastern Europe after the breakdown of socialism, resulting in widespread farmland abandonment and reforestation. Our goal here was to examine how land use trends altered net carbon fluxes in four states in Western Ukraine (57,000 km^2) for the socialist (1945-1991) and the post-socialist period (1991-2007), and to assess the regions' future carbon sequestration potential. We quantified forest disturbance and farmland abandonment from Landsat images from 1988-2007 and used historic forest inventories to reconstruct forest trends back to the mid-1800s. Using a carbon book-keeping model, we quantified net carbon fluxes from land use and assessed potential future carbon fluxes for a range of reforestation and logging scenarios. Our results suggest that the low-point in forest cover occurred in the 1920s. Forest expansion in the second half of the 20th century turned the region from a carbon source to a sink, despite heavy logging during socialism. The current land-use related sink strength is

about 1.5 Tg of carbon per year. Sequestration potential on abandoned farmland is enormous, even when assuming that only a minor fraction of the currently abandoned land will revert to forests. Beyond our study area, farmland abandonment has been widespread throughout Eastern Europe and the former Soviet Union, suggesting that a substantial proportion of the regions' industrial carbon emissions may be offset by reforesting farmland.

LAND COVER CHANGE IN THE POLISH CARPATHIANS OVER THE LAST DECADES

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Keywords: land cover change, political transformation, natural and socio-economic factors, Landsat data, the Polish Carpathians

The political and socio-economic breakthrough after the fall of the Iron Curtain (1989) affected land cover and land use change (LUCC) in the Polish Carpathians in a variety of ways, both directly and indirectly. The new set of drivers was triggered firstly directly after the breakthrough related to the beginning of the marked-oriented economy and secondly after the accession of Poland to the European Union the introduction of EU policies (predominantly the Common Agricultural Policy; CAP). The new socio-economical situation hastened mostly changes in agriculture, rural to urban migrations or growing welfare of societies and increasing share of the tertiary sector. Two major types of LUCC were observed: agricultural land abandonment leading to slow forest area increase, and increase of built-up areas.
The aim of this paper is to create a spatially explicit model of past land cover change (LCC) in the Polish Carpathians since '80s taking into account both biophysical and socio-economical selected drivers influencing LCC directions. We were focusing mostly on changes in three land cover classes: forest, agriculture and built-up areas.
To map land cover classes (built-up areas, agricultural areas, forest, semi-natural non-wooded areas and water) and its change we used 12 Landsat TM and 6 Landsat ETM+ scenes from NASA Global Orthotectified Landsat Data set. The images from the NASA archive were acquired between May and September (mostly July), for three points of time late '80 – beginning of '90, 2000-01 and 2005-07 which reflected respectively the time before political and socio=-economic transformation in 1989, the time before the accession of Poland to the European Union and after the accession. Ancillary data were CORINE land cover (CLC) database for years 1990 (CLC90), 2000 (CLC00) and 2006 (CLC06), and Shuttle Radar Topography Mission digital elevation model (STRM DEM) – training data sources. The land cover maps were generated by a supervised and unsupervised, hierarchical approach combining image segmentation, knowledge-based rules to extract a training set and support vector machine classification. The information about biophysical and socio-economic variables was received from the Shuttle Radar Topography Mission digital elevation model (SRTM DEM - elevation) with a spatial resolution of 3 arc seconds (approximately 90 m), vector data (roads and railway network – Digital Atlas of the Małopolska Region and the V-Maps of the Silesian and Podkarpackie Regions – accessibility, Polish State Forest data – forest ownership), socio-economic statistical data from socio-economic statistical survey data from the Polish Central Statistical Office (NUTS 5 level; level of migration, employment in industrial, agricultural or service sector).
We used geospatial analyses (PCA and non-linear regression) to assess and model the relation between the LC and its changes distribution and its driving foresees.
Generally, the previous and preliminary simulations of LUCC show that in the next 45 years the abandonment of agricultural land and subsequent forest succession may contribute to a significant increase in forest cover in the Polish Carpathian Mountains.

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POSTER PRESENTATIONS

LAND USE CHANGES WITHIN THE BIOSPHERE RESERVES' ZONES IN SLOVAK CARPATHIANS

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Keywords: land use changes, biosphere reserves, slovak Carpathians, Tatra Mts, Poľana, East Carpathians, Slovak Carst

Biosphere reserves UNESCO in Slovak Carpathians represent worldwide system of protected areas with three basic functions – nature conservation, research and sustainable development. Each biosphere reserve is divided into three zones according to their prevailing function. Zoning should correspond to the areas' rarity and originality of natural values. The topic of the study was identification of past land use and its changes (1770- 2009) within the declared Slovak biosphere reserves zones as indicators of their ecosystems originality. The land use development was identified from historical maps and aerial photographs. The most stable areas (with unchanged land use forms) as well as the intensity of land use change were identified within the BR zones. For a comparison of the 4 Slovak biosphere reserves study areas the coefficient of ecological stability was applied. The results in general justify the Slovak BR zoning and pointed out certain similarities of the studied areas.

CHANGES IN TIME THROUGH CADASTRAL DATA: THE CASE OF ZARSZYN, A VILLAGE IN THE CARPATHIANS

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Keywords: GIS, Historical GIS, Cadastre, Austrian-Hungarian, Poland

Cadastral documents for areas of current day Poland that had been Austrian-Hungarian territory before World War I can be a tremendous resource for the analysis of parcel related changes in an area. For a project examining the changes in the village of Zarszyn the availability of cadastral maps from the period together with the most recent cadastral materials allowed us to undertake a GIS-based analysis of changes to parcel boundaries.
In our comparison of 1852 and 2009 cadastral materials, the analysis established that the average area of parcels at least doubled form 2038 m2 to 4455 m2. We found similar changes in perimeters and the circumference/area ratios, but we noticed differences among upland and valley portions of the village, as well within the developed areas. We conducted several shape analyses to establish spatial clusters of changes. While parcel consolidation in the period occurred in all areas, the increase in parcel size was strongest in the upland area of the village. Some valley areas also went through considerable consolidation of parcels, that led to increases in parcel size. In contrast, the built-up village areas experienced an increase in the number of parcels. The subdivision of parcels left existing boundaries largely intact however. Specific changes also resulted from the building of a railway and changes to the courses of the river and streams.
The results of these analysis help to document both changes and in some instances the over 150 year stability of parcel boundaries. Underlying reasons lie in the historical stability of the village and socio-economic changes.

IMAGES FROM THE PAST - USING GROUND-BASED REPEAT PHOTOGRAPHY IN ASSESSING LONG TERM LAND COVER CHANGES IN SZCZAWNICA (THE POLISH CARPATHIANS)

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Key words: land cover change, ground-based repeat photography, Polish Carpathians

Repeat photography is a valuable method which enables analyzing land cover changes in much longer periods than aerial or satellite images. Although it has some limitations due to oblique perspective, which creates a continuously varying scale and prevents linking landscape features in the photograph to absolute spatial coordinates.
In the study, the process relocating camera position and both qualitative and quantitative image analysis is presented. Quantitative analysis was based on the method, where a regular grid is used to assess land cover changes between the old

and contemporary image. Photographs taken in 1930s are additionally compared to the content of a topographic maps in scale 1:25 000 and 1:100 000 (1936, 1937) covering the same area.
The results show an increase in forest cover and settlement combined with the decrease of agricultural lands in most of the analyzed scenes. Comparing photographs to the maps from the same period, give us a suggestion about possible biases in forest cover presented on the maps – especially on the steepest slopes.

FOREST CHANGE IN THE CENTRAL PART OF THE SOUTHERN CARPATIANS IN THE LAST CENTURY

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Keywords: Southern Carpathians, Parang-Cindrel, forest cover change, forest metrics, deforestation

This paper aims at a forest change analysis in the central part of the Southern Carpathians in the last century, namely in the Parang-Cindrel Mountains. The Parang-Cindrel Mountains stand out as one of the tallest Romanian Carpathian groups with the highest altitude of 2,518 m. The most characteristic features of this group are its massiveness and relatively wild forest areas preserved in spite of intensive population and related human activities. These mountains have one of the Romania's largest forest ecosystems and shelter important Carpathian hotspots of biodiversity.
There were used three main cartographic product types that point out three major time stages: old maps from the end of the XIXth century and the beginning of the XX, topographic maps from the 70's and Corine Land Cover Data 2000 and 2006. The chosen working scale was of 1:100,000 primarily due to the input cartographic sources used and its suitability in various analyses linked with the main trigger-factors of vegetation. In order to quantify forest fragmentation various forest metrics were calculated (core, perforated, edge and patch patterns revisited, patch size, inter-patch distance, patch-density, edge-density, corridors, etc.).
Forest change was brought about mainly by anthropogenic pressure materialized in deforestation for settlements and communication routes but also by natural factors that determined long-run oscillations of the forest extent. Analyzing and interpreting forest change, one can easily remarks three main stages that experienced major anthropogenic disturbances. In the beginning of the XXth century the most significant forest changes appeared in the northeastern part of the study area (Northern Cindrel Mountain) where human pressure was mostly determined by the need to extend the grazing space but also by high-altitude settlements related to an intensive pastoral activity that emerged here at its largest extension in the Southern Carpathians. The second stage of drastic reductions was in the 70's when large hydrotechnical constructions appeared especially in the Lotru and Sebes watersheds with its adjacent logging, increasing timber harvesting rates in the area and tourist infrastructure. The third stage is the post-socialist period when due to forest ownership change and lax institutional policies, the Southern Carpathians underwent a new increase of forest harvesting explained mainly through the interest of the new owners to achieve a massive short-term profit which caused an overexploitation of the forests. Qualitative and quantitative disturbances were especially highlighted in the post-socialist period.
Present forested areas represent around 80% of the study area while core forest areas cover more than 65%. Forests in the study area shows significant connectivity over large regions but timber-exploitation fragmentation tend to become an extremely negative influence on forestry ecological processes.

FRAGMENTATION AND DEFRAGMENTATION OF FOREST COVER IN THE NORTH-EASTERN PART OF THE BESKID ŚREDNI MOUNTAINS

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Keywords: forest cover changes, Beskid Średni Mountains, topographical maps

The study presents forest cover dynamics in the north-eastern part (298 km2) of Beskid Średni Mountains since the 1860s. The main method used was analysis of 1:25 000 scale topographic maps to determine changes in the area, spatial distribution and geometry of forest outlines (centroid, coherence and tortuosity of borders) with reference to selected natural, social and economic conditions. A forest outline is taken to be a forest area separated by cultivated lands from other forest areas. Special attention was paid to defragmentation and fragmentation of the forest. Defragmentation, namely a decrease in the number of forest outlines, led to an increase in the coherence of the total forest area and reduced landscape heterogeneity. Fragmentation, on the other hand, led to reduced coherence and increased landscape heterogeneity. The study was conducted for two spatial ranges: the whole area, and a network of squares with sides of 200 m; and for four time ranges: 1861–1862, 1911–1914, 1978–1980 and 2003.

For the whole area, the forest cover increased from 26.5% in the 1860s to almost 50.0% in 2003. That increase resulted mainly from fields being put to fallow, which then underwent natural plant succession. Small forest outlines merged, forming corridors with a longer axis in a latitudinal direction, related to the shape of mountain ranges. The area of the largest forest outline increased from 15.2 km2 to 66.5 km2.
In the squares a count was made of forest outlines. The more forest outlines were found in a square, the higher was the heterogeneity of use. The agricultural and forest landscape had the greatest heterogeneity in the years 1911–1914. In that period almost 3% of all squares contained three or more forest outlines. At the present time the landscape heterogeneity is significantly lower than in the 19th and early 20th century, although it may increase due to intensive fallowing. Current mid-field woodlots, more numerous than in the 19th century, not marked on modern maps as forests, may become centres for an increase in forest outlines.
In the period studied, the areas with the highest dynamics of forest coverage were upland clearings and steep slopes away from buildings. The lowest dynamics were found in forests belonging to large landowners and cultivated fields in the vicinity of buildings.

AUTOMATIC ASSESSMENT OF BUILT-UP AREA EXPANSION – AN EXAMPLE FROM THE POLISH CARPATHIANS

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Keywords: urban sprawl monitoring, spectral indices, Landsat

The increase of the urban and built-up areas can be recognized as very significant process in the last years, taking place almost all over the world. It is clearly visible also in the Carpathians, especially after the 1990 socio-economic transformation. Thereby an efficient monitoring of this process became a very important and necessary task. This study present the methodology for the fast and automatic estimation of the built-up land expansion, assessing the changes for the part of the Polish Carpathians, for the period of 1987-2006. The information were extracted mainly from the Landsat TM and ETM+ satellite images and partially from the Corine Land Cover 2006 database. The methodology consists of two stages: 1) delineating current extent of the built-up areas based on the supervised image classification, with the fully-automatic training stage, 2) reconstructing changes based on the spectral indices and the textural information. The methodology is valid only under the assumption that the only possible change direction was the built-up land expansion.

RECENT LAND COVER CHANGES IN THE LOW MOUNTAIN LANDSCAPES OF LVIV OBLAST (UKRAINIAN CARPATHIANS)

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Keywords: Carpathians, Ukraine, land cover change, potential natural vegetation

The goal of the study was to detect and analyse land cover changes with respect to the natural landscape structure and proximity to roads in the two model municipalities -- Stara Sil (3208 ha) and Boberka (6819 ha) using old soviet topographic maps and recent satellite images dated from respectively 1983 and 2005.
A natural landscape is perceived as a mosaic of natural geoecosystems (GES), which are delineated using landforms as the primary component (feature), and which reflect distribution of other hydroclimatic and biotic components, including the potential natural vegetation (PNV). The landforms were manually delineated from scanned 1:50,000 topographic maps and characterized by average slope, concavity, and mean elevation (representing altitudinal elevation belts) using statistical overlays with SRTM 3-arc-second data. Then, the PNV and soil were established as a function of morphometry/surface drainage and elevation within the landforms.
The forest cover pattern of 1980s was digitized from the topographic maps, while its recent changes were manually detected using high resolution images from the Google Earth. Then, the land cover change data were overlaid with the natural GES data for further analysis. Transportation accessibility was included into the analysis as additional economic parameter. It was calculated as a cost-distance surface from the settlements and roads using terrain slope value as a cost surface.
The important intermediate result of the study is a geo-dataset of natural GES embracing 35 types with attributes on topographic location, average altitude, mean slope, type of bioclimatic altitudinal belt, soil and dominant PNV. Overall, nine types of PNV were distinguished. In Stara Sil, Fageto-Querceta and Carpineto-Querceta PNV types dominate. However, in Boberka Abieto-Fageta and Fageto-Abieta PNV types cover about 70% of the area.

Five types of land cover changes were distinguished. Four of them can be aggregated in a group with secondary succession changes. In these areas, which were formerly extensively used by agriculture, land cover was replaced by coppice, shrubs, and forest.
The total area with land cover changes is: for Stara Sil estimates 79,4 ha (2,5 %); while for Boberka - 715,9 ha (10,5 %). In Stara Sil, replacement of grassland with broadleaves forest dominates. However, in Boberka, the occurrence of coniferous forest is more frequent.
In Stara Sil, the majority of landcover changes could be found in Fageto-Querceta (over 50%) and Abieto-Querceta (about 10%) PNV types. However, in Boberka land cover changes mainly occured in the GES with Abieto-Fageta (over 40%), Alneta incanae and Fageto-Abieta (about 10% each) PNV types.
Areas with land cover changes are mainly remote and are situated on forest edges or within the forest. Nevertheless, the analysis of transport accessibility shows that there is no relation between the emergence of land cover changes and distance to the roads.
A common tendency is the increase of the forested area owing to degradation of former agricultural lands.

FOREST COVER CHANGE IN THE POLISH CARPATHIANS BETWEEN 1980 AND 2010 – CASE STUDY OF THE SKRZYCZNE MASSIF (SILESIAN BESKID MTS)

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Keywords: forest cover change, deforestation, spruce monocultures

Restoration of clearcuts with spruce (Picea abies) of various provenances was a common practice in the forest management in the Polish Western Carpathians up to the first decades of the 20th century. Such spruce monocultures have started to decline in the second half of the 20th century following the industrial development of the regions located at the borderland of Poland and former Czechoslovakia, especially the Upper Silesia Industrial District. In the Silesian Beskid Mts spruce monocultures, covering about 90% of the total forested area, have been most affected by air pollutants. In the 1980s first visible symptoms of forest degradation were observed, especially on the summit plains of the highest part of the Silesian Beskid Mts – Skrzyczne massif (1257 m a.s.l.), were habitat conditions are similar to the conditions of the upper treeline zone.
Forest cover changes between 1980-1993 in the Skrzyczne massif were mapped by the author during field research in 1993, with help of foresters (interviews) and forest maps changes. Forest changes which occurred after 1993 were analysed on digital orthophotomaps based on aerial photos taken in the second half of 1990s and in 2009. Additional field studies were conducted in the summer of 2010. Data on forest division and statistical data for forest stands were obtained for 2008 (Forest Numeric Map for State Forests).
Forest cover changes occurred in the Skrzyczne massif during 30 years (1980-2010) are an example of successive replacement of spruce monocultures with mixed forest as the result of forest degradation. Process started on summit plains and moved downslope as well as along the ridges following the migration of the anthropogenic treeline formed around the oldest clearcuts. Clearcuts are now forested with various tree and shrub species, e.g. Fagus silvatica, Pinus mugo. Observations taken in 2010 show that spruce decline process will continue and spruce monocultures can be completely removed in this part of the Polish Carpathians.

Thematic session: Natural Hazards and Risks

Chairs:
Iuliana Armas (University of Bucharest, Romania),
Dan Balteanu (Geography Institute of Romanian Academy, Romania),
Juraj Hreško (University of Constantinus Philosopher, Slovakia),
Adam Kotarba (Polish Academy of Science, Poland),
Zofia Rączkowska (Polish Academy of Science, Poland)

The session focuses on current trends in estimating natural hazards in the Carpathians against the background of global climate change and growing human pressure on the mountainous environment. The assessment of disaster impacts on social, economic and environmental conditions could be conducted using vulnerability indicators. This session proposes the investigation of methods used for measuring physical and social vulnerability on the basis of different case-studies from the Carpathian region. It is organised in the following thematic clusters: case-studies of geomorphologic, climatic and hydrologic hazards in different parts of the Carpathian arc and identification of target areas; driving factors for increasing disaster risk during the transition period (differentiated vulnerability, poverty, deforestation and declining ecosystems); and information on sharing and networking of hazard assessment, education and pro-active actions.

ORAL PRESENTATIONS

LANDSLIDE AND FLOOD SUSCEPTIBILITY IN THE BEND CARPATHIANS AND SUBCARPATHIANS

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Keywords: landslides, floods, susceptibility, Romania, GIS

This paper evaluates landslides and floods susceptibility through GIS-based methods, and significant case studies of extreme events. The studied area is one of the most affected by natural extreme events in Romania. The landslide susceptibility assessment in the studied area was accomplished using a Landslide Susceptibility Index (LSI) computed in GIS, which considers and weights the main factors that control landslide activity: lithology, slope gradient, maximum rainfall in 24 hrs, land use, seismicity and local relief. Each factor was classified into 7-18 classes which were rated from 1 to 10 by means of expert judgement. A formula was devised to compute Landslide Susceptibility Index over each 100 m x 100 m pixel and the resulting values were ranked into 5 landslide susceptibility classes (Balteanu et al., 2010). The landslide susceptibility map indicates that the sector most prone to slides is the Bend Subcarpathians, where high and very high susceptibility classes represent over 50% of the area. The great majority of the active landslides correspond to partial reactivations of older landslides.
In the area, the majority of peak discharges and floods originated in exceptionally heavy and intense rains fallen over a short time-span, while floods unleashed by rain associated with snowmelt were less involved. The maximum rainfall/24 hours (over 200 mm) and maximum rainfall intensity (5-6 mm/min) occurred in the middle sectors of the Ialomița and the Buzău rivers. Flood-waves were triggered also by other factors, such as soil texture and permeability, channel, previous excess moisture, vegetation, channel and slope gradient, shape and reception basin area, etc. The paper presents as case studies the severest floods occurred in the river basins within the study-area (1975 and 2005), their propagation and effects.

LANDSLIDES RISK ASSESSMENT: GIS APPLICATION TO A COMPLEX MOUNTAINOUS ENVIRONMENT

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Keywords: vulnerability; landslide risk; GIS; geomorphological mapping; the Eastern Carpathians

Mass movements risk assessment has experienced extensive development in the last few decades, being considered an efficient way to notably improve land-use planning. However, studies on vulnerability communities subject to landslides related consequences are limited, and in Romania, the situation is not different. This paper focuses on the applicability of landslides risk zoning, at different scales, to the Depression of Lepsa-Gresu from Eastern Carpathians (Romania), where landslides and other geomorphologic processes are present and where emergent mechanisms of touristification are evident

in the last years, with complex, systemic implications at the local level. Special attention is given to the assessment of the vulnerability of communities, that we consider the most important component in the risks' equation. The study area, of about 200 km², belongs to geo-structural unit of flysch, known by its structural diversity, active tectonics (local positive epeirogenetic movements of 2-4 mm/year and intense seismic activity) and petrographic heterogeneity. Clay-schiste, disodilic marl and sandstone strata alternance, the geo-morphometric parameters and the anthropic factor (intense deforestation, excessive grazing, buildings expansion on slopes) favors the slope processes occurence, at first, landslides occurence. Multiple data domains were used for this study: geological maps, topographical maps and ortophotographs at 1/10,000 and 1/5000 scale, specific information extracted from GUP (General Urban Plan) provided by local administrations. The landslide inventory, multicriteria qualitative and quantitative analysis and GIS application have facilitated data processing and spatial visualization results. A 5-m-resolution DEM was used for the analysis and allowed obtaining thematic layers, all with 5 x 5 m² pixels or cells. Statistical relationships for landslide susceptibility were developed using landslide and landslide causative factor databases. Logistic regression allows forming a multivariate regression relation between a dependent variable (landslides) and several independent variables (causative factors: slope, aspect, elevation, distance to settlement, land cover, plan curvature, profile curvature, depth fragmentation, density fragmentation, distance to road network, terrain roughness, geological conditions, soil type). The effects of both precipitation and seismicity can be regarded as uniform throughout the area, therefore, they were not considered for the analysis. The probability of landslides occurrence and, respectively, the landslide susceptibilty map was obtained through the binary model (1 for landslide presence, 0 for landslide absence) and by the buffer zone application into TNT MIPS software. Identification of basic elements at risk (buildings, roads, agricultural land) and consideration of specific indicators (distance to buildings, distance to road network, population resilience) allowed to assess communities' vulnerability. The final risk map, obtained by the combination of both the landslide susceptibility map and vulnerability, reveals significant weight of high (11%) and very high (4%) risk classes in all area affected by landslides. Among remedy measures required we consider, at first, land-use changing (restriction of buildings' expansion on slopes, redesigning roads, afforestation). Fine judgement is expected to accompany the interpretation of results. Also is obvious the importance of a correct characterization of the processes leading to landsliding to produce reliable susceptibility, hazard and risk zoning maps.

LANDSCAPE PATTERNS OF MOUNTAIN ARCHETYPES IN SLOVAKIA

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The mountainous part of Slovakia represents the landscape with the huge geodiversity and biodiversity of different scales and hierarchical levels. The West Carpathian Mountains as the basic morphostructure represent the vault head of the Carpathian arch consisting of the set of zonally arranged mountain range, tectonically conditioned hollow basins, fluvially modelled erosive furrows and erosive valleys. Development of the mountain region landscape structure had been determined by the climatic conditions correspondents with the height gradient as well as by the factors of the environment influenced by the attributes of the geological subbase and its lithologically stratigraphic complexes, hydrological regime and the human being activities from the young Palaeolithic to the present. Archetypes of the mountainous units are being changed within the individual landscape types and relief types of the low mountain and the high mountain. We can identify many types or structures of the arranged landscape elements with the close correlation to the relevant variable environment. The paper mentions the type examples in the conditions of the karstic area archetypes, flysch and volcanic mountains, high mountain areas with the respect to the selected landscape attributes and forms of utilization.

RECENT TRANSFORMATIONS OF RELIEF IN THE POLISH CARPATHIANS

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Keywords: evolution of landform, last few hundreds years, the Polish Carpthians, human influence

The paper aims to examine recent evolution of landform in the Polish Carpathians. Analysis of geomorphologic processes modelling Carpathian relief during last few hundreds years, together with taking into account human influence is a base for evaluation of relief transformation. The following processes are analyzed: mass movements, sheet erosion, gully erosion and piping, aeolian processes, periglacial processes, karst and pseudokarst, fluvial processes, biogenic processes. The

analysis is based on results of the authors studies and results of former studies collected from relevant references. Geomorphologic processes in the Polish Carpathians have been the subject of numerous researches, since the beginning of the 20th century (Margielewski et al., 2008; Rączkowska, 2008).

Increased human impact and extreme hydrometeorological phenomena are a key factors affecting contemporary geomorphological processes shaping Carpathian relief. Over the last 200 years, deforestation, intensive agriculture, mining, home construction on slopes, channelization of streams, and construction of reservoirs all have contributed to appreciable changes in the impact of particular geomorphological processes on the formation of Carpathian relief compared to that of earlier periods in history. An increase in the amount of land farmed has resulted in a previously unseen increase in sheet erosion and deflation. Moreover, slopes bearing poorly constructed infrastructure have become susceptible to mass surface movements.

Extreme downpours, continuous rainfall, and the rapid melting of snow have always been the most important factors of relief transformation in the Polish Carpathians. Threshold values are quickly exceeded during such events and powerful morphological processes are initiated. However, the difference between earlier stages of morphogenesis and the anthropogenic stage is, that at this stage, different geomorphological processes may play key roles in the contemporary transformation of mountain relief, as their intensity and their effects are often stimulated by human activity. Moreover, the diversity of geological structure and relief of the Polish Carpathian Mountains leads to extreme hydrometeorological phenomena that affect the course of slope and valley floor formation in diverse ways.

The differences in recent evolution of high mountain, middle mountain and the foothills relief are visible.

The geomorphic hazards such as debris flows, dirty avalanches, and extreme floods play a key role in the high mountain relief transformation. Yet, the tendency for relief to become stable following the end of the Little Ice Age and a reduction in human is observed in the Tatras.

In flysch mountains, dominated by an infiltration-evapotranspiration water circulation pattern with significant throughflow, leaching of surface materials is quite common, and when favourable conditions emerge, landslides and piping are quite frequent. Mass movements predominate in certain areas of the Polish Carpathians, however, the many landslides that do take place are usually shallow and their surfaces become quickly smoothed over. Such mass movements, with some exceptions, tend to leave only a temporary mark on relief. However, only during long time mass movements create concave slope profiles, dissected and generally lower slopes. In most cases, new landslides follow earlier ones and due to reactivation, younger generations of mass movements cause enlargement of landslide zone areas. Moreover, mass movements determine the course of other denudational processes.

Deforestation and agriculture, particularly in the Carpathian Foothills, have made sheet erosion the predominant geomorphic process during the past 200 years. Material washed off fields builds up across deluvial flats at the base of slopes, which encroach onto flat valley floors. The steeper slopes of the Beskidy Mountains show agricultural terraces that stabilize slope surfaces with fields that run perpendicular to contour lines, which results in limited sheet erosion. Linear incisions and field roads play key roles in the transport of surface material from slopes. In certain parts of the Polish Carpathians, intense aeolian processes lower crests and windward slopes, while leeward slopes built up and become longer. The tendency over the last 20 years has been to decrease the amount of land used for agriculture and to reduce sheet erosion and deflation as well as to intensify gully erosion on slopes, the incision of river channels, and the activation of shallow landslides.

The reduced delivery of fine-grained material from slopes to valley bottoms as well as the channelization of rivers since the early 20th century has resulted in deeper river channels and a reduced rate of sediment deposition on floodplains. The opposite is true in valley floors upstream from dams. On the other hand, rivers in the Carpathian Foothills that drain areas still dominated by agriculture are characterized by wide floodplains that continue to collect sediment during flood events.

Only high-energy precipitation can normally lead to simultaneous transformations of slopes and valley floors in high mountain, middle mountain, and foothill areas. Despite the creation of terraces and the construction of all types of dams on valley floors, localized debris flows overrun barriers and transport material along the full lengths of slopes and river channels. Suspended sediment may also be carried beyond the Polish Carpathian region.

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RISK ANALYSIS OF NORWAY SPRUCE FOREST STAND DECAY IN THE SLEZSKÉ BESKYDY MTS. (CZECH REPUBLIC)

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Keywords: Norway spruce forest, risk assessment, forest decay, multifactorial analysis, logistic regression.

Introduction

In last years Norway spruce forest stands in the Slezské Beskydy Mts. have been inflicted by outstanding needle yellowing, finally resulting in individual tree dying. These symptoms have been observed in neighbouring forest stands in Slovakia and Poland, too. The aim of this contribution is to present the analysis of the relationship between incidental felling and site conditions and the method of the risk analysis of forest stand decay using logistic regression. Predicated decay probability of forest stands with prevailing Norway spruce will enable to calibrate the stress module of the growth simulator Sibyla to estimate a subsequent development of studied forest stands according to climatic change scenarios, including an exchange in forest stand biomass and consequently also in principal ecosystem service providing.

Methods

Data for analysis of the relationship between incidental felling and forest stand conditions were obtained from forest records of selected forest districts in Forest Administration Jablunkov. These forest stands have been recently suffered from „non-specific forest stand decline". Incidental fellings from the period of 1999 - 2008 in m3ha-1 were subdivided according to the date of origin, cause of felling, crop density and forest tree species representation. Causes of felling were divided into categories: felling caused by natural disasters, tracheomycosis and root rot, bark-beetles and other insects. Elevation, exposition and inclination of a forest stand division (the smallest forest stand identification unit) were determined using Digital Elevation Model for geographic coordinates of their median points. Data on forest type and forest stand age were obtained from Forest Management Plan. There were made summary sheets for individual years and reasons of felling according to the individual forest stand division and the whole forest districts.

Data on volumes of incidental fellings caused by various factors were processed with multivariate methods of Canoco programme. Redundancy analysis (RDA) was used. Effect of independent variables was tested using Monte Carlo permutation test. Only statistically significant variables were selected (Ter Braak & Šmilauer, 1998). Forest types, stand characteristics, climate data and year of felling were used as independent variables.

For computation of coefficients of the risk of forest stand (with dominance of Norway spruce) decay in two forest districts (Nýdek and Písek) of Forest Administration Jablunkov the method of using of common linear models based on logistic regression for finding of measure priorities for transformation of declining Norway spruce forest stands in the Kysuce and Orava Regions in Slovakia (Kulla & Hlásný, 2009) was modified. Logistic regression, based on „link, logit" function and successive variable selection for the model, was performed with use of the Statistica 6.0 programme (Fridman & Stahl, 2001).

Enter data for logistic regression were obtained from forest records of the Forest Administration Jablunkov and from the field survey. Forest stand and forest site characteristics were used as independent variables. Forest altitudinal zone was derived from specification about forest type group of given forest stand, ranging from 0 to 9 according to the Forest Management Institute (FMI), as well as trophic level (Průša, 2001). Hydric level was derived from characteristics of edaphic categories of Natural Forest Area "Moravsko-Slezské Beskydy", adaptation FMI 2009, ranging from 0 – dry to 8 – peatbog. Insolation was derived from exposition of a forest stand, ranging from 1 to 4. Norway spruce representation and forest stand age were assessed according to Forest Management Plan; forest stands younger than 50 years were excluded from the analysis. Vertical forest stand structure was assessed as presence of one or more forest stand storeys. Canopy closure was stated as forest density ranging from 0 to 9. Initial damage was determined as presence of incidental felling of abiotic and biotic reasons in the first two years of the decennial management plan in the particular forest stand. Abiotic and biotic risk was set from volume of incidental felling during ten years caused by abiotic and biotic factors. Pollution load was derived from zones of exposure, defined by the Ministry of Africulture CR. Health status was derived from damage degrees of Norway spruce forest stands that were specified on the base of satellite images Landsat (data Ministry of Agriculture CR). Dependent variable, potential forest stand damage, was ascertained from the original scale 1 to 4, by personal field survey and geo-statistical assessment, elaborated by experts of a branch of FMI in Frýdek-Místek, adapted to categories 1 and 2. Value 1 was given for relatively healthy forest stands with defoliation to 30% inclusive and value 2 for decaying forest stands with damage more than 30%.

Results and discussion

The results of RDA informing about the explained percentage of variability in incidental felling by individual groups of independent variables are figured in Table1. The highest variability in the composition and volume of incidental felling was explained by time variable - differences between individual years (16.5%). The most of variability given by forest stand and its site was explained by site conditions as a part of forest type classification (10.5%); other site and forest stand

characteristics, as inclination, exposition, forest stand age and timber reserve in the forest stand explained 8.2%. Climate data explained only 3,7% of variability.

Results of RDA analysis showed, that natural disasters (above all wind) and disaster caused by other insects occurred mostly in forests in the 4th altitudinal zone on acidic forest sites. In addition, RDA analysis revealed the relationships between forest stand age and disaster caused by other insects and between forest stand age, standing volume and bark-beetle outbreak. Positive relationships among bark-beetle outbreak and T30 value, which means number of days with temperature more or equal than 30°C, and among natural disasters and number of episodes, when daily precipitation was less than 1mm for 10 days at least, were proved. On the contrary, value T30 influenced least quantity of other insect disasters. The most important years, concerning the occurrence of incidental felling, were years 2007 and 2008. Disaster felling caused by tracheomycosis and other root rots significantly occurred in 2008, bark-beetle outbreak in 2007 and the minor importance had disaster felling caused by natural factors in the years of 2007 and 2008.

Probability predictions, that Norway spruce forest stands will be heavily damaged in the following years and that they will start to decay, were computed for individual forest stand division in the districts Nýdek and Písek with Norway spruce representation more than > 50% and age 50+ there, using coefficients of regression equation. These predictions were transformed into graphic form (Figure 1). With use of logistic regression we found that following independent variables (according to decreasing statistical significance) have had the highest statistically significant influence on the state of dependent variables: biotic threat, hydric level, initial damage, Norway spruce representation and zones of exposure.

Results of RDA proved that the most endangered Norway spruce forest stands by natural and bark-beetle disasters are those situated in the beech altitudinal vegetation zone. This implies that this zone is not (and also in the future under global climate change will not be) suitable for Norway spruce growing as a dominant forest tree species. Forestry management of Norway spruce should be adapted according this fact not only in the above mentioned areas.

Results of logistic regression can help to determine endangered forest stands, for those could be possible to carry out a forestry intervention focusing on minimalization of forest decline. There is a high probability that trees in the Forest Administration Jablunkov will not survive to the end of rotation period. The reasons are increasing multiple stress factor level and insufficient regeneration potential.

Table 1. Results of RDA analysis for the particular groups of explanatory variables

Independent variables	Explained variability (%)	Explained variability 1. axis (%)	p
Forest type	10.5	9	0.002
Forest site characteristics	8.2	7.6	0.002
Climate data	3.7	3.2	0.001
Year	16.5	8.7	0.001

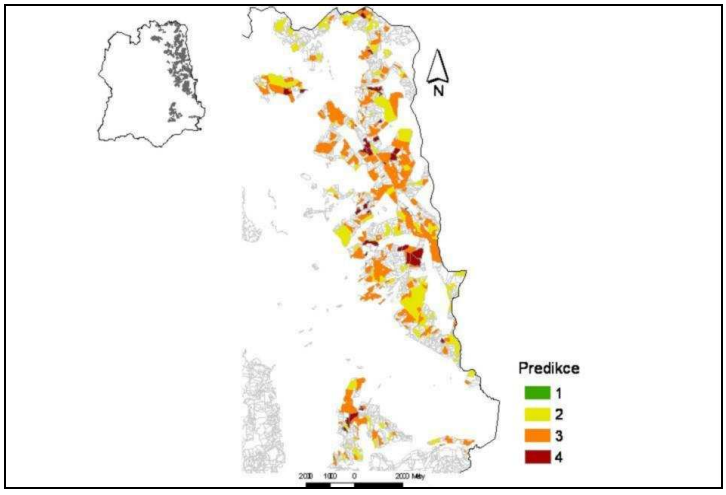

Figure 1. Probability prediction of Norway spruce forest stand decay (1:0-10%, 2: 11-30%, 3: 31-60%, 4: 61-100%) in forest districts Nýdek and Písek in autumn 2008

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FOREST FIRE RISK ASSESSMENT IN NEAR-REAL TIME, USING GIS AND REMOTE SENSING PRODUCTS

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Keywords: risk, forest fire, remote sensing, GIS

Even though the forest fires have a small percent of occurrence in Carpathian Mountains, they can affect the forest health and productivity, producing high damages on environment. Taking into consideration the possibility of global warming, is expected an increase of forest fire number in Romanian mountainous area. Mapping the forest fire risk gives a real benefit in managing crisis situation given by this kind of event. Countries like Australia, Canada and USA has been developed highly sophisticated systems for a better identification of the areas liable to forest fires. Introducing this kind of systems can be difficult, especially in countries with low real time meteorological data, because they are fully dependent on a dense network of weather stations and radars (i.e. NEXRAD).
In this paper, taking into consideration that the detection of the endangered zones can be made with the aid of drought indexes, an efficient methodology is proposed, for locating and estimating the forest fire risk in near real time.

Methodology

The proposed method combines remote sensing products and geospatial procedures in order to provide from primary meteorological data input, the forest fire risk assessment. The mathematic fundaments of the method were founded on Keetch-Byram Drought Index (KBDI). KBDI is an early warning tool for fire potential and severity, requiring only 3 meteorological elements: maximum daily temperature, daily precipitation, and the normal precipitation (Janis et. Al, 2002). This index quantifies the moisture deficiency relative to approximate 20 cm of water as field capacity.
Closely related to KBDI levels (SERCC 2002; USDA 2002), the method divides the study area into 5 fire risk categories:
very low risk (where the conditions on the surface indicate high wetness),
low risk (where the upper soil and surface litter are moist and do not contribute to fire intensity)
moderate risk (where the soil and surface litter are dry and may contribute to fire intensity)
high risk (where the conditions indicate very dry conditions, being associated with severe drought)
very high risk (where the upper soil ant surface litter are extremely dry)
For calculating KBDI, 2 meteorological data types were used (precipitations and temperature), and for integrating this data into GIS, grid data were needed. Surveying large forested areas, like Carpathian Mountains, the Romanian weather station system cannot offer a good density of points for interpolation and grid extraction. This is why in proposed method, for maximum daily temperature was used the MODIS anomaly product and for daily and normal precipitation was used TRMM product.
The method application needs several steps for accomplished:
setting the origin – the KBDI is initialized by setting it to 0.
calculate the actual KBDI
KBDIt=KBDIt-1if P=0 cm and $T_{\max} \le 6,78^{\circ}C$
KBDIt=KBDIt-1+DFtif P=0 cm and $T_{\max} \ge 6,78^{\circ}C$
KBDIt=KBDIt-1+DFtif P>0 cm and $\sum P \le 0,51cm$
KBDIt= KBDI`t-1+DFtif P>0 cm and $\sum P > 0,51cm$

$$DF = \frac{(800 - KBDI_{t-1})(0,968e^{0,0875T\max +15552} - 8,3)\cdot 10^{-3}}{1+10,88e^{-0,0174R}}$$

Where TMAX is the maximum temperature $^{\circ}C$, R is mean annual rainfall (cm)
For field validation of the calculated risk category, ground measurements with scientific weather station (HOBO Weather Station H21-001) have been made in a plot situated in Ciucaş Mountains from Outer Eastern Carpathians group. Two ground verifications have been made: the differences between "in situ" maximum temperature and MODIS anomaly and the difference between "in situ" precipitation and TRMM product.

Results and Discussion

The measurements made in the plot with the scientific weather station revealed a significant correlation between the "in situ" precipitation measurements and TRMM daily product. The MODIS anomaly product appeared in correlation with the temperature measured in the plot situated in Ciucaş Mountains.
The presented method is a fair alternative to other fire risk assessment methods based on the Keetch-Byram Drought Index. Using spatial analysis tools, the method provides fast mapping of forest fire risk on large zones, having the same confidence as the grid data input.
The usage of remote sensing products makes possible the near real time monitoring of fire potential in forested mountainous zones from Romania. The new method ensures a fast, fair and accurate way for managers to react promptly to changing weather conditions. The applicability of the method is guaranteed both by the reduced costs (i.e. the TRMM and MODIS products are free, the GIS spatial analysis tools like SAGA GIS and GRASS are open source) and by the agencies

that made the primary data (JAXA – Japan Aerospace Exploration Agency and NASA - National Aeronautics and Space Administration).

EXTREME SNOW AVALANCHE EVENTS IN TATRA MOUNTAINS

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Keywords: Snow avalanches, Tatra Mountains, avalanche mapping and monitoring

During winter season 2009/2010 significant amount of snow precipitation occurred. The overall cumulative snow depth was 85 cm higher than the average within period between 1993 and 2006. Snow precipitation was unevenly distributed reaching its peak in March. In conjunction with strong northwest winds the avalanche danger reached level four (4) out of five (5) scales avalanche danger scale. Several catastrophic avalanches were naturally triggered in the week from the 21st March to the 28th March. On majority of the slopes medium to large avalanches were observed. For the purpose of avalanche monitoring it was necessary and crucial to perform reconnaissance flight. The aim of the study was to compare extreme avalanche events on the Polish side of the Tatras and the ones that occurred in Slovak Tatra Mountains. Several sites were visited in the field and avalanche run-outs were mapped with GPS. Geomorphometric analysis was focused on vertical and horizontal travel distances, area of deposition and avalanche track widths. The analysis revealed that the extreme avalanche events on both sides of Tatra Mountains manifest common results. On the other hand several events differed significantly. The study underlined the importance of bilateral cooperation among Poland and Slovakia in the matter of avalanche monitoring and mapping. It would be particularly useful to develop common scale for avalanche size classification within Carpathian mountain range.

SNOW AVALANCHE RUN-OUT SIMULATIONS OF VARIOUS EVENTS IN CARPATHIAN MOUNTAIN RANGE

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Keywords: snow avalanche simulation, Carpathian mountain range, RAMMS, AVAL-1D, Alpha-Beta model

Since the beginning of modern-snow and avalanche science the run-outs have been always subject of exhaustive research. For avalanche hazard zoning and decision-making concerning land use in mountainous environment it was crucial to investigate the possible outline of avalanche run-outs. The winter of 2008/2009 and its consequences confirmed the importance of implementation of run-out simulations into decision procedures. For the purpose of the study two approaches of run-out calculation were used. The first one was based of dynamic simulations; models RAAMS and AVAL-1D were used. The second approach was based on the application of alpha-beta statistical model. Various avalanche events in Poland, Slovakia and Romania were selected and visited in the field in order to obtain data on avalanches extents. In the case of Žiarska valley, where disastrous avalanche occurred, the snow deposition was surveyed with submeter accuracy GPS stations. Flow heights and run-outs were back calculated and compared with data obtained by field surveys. Comparison revealed that the difference between simulation results and field data varies in space. The work also showed the strength and weakness of both approaches.

USING HIGH RESOLUTION LIDAR AND PHOTOGRAMMETRIC DATA FOR SNOW AVALANCHE HAZARD MAPPING

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Keywords: snow avalanche mapping, LiDAR data, terrestrial photogrammetry, Tatra Mountains, Karkonosze Mountains

Each year in Carpathian and Sudety Mountain areas snow avalanches cause great number of accidents. Destructive element brings not only casualties, but also significant forest and infrastructure damage.
GIS technology is widely used for research on snow avalanches, mainly for creating avalanche risk and hazard maps. Recent studies show that there are many problems with obtaining satisfactory results for smaller avalanches which make significant amount of total recorded cases. The analyses which were made for chosen Polish mountain ranges showed that these problems strictly depend on quality and resolution of digital data.
The main goal of this study is to compare different types of Digital Elevation Models (DEM), especially with high resolution DEM generated from Light Detection and Ranging (LiDAR) - Airborne Laser Scanning (ALS), Terrestrial Laser Scanning (TLS), and terrestrial photogrammetric in context of estimating potential avalanche release areas and making run-out calculations. Study shows how different digital data may influence predictions' results and procedures. Test sites in the Karkonosze Mountains, Sudety and the Tatra Mountains in Carpathian Mountains were selected for this study.

COMPARISON OF DIFFERENT METHODS FOR OBTAINING SNOW AVALANCHE DATA

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Keywords: snow avalanche mapping, avalanche data, terrestrial photogrammetry, laser rangefinder, avalanche cadastre

Still developing avalanche hazard mapping tools and procedures offer more options that provide more accurate risk and hazard localization. Validation of run-out models strictly depend on quality of recorded historical avalanche data like avalanche outline and release high. More accurate information about historical avalanches to let obtain more real – factual, topical, concrete avalanche characteristics (like release area, flow high and profile, run-out distance and total amount of release snow mass) and next to it they make better model calibration. Incorrectly validated (elaborated) models and their results can influence decisions-making which directly leads to safety of humans. In this reason all these analyses must be prepared through very sensitive studies. Usual lack of high quality data on historical avalanches is often caused by high risk which permanently exists within avalanche area. Study shows comparison test of different remote sensing methods, such as photogrammetric methods or rangefinder measurements which allow obtaining avalanche data with strong emphasis on the measurement safety.This test also evaluates these methods in context of optimizing measurement time and their costs. Test sites in the Tatra Mountains in Carpathian were chosen for this study.

GEOMORPHOLOGIC EFFECT OF THE JULY 2008 FLOOD ON UPPER TOPĽA RIVER

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Keywords: Topľa River, local flood, flood geomorphology

During 22 and 23 July 2008, excessive rainfall with consequential extreme runoff occurred in Čergov Mts. in eastern Slovakia. The maximal 24 hours precipitation rate of 123 mm was recorded in Livovská Huta precipitation-gage station, localized in narrow valley in central part of the mountain range. Associated high water levels on streams flowing from the mountains filled the riverbeds. At the nearest stream-gauging station on River Topľa in Gerlachov, which is located 19 km downstream from the spring, a record-setting discharge of 90,09 m3.s-1 was measured. Not only the volume of flood wave, but the high water power caused by high longitudinal gradients and capacious amounts of bedload increased the geomorphologic effect of the river. The most affected municipalities by the flood were Livovská Huta, Livov and Lukov, situated on the river. The infrastructure was damaged considerably, dominantly by lateral erosion of the riverbanks, channel shifting and by sedimentation of the material as well as some residences were attacked. One of the key contributions of the paper is to point out, that local floods in mountainous regions differ generally from those regional floods in lowlands. The main difference is, that oftentimes the river does not even overflow from its channel, thus there is no flooding, but the great damage is made by the fluvial geomorphological processes. Thank to immediate observing of the interested flood event and the accompanying processes the development of the flood in affected municipalities was immediately recorded using video-capturing and photographing. Numerous pictures were also taken after the event by authorities and forest managers. The stream behavior during bankfull stage has its specificities. It is not only the morphometric parameters of the channel, which order the directions of geomorphologic processes, but in most cases the human activities in form of inappropriately localized bridges, watergates or similar blockades which constrains the channel. These can often give rise to stream tension and if the threshold values are exceeded, the stream energy can rise rapidly and thus it can be spend for increasing of the geomorphologic processes in the channel or even a channel shift is strongly probable. Another particularity is the lateral connectivity of the stream towards the valley slope. An undermining of a slope results to a fall and the failure debris increase the volume of loaded material or even can cause a debris dam and thus the stream is prone to overflow. In mountainous regions there were observed increased large wood debris loads during high water level situations and these can also initiate damming and overflowing. By the combination of slope debris fall and thus creation of the debris dam as well as by participating of fallen riparian trees and consequential damming of the bridge above the fall, an unexpected situation arose out in Livovská Huta, when the stream was redirected from such dammed channel, flowed down the smooth asphalt road and then after 200 meters returned back into the main channel. After few hours an avulsion trough was developed by backward erosion of the redirected stream, thus the road was destroyed. Overall 830 meters of road communications was destroyed between Lukov and Livovská Huta municipalities by this flood event. The re-modeling of the channel was enormous. Besides changes of horizontal structure of the channel-floodplain geosystem caused by lateral erosion, bend flattening or by channel shifting, a remarkable change of longitudinal channel profile developed. Up to a half meter incision of the channel was observed on selected profiles. On some river reaches, originally Holocene floodplains became terraces and flood benches developed, with deeper incised channel. In general, fine material as well as granules and pebbles were removed from the riverbed and bed armoring was the result. Previous riffle-pool system was adjusted into uneven bottom. The main method used was identifying flood landforms and processes in the framework of channel-floodplain units, which were classified using River Morphology Hierarchical Classification, provided by Lehotský and Grešková. By the survey undertaken in November 2009, along the Topľa River channel from its spring down to Gerlachov stream-gauging station, all sources of geomorphologic effects of the interested flood were registered. Their amplitude was so intense, that the changes in channel-floodplain geosystem remain up to this day, so we can qualify the river discharge from 23 July 2008 as a bed-forming discharge.

GEOMORPHOLOGIC EFFECT OF THE JULY 2008 FLOOD ON UPPER TOPĽA RIVER

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downstream from the spring, a record-setting discharge of 90,09 m3.s-1 was measured. Not only the volume of flood wave, but the high water power caused by high longitudinal gradients and capacious amounts of bedload increased the geomorphologic effect of the river. The most affected municipalities by the flood were Livovská Huta, Livov and Lukov, situated on the river. The infrastructure was damaged considerably, dominantly by lateral erosion of the riverbanks, channel shifting and by sedimentation of the material as well as some residences were attacked. One of the key contributions of the paper is to point out, that local floods in mountainous regions differ generally from those regional floods in lowlands. The main difference is, that oftentimes the river does not even overflow from its channel, thus there is no flooding, but the great damage is made by the fluvial geomorphological processes. Thank to immediate observing of the interested flood event and the accompanying processes the development of the flood in affected municipalities was immediately recorded using video-capturing and photographing. Numerous pictures were also taken after the event by authorities and forest managers. The stream behavior during bankfull stage has its specificities. It is not only the morphometric parameters of the channel, which order the directions of geomorphologic processes, but in most cases the human activities in form of inappropriately localized bridges, watergates or similar blockades which constrains the channel. These can often give rise to stream tension and if the threshold values are exceeded, the stream energy can rise rapidly and thus it can be spend for increasing of the geomorphologic processes in the channel or even a channel shift is strongly probable. Another particularity is the lateral connectivity of the stream towards the valley slope. An undermining of a slope results to a fall and the failure debris increase the volume of loaded material or even can cause a debris dam and thus the stream is prone to overflow. In mountainous regions there were observed increased large wood debris loads during high water level situations and these can also initiate damming and overflowing. By the combination of slope debris fall and thus creation of the debris dam as well as by participating of fallen riparian trees and consequential damming of the bridge above the fall, an unexpected situation arose out in Livovská Huta, when the stream was redirected from such dammed channel, flowed down the smooth asphalt road and then after 200 meters returned back into the main channel. After few hours an avulsion trough was developed by backward erosion of the redirected stream, thus the road was destroyed. Overall 830 meters of road communications was destroyed between Lukov and Livovská Huta municipalities by this flood event. The re-modeling of the channel was enormous. Besides changes of horizontal structure of the channel-floodplain geosystem caused by lateral erosion, bend flattening or by channel shifting, a remarkable change of longitudinal channel profile developed. Up to a half meter incision of the channel was observed on selected profiles. On some river reaches, originally Holocene floodplains became terraces and flood benches developed, with deeper incised channel. In general, fine material as well as granules and pebbles were removed from the riverbed and bed armoring was the result. Previous riffle-pool system was adjusted into uneven bottom. The main method used was identifying flood landforms and processes in the framework of channel-floodplain units, which were classified using River Morphology Hierarchical Classification, provided by Lehotský and Grešková. By the survey undertaken in November 2009, along the Topľa River channel from its spring down to Gerlachov stream-gauging station, all sources of geomorphologic effects of the interested flood were registered. Their amplitude was so intense, that the changes in channel-floodplain geosystem remain up to this day, so we can qualify the river discharge from 23 July 2008 as a bed-forming discharge.

INFLUENCE OF THE PRESENT GEOMORPHOLOGICAL PROCESSES ON THE GLACIAL LAKE SILTING IN THE EAST PART OF THE HIGH TATRAS (SLOVAKIA)

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Trend on the present geomorphological processes in the area of the High Tatras´ alpine belt demonstrates the growth of intensity, frequency and influence on the environment in the connection with climatic conditions of alpine landscape that are being transformed. One of the morphodynamic phenomenons of Tatras´ glacial valleys is silting of the lakes and their gradual destruction. Slope gravitation processes the types of which are rock falling, sloughing, and water-gravitation processes, as are for example debris flows and nivation processes represented by avalanches, are being considered to be important factors of this process. Each of the mentioned processes transfers different type and amount of the material with various grain composition and way of accumulation in the hydride lake area. The important factors influencing the presence of processes are structural-lithological and morphogenetic conditions of the surrounding slopes and ridges. Dynamics and frequency of the processes closely correspond with the seasonal occurrence of extreme meteorological situations and their fulminate changes that are being confirmed by the present research of morphodynamic processes influencing the upper forest border in the High Tatras. The aim of the paper is to emphasize the time-spatial extension of geomorphological processes and demonstration of glacial lake silting in the selected valleys of the High Tatras.

ASSESSMENT OF SOIL EROSION RISK AND ITS UTILIZATION IN LANDSCAPE PLANNING

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Keywords: soil erosion, risk, assessment

In last decades, soil erosion become one of the major problems resulting from mismanagement of agricultural land, causing economical and environmental damage. Enlargement of scale, intensification, specialization and mechanization of agricultural production are factors which often lead to problems such as soil erosion and associated water pollution with soil nutrients. Erosion is a diffuse process that occurs at relatively low and widely varying rates from year to year and from location to location. Thus the technology for estimating rates of soil erosion has thus emerged as a major tool to overcome these difficulties. Erosion prediction has been most widely used as a tool to guide conservation planning. And for this purpose many empirical and physically based models have been developed.
Application of physically based models represent recent trend in soil erosion research along with development of GIS and remote sensing techniques. Due to high demand of input parameters, financial and personal requirements most of the models have been applied to small experimental watersheds and catchments.
The presented poster describes a methodology of evaluation of erosion risk on sample area using a physically based modeling approach. To capture the spatial and temporal variability of erosion processes, erosion simulations were based on modeling scenarios. Scenarios were designed in a way to reflect the variability of soil vegetation cover, soil properties and impact of erosion mitigation measures over the vegetation period. The simulation results showed a significant decrease of erosion values, especially in the case of scenarios showing highest soil loss. Based on mutual comparison of individual scenarios we could demonstrate their impact on soil erosion in sample area. The simulation results were also used to classify the sample area according to erosion risk and calculation of its main causative factors.
Results of such erosion modeling should be validated using experimental data. A process of validation is based on comparison of experimental (measured) and simulated data. Since there were no quantitative experimental data available for the sample area, we had use so called indicative method to validate results. Due to this reason the simulation outputs could be used only for assessment of erosion risk but not precise quantification amount of eroded soil. The indicative method was based on assessment of transformation of soil profile. However this method could not sufficiently proof whether the erosion/accumulation forms were created only by water erosion but also by tillage.
Despite these limitations, the model could provide adequate information, which could be used for optimal localization and the dimensioning of site-specific measures and assessment of their impact on soil erosion.

GEOMORPHIC PROCESSES MODELING IN THE WESTERN TATRA MOUNTAINS

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This paper present results of modelling selected geomorphic processes groups in the Western Tatra valleys (Jalovecká, Žiarska, Jamnická). We identificated geomorphic processes, visible on the aerial photographs and evaluated by GIS tools. These were assessed in the relation to morphometric characteristics of relief, geomorphic resistance of rocks and land cover about process. The measurements were further statistically processed by methods of the classification trees (CART) and the linear regression because of data. For the processes with suitable data (water-gravitational processes, fluvial processes, nivation) we quantitatively evaluated the predictors of their genesis. Then we suggested the model of potential hazard, for concrete process. We validated the model just in our study area, where it showed high accuracy especially in water-gravitational processes and nivation. For water-gravitational processes validation accuracy is 80,1% or 77%. For prediction of nivation areas accuracy of the model is 78,7% or 77,8%. We consider obtained models sufficient due to their high accuracy for both these processes. The lowest accuracy we have achieved in fluvial processes, there is 66,8% or 62,8% due selected statistical method.
In the eastern Italian Alps the prediction of the source areas of debris flows also deal Carrara, Crosta, Frattini (2008). They compared two statistical methods, discriminatory analysis (multiple linear regression) and logistic regression. The difference in the accuracy of these two methods is 9% in favour of discriminatory analysis. The difference is considered small, almost negligible. Discriminant analysis model is made for accurate 82 to 85%, what they regard as very good and sufficient accuracy. Gartner, Cannon, Santi, Dawolfe (2008) in the Rocky Mountains in the western U.S used in predicting the debris flows method of linear regression. The accuracy of the model reached 83% and also consider it very good. This method model size resp. area of process in the selected cell unlike logistic regression. We selected logistic regression to model the exist or not exist process in cell and in terms of additional life model we prefer. Resizing the grid (cell) we can achieve results as appropriate task resp. project, of course, taking into account the overall accuracy of the model. We used the methods like Halabuk, Halada (2006) for the model of deployment of different types of grassland in the Eastern

Carpathians. These outputs must be confirmed also in different areas to be generally applicable in the similar areas as Western Tatra Mountains. This paper was developed with support VEGA 02_0217_09 Effect of experimental warming and nitrogen deposition on sensitive alpine meadow ecosystem.

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THE ENVIRONMENTAL RISK IN THE FORESTS OF THE NORTHERN HALF OF THE CARPATHIANS

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Keywords: break snow, climate risk, forest

The circumstances that led to massive throwing down and rupture of spruce caused by snow in the last decades are correlated with the organic destruction of forest ecosystems.

The throwing down and rupture caused by snow, as a disaster of nature, are a less common phenomenon in the forests of this area and are not recorded as such in their historiography. However snow damage occurred in the past, but they were not registered in the records and writing of the forestry yard, being reduced in amplitude or have been registered together with the wind throwing down.

The biggest damage caused by snow, so far, occurred in 1977 and 1979, affecting large areas of forest, causing major damage and creating huge difficulties to the forestry yards in the exploiting of the potential of forest and to the profile unities in the operation of timber .

The one during the days of the 14th -19th of April 1977 is considered the largest natural disaster that affected the forests of the northern half of the Carpathians. The main factor that has favored its production is likely to be considered the weather and it is especially about the large amounts of wet snow that fell in a very short time. Being used only with the wind damage, the foresters in this area were surprised by this phenomenon. The exploiting unities concentrated forces throughout the country, people, equipment, vehicles, harness, in order to act speedily.

Most of these disasters were located in Moldova basin, then Suceava and less in Bistrita basin. Young spruce from the second class of age from plantations made after the catastrophic throwing down in 1947/1948 was mainly affected . It adds to the intense damage caused by deer by peeling and gnawing. The injuries consisted mainly in throwing down and uprooting of trees, and the red root rot amplified these damages. Being located on much stable lands, with deep soils, rich in humus and very fertile, with higher humidity, the trees have recorded here remarkable growth and size, tall and cylindrical trunks, crown and weak roots, all these causing a weak resistance to huge amounts of wet snow that fell.

Both disasters in 1977 and 1979 were located about the same altitude limits, 600 to 960 m in 1977 and 500 - 1000 m in 1979, in areas free from air stream. The upper slopes (over ½, respectively 2 / 3), because of air streams, the snow was largely dispelled. This explains the fact that ruptures affected only conifers and mixed forests from the sub-mountain area or low mountain area, located on valleys and inferior part of slopes, where snow was deposited on the crown in the absence of air currents. The throwing down and rupture caused by snow in 1977 and 1979 as well as those caused by wind in previous years have had negative influences on production and productivity of these forests, as well as their stability.

NATURAL HAZARDS AND HUMAN PRESSURE IN THE NORTHERN ROMANIAN CARPATHIANS

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By tracking lake sediments we obtained information on huge landslides having occurred in the flysch mountains in the Obcinele Bucovinei Mts. We know that flysch area is susceptible of landslides, but sometimes they were very destructive and were regarded as disasters by people facing them. Such an event happened around 1600 BC in the Sadova basin when at least two huge landslides occurred and blocked two valleys and left behind two landslide dam lakes: Iezerul Sadovei and Bolatau.

Using lake sediments we assessed the human impact on Ştiol glacial lake (Rodna Mts), which was planned to become the heart of the touristic resort within Bistricioara armchair glacial cirque by the mayor of Borşa in 2002. Beside the changes of form, water volume and maximum deapth, there are also strong changes in terms of rate of sedimentation and source of sediments.

In order to get more resources, the communist administration attempted to drill for Uranium in Maramures Mts in the 70s. They set off doing this and when realizing there is no valuable concentration of Uranium in the area, they left the mines,

which remained that way until 2009, when local authorities found some funds to cover them and to protect the spoils. Has there been any impact on population and biodeversity?
On 25-26 July 2009 there was a heavy storm in northern Romania, also naturally in the mountain area. For example, the Suceava river has a historical discharge of 1.946 m3/s (the average value is 12.5 m3/s at Iţcani/Suceava station). On the western part of the mountains, in the Maramureş Mts- in the Ruscova basin -two days later the same situation occurred, when a heavy storm and the consequent huge floods destroyed the entire infrastructure in the basin. Deforestation amplified the effects of these floods.

GIS EVALUATION OF EROSION-SEDIMENTATION RISK CAUSED BY EXTREME CONVECTIVE RAINSTORMS

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Keywords: GIS, erosion, sedimentation, deposition, rainstorm, USPED

Soil erosion, especially in its accelerated form, is one of the natural hazards related to the extreme hydrometeorological events. The consequences of the soil erosion can be divided into two part. The first one are the consequences related to the loss of soil particles and other soil components like organic material, the second one are the consequences are related to the deposition of the eroded and transported material in the valleys or downslope parts of georelief. There are number of model solutions to quantify the vulnerabillity of the watershed landscape to the erosion-sedimentational processes. No matter these solutions are based on the theoretical analyses of the erosion and deposition process or on the long-term field measuring of the erosion and deposition rate, together wiht GIS they are effective tools usefull to solve these kind of problems. In the case of this poster contribution the combination of USPED model(Unit Stream Power based Erosion/Deposition model) (Mitašová et al., 1996) and the variants of USLE equation for single event modelling together with equation to solve the rill erosion was used as the main tool. All the analyses were done using ArcGIS and GRASS GIS platforms. The area of interest of the analyses was the Stonávka River catchment. The Stonávka river is a stream starting on the northern slopes of the Moravskoslezské Beskydy mountains and in its upper part it has a character of a mountain stream. From geological and geomorphological point of view the Stonávka watershed in its lower part belongs to the Outer Northern Carpathian lowering parts and it is formed mainly by quarternary sediments. In its upper part the watershed belongs to the Outer Western Carpathians formed by Carpathian flysch. The model was applied to two rainstorm episodes in June 2009 which occured within the series of serious rainstorms that caused catastrophic flashfloods in the Czech Republic.

Thematic session: Tourism (Re-)development and Sustainability

Chairs:
Elena Matei (University of Bucharest, Romania),
Mirosław Mika (Jagiellonian University, Poland),
Robert Pawlusiński, (Jagiellonian University, Poland)

The session presents contemporary models, directions and strategies on tourism development from a Carpathian perspective. It enhances understanding on the effect of changing demands of the tourists in the socio-economic framework at the national, regional, and local levels. Emphasis is placed on the following points: tourism (re)development by maintaining mountains' diversity, promoting good practices and sustainability, and fostering international and interdisciplinary cooperation in Carpathian tourism research.

ORAL PRESENTATIONS

A PROPOSAL FOR THE ESTABLISMENT OF THE MUNȚII PERȘANI GEOPARC. A REASON FOR PROMOTION OF EDUCATIONAL TOURISM

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Keywords: Perşani Mountains geopark, geo-tourism, education tourism, Romania

Perşani Mountains, part of the Curvature Carpathians, are both a "bridge" between Eastern and the Southern Carpathians and a “threshold" between the Braşov Depression (Bârsei Country) and the Transylvania Plateau (Făgăraşului Country).
Although low in altitudes (Măgura Codlei, 1 292 m) they impose through a large variety of geomorphologic landscapes. This is due to their geological "mosaic" and a dense network of tectonic lines in a rectangular arrangement. It is not by chance that a large part of the geomorphologic and geological patrimony in this mountaineous area is under protection since the interwar period of the last century. Out of the *12 natural reserves*, which occupy 14% of the Perşani Mountains, nine are exclusively geological and geomorphological and the other three present forms of special landscapes. One notices some forms of *geomorphologic patrimony* (picturesque isolated cliffs, forms of relief looking zoomorphic, canyons, gorges, caves), *geological patrimony* (basalt columns, basaltic scoriae fossiliferous outcrops) and *mixed patrimony* (muddy volcanoes).
The study of this important and diverse patrimony concentrated in the Perşani Mountains sustains the proposal for *institutionalizing a geopark* here. Our recent research work has been extended to the role of ecotourism and geotourism as an economic alternative for sustaining development of rural communities nearby. Our review presents the rationale for developing tourist activities with educational character. It ought be supported by minimal investments into the local infrastructure -the network of waters and roads which will make the tourist objectives easily accessible. Aimed at diversification of nature tourism, such investments would offer *rafting* and *cycling*, and other forms of adventure tourism. In rural communities around the Perşani Mountains, establishments providing services (motels, inns, hostels and camping grounds) is on a slight rise (there are 17 units), but miles from what is possible and required.
Perşani Mountains Geopark has still much to offer in terms of economic, social and tourism value. A comprehensive documentation to support its future multi-faceted development would be a right step to this direction to the benefits of local rural communities around. A balanced study to this effect might successfully compete for LIFE projects for Romania with EU co-financing.
Arguments supporting the establishment of the Perşani Mountains Geopark:
The *Geopark* regime has local institutionalization. Apart from geological, botanical, wildlife, hydrologic natural areas, the case for such a park is enhanced by the existence of significant arhaeological sites. Another argument in support of the proposal is the fact that in Perşani areal, natural reservations have a fully scientific character, with a significant paleontological, geological, botanical and fauna diversity. One could note some *Paleontological reservations* scientifically relevant: *the Carhaga* fossiliferous site**,** olistolith marl and limestone, with fossil ammonites; *the Ormeniş* fossiliferous site, which has also become internationally famous due to its *inoceram* fauna.
In the same vein, one mentions Geological and geomorphologic reservations: *The basalt columns at Racoş,* marking the end of the volcanic eruption area in the Eastern Carpathians; *The Hegheş microcrater* and scorias, pyroclastites, basaltic lava flows; *The basalt columns at Piatra Cioplită,* witness of the southern-most point of Pliocene – Quaternary neo-volcanism in Romania; *The Dopca Gorges,* a reservation that comprises stratigraphic scientific elements (a sediment discontinuity marking the Tortonian transgression in the Transylvanian Basin; *The Vârghiş Gorges*, with a level of the valley talweg, marked by fossil tubes, overhanging cliffs, lateral developments of cave galleries on the same level; the *mineral springs of Ocland and Doboşeni***;** *The Bogata Forest Reservation* as a sample of lamellar forests in this country; *ornithological reservation of the Turzun Bend (Racoş)*, where the marsh vegetation is the nesting ground of countless bird species engaged in migration over European territory.

The richness of the areal is augmented by the *River Olt Pass between Augustin and Racoş.* The pass itself could be a natural reservation of its own as the axis of the proposed geopark. The borders of such a reservation would be only natural, that is the mountains bordering the narrow pass: *Vârghiş Massif* in the north and *Bogata Massif* in the south.
The whole areal attracts the nature lovers from Brasov – a major city located 15-20 km away. Being a small territory with a high concentration of tourism values, the areal traditionally has become a "field course" for teachers and students, an "outdoor school" for *educational geotourism*. We joined the trend and started with a student exchange program in 2007 between Romanian American University and "De Sales" University, U.S.A. at Şinca Nouă village. The diversity of protected elements represents a well founded case for setting up a cross-county geopark. Geotourism will be at home in these places, including accessible premises like Codlea facility or Racoş fortress. The Perşani Mountains geopark would quickly become part and parcel of the ecotourism flow in protected areas in Braşov, Harghita and Covasna counties. Thus in the summer, tourists would be able to sample a rather large region for *mountain biking, rock-climbing, hiking, rafting on the river Olt,* whereas in winter they might go for cross-country skiing.
In order to achieve an efficient management of tourist resources, an economic and environmental audit needs to be devised, as well as a diagnosis analysis of the territory able to support tourist development. In practice, the analysis of data regarding the tourist potential of the Perşani Mountains Geopark at the level of the three counties needs constant diversification by using detailed data at the level of rural communities.

CAUSES OF ENVIRONMENTAL AND SOCIO-CULTURAL DYSFUNCTIONS GENERATED BY MASS TOURISM IN AREAS OF OUTSTANDING NATURAL BEAUTY

CASES: BESKID ŚLĄSKI (POLISH KARPATY) AND GOÐAFOSS (NE ICELAND)

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The research deals with challenges facing areas of particular natural value and/or outstanding natural beauty, in terms of mass tourism. The research is comparative and focuses on the problem of degradation of natural environment and socio-cultural tourist dysfunctions from an Icelandic and Polish perspective. The purpose was to estimate the degree of socio-cultural dysfunctions and natural environment degradation. Underpinning the presentation proposed for this session is a larger research project aiming to identify the nature-based tourism potential, the socio-cultural dynamics and possible dysfunctions of by different type of tourists in Poland and Iceland.
The research tools used in both cases were primarily semi structured interviews with key industry stakeholder, but also stakeholder focus groups, participant and non participant observation, and secondary data analysis. The term dysfunctions is understood as negative consequences of tourism development, which contradict or work against intended or planned development goals. Dysfunctions can lead to a loss of balance in natural environments (environmental dysfunctions) and/or intervene in a negative way as perceived by locals (socio-cultural dysfunctions). The scope of factors which can generate these dysfunctions is obviously very large. But in the context of this research project the aims are to identify these dysfunctions in terms of the type of tourist, their home market or origin, communication and accessibility and type of tourism attractions, which we deem as the most important. Through analysing the origin of those visiting the regions under study we propose to understand the general behaviour and the generation of knowledge of the region. Whilst analysing the The type of tourist is indicative of the travel expectations and travel organization of the participants. The point of departure for the analysis is the term mass tourism, most commonly understood as one organized by travel agency or, like it was in Poland's socialist period, by the work place. The term is here also used and can be understood as high pressure of tourism visits. Communication and accessibility is understood as the distance and access to the region under study from the tourist's area of origin, the time involved in communication and the price of this.

The cases

In the case of Beskid Śląski the research was conducted in Szczyrk, Wisła and Ustroń, where mass tourism dominates. Because of the proximity to the Upper Silesian Industrial Region (GOP) the area of Beskid Śląski was very popular. A strong development of mass tourism was already taking place in the time of the socialist Polish People's Republic (PRL). Most of the holiday resorts currently used with capacity of many hundred beds were built for Upper Silesian mines and factory workers. The tourist's to the region were mostly the members of working class, which means people with low level of education and income. During this period most of the ski trails were constructed. The investments were done mostly in Wisła, Szczyrk and Ustroń. The resort architecture had no relation with the traditional Beskidy one. Buildings were built and located with no respect to the local landscape. Tower blocks were indiscriminately placed on the mountain slopes similar to one's in Poland's biggest cities. The lack of harmony between the tourist product and service facilities and the original local architecture and culture does not makes the product quality any lower – just quite the opposite – for the mass tourist taste – which conceive of the product and facilities as "modern enough". The domination of mass tourism is observed in Beskid Śląski also at present time. The material level of Polish society in general has become higher, resulting effectively in the increase of the quality of the product. In the older resort the renovation work has been done, the standard of new built ones is about 3-4 stars. The style of new resorts is still done for a Polish mass tourist taste and expectations. A good example of such could be the Gołębiewski Hotel in Wisła with 564 rooms. An inherent part of mass tourism in the area is

conferences, incentives and team buildings organized by big enterprises from GOP and more and more commonly for other big cities in Poland. Hotel Gołębiewski has for this purpose 25 conference rooms and several congress halls. The "tradition" of abusing alcohol on the occasions of business travel or holiday "relaxation" is generating huge levels of socio-cultural dysfunction between locals. Mass tourism impacts directly the loss of forests, levels of water pollution and other negative environmental consequences in the researched area. But in Beskid Śląski case the impact of mass tourism cannot be considered as the negative only. A high tourism pressure has "pushed" the local authorities to build good road infrastructure in the mountain area. The road infrastructure is much better that in other regions of Carpathian mountains. Paved tourist tracks extend even to mountain summits. The tracks serving as the resorts' access roads, this is why they become paved, but paradoxally - the consequence of this is the limitation of tourist erosion on the tracks. Despite the high tourism pressure on the tracks, the pollution is much lower than in other, much less visited parts of Carpathian mountains. Thanks to a better communication infrastructure the management of waste, even during heavy winters, is functioning flawlessly.

In Iceland the research was conducted in the area of Goðafoss – which remains one of most visited places in Iceland valued for it's natural environment. There mass tourism is creating pressure on the natural environment. In general Iceland's main attraction is its areas of particular natural value, as many of them are unique in Western Europe. The primary motivation for travel to Iceland is visiting and experiencing its nature and wilderness. Other attractions only play an additional/ secondary role in the travel destination choice. Mass tourism in Island should be understood in terms of tourism arrivals, the organized groups and individual travellers, and the need to develop the necessary infrastructure to cope with that in hitherto untouched or un-developed areas. The destination used to exemplify the challenges of mass tourism in Iceland is Goðafoss a waterfall in the NE of Iceland right on highway nr. 1; about 60 km East of Akureyri, the biggest town in North Iceland. It is a very popular destination for day trippers travelling from cruise ships anchored of Akureyri to Mývatn and generally all those that travel highway nr. 1 for sightseeing purposes. The waterfall is named after the pagan Gods of Iceland and its name would translate as the Gods' waterfall. As the story goes it got its name as Icelanders adopted Christianity in the year 1000 AD at Althing. The chieftain Þorgeir of Ljósavatn (Lights Lake, nearby the waterfall) made this decision on behalf of all Icelanders at the Althing after the Althing had sought his advice. In order to be true to his own advice he travelled back home and took all the pagan icons from his temple and threw them into the waterfall, and hence the name. The waterfall itself is part of the river Skjálfandafljót which runs from the Vatnajökull icecap in the interior of Iceland to the sea in Skjálfandaflói (Trembling Bay). The waterfall is renowned for its scenic value and is the photographic material of many a visitor and most recently adorns the 2007 cover page of Iceland's promotion booklet published by the Icelandic Tourist Board. The destination itself is composed of the main attraction; the waterfall, walking paths and a parking lot built into the lava flow framing the waterfall, a memorial plaque on one of the stones, a road bridge and a footbridge crossing the river to a nearby souvenir shop, toilet facilities and kiosk and finally a small guesthouse on the other side of the river. As stated above the people stopping at the waterfall are by-passers on route 1 round the country and those doing daytrips to Lake Mývatn from Akureyri harbour. In the period of June till August the pressures each day can be immense as literally thousands of people go from the car park to the waterfall, trampling vegetation and rock formations in the process. In addition the pressures on the locals has prompted them to develop a cheap souvenir outlet, now dominating the small co-op shop residents use. The main pressure in the shop is for toilets and paraphernalia and there is no sustained engagement with locals, their customs, traditions or points of view – mainly ass each stop is only 15 minutes.

Conclusions

Tourism dysfunctions generated by the mass tourism in Beskid Śląski are different from the one's observed in Iceland or in other areas of particular natural value in European Community countries, but also differ from dysfunctions in other regions of the Carpathian mountains. The main reason for the difference is that the driving forces of tourists are wholly different. Whilst in Iceland they come the natural attractions, wilderness areas and untouched nature – leading to management challenges – the people visiting Beskid Śląski on the other hand, comed for the possibility to profit from a complimentary holiday – offered by enterprises owning resorts. The natural attraction played a secondary role there. The mass tourism character in Beskid Śląski was built in socialist times, setting the tone for both the type of tourist and type of source market. So, whilst for the Goðafoss areas in NE Island mostly natural environment degradation is observed but the socio-cultural dysfunctions come second, whilst in Beskid Śląski it is vice versa.

The reason of the differences of dysfunctions in areas of particular natural value between Beskid Śląski and other Carpatian regions, except of socialism consequences, is the location in a very close distance from Upper Silesian Industrial Area.

The results of the comparative research shows that mass tourism (understood as a high pressure of the tourism) does not always lead to dysfunctions in areas of particular natural value. A factor of high importance is a type of source market and the question if natural attractions were a main reason for undertaking the tourism activity or not.

THE TRANSNATIONAL HIKING TRAIL VIA CARPATICA - A CONCEPT FOR THE SUSTAINABLE DEVELOPMENT OF THE CARPATHIANS

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Keywords: mountain tourisme, sustainable development, improvement of local adding value, creation of employment

The via carpatica will one day connect seven European countries, and it will be a model for sustainable mountain tourism. It creates new jobs, promotes an ecologically compatible landscape and infrastructure development, and enables comprehensive possibilities for arranging leisure time activities, international encounters, natural experiences and the maintenance and further enhancement of the regional cultural heritage. A traversal on the transnational hiking trail of the Carpathian bend, "via carpatica", is certainly a vision today. Although single sections of the Carpathian mountain bend are more or less well developed, a continuous route with paths and huts along the mountain bend is still lacking. For this reason, the creation of a transnational hiking trail, which runs through the seven European countries of this mountain region, is of far reaching importance. The merging idea behind this transnational hiking trail via carpatica, consists in developing and promoting this European mountain region with a sustainable social and ecologically compatible tourist concept, the core of which is hiking tourism. The current investigations of our project in the Carpathians refer to very different and disparate regional developments in a variety of areas. In attempt to intensify transregional developments, another important result shows that it still remains difficult to cross national borders. With progressive European integration it can be expected that the borders will be more permeable in the future, primarily between the EU member states Poland, the Czech Republic, Slovakia and Romania. Whether it actually succeeds in getting the transnational exchange to occur and to thus create the bases for transnational regional development will, however, be decisive. For the fulfilment of this aim via carpatica can represent a central instrument. At present, our investigations show that there is a strong need for further development in sustainable tourism, in particular for hiking tourism in the individual countries of the Carpathian bend. We therefore, first, want to outline the current state of important areas in regard to sustainable tourism. Following this, the expected effects of the sustainable development of the tourism sector will then be introduced. In conclusion, we want to outline the first steps for implementing such a corresponding concept. Current state of sustainable tourism in the Carpathian arch The present conditions for hiking tourism are characterised by an exceptionally heterogeneous situation between and within the countries of the Carpathian bend as well as by a high demand for development. This shall be represented briefly for the most important areas. We have different conditions of mountain hiking traditions:
regions with long traditions in hiking, for ex. in Poland with his PTTK, in High Tatra, and
in the Romanian Carpathians with the Siebenbürgischer Karpatenverein
then we have regions without a remarkable mountain hiking tradition.
we have different stages of infrastructure development:
the path maintenance is regulated differently in every country
there are only national or single mountain massif related path systems; transnational systems of hiking-trails are completely lacking til now
the quality of accommodations is very different
concerning Mountain guides: There are also considerable differences between the Carpathian
countries and even inside of the countries.
very useful for a bottom-up-approach is the fact, that there are many local active groups
with a high readiness to co-operate and to take over certain tasks
in the same time, there is considerable scepticism among some local protagonists towards ‘foreign ideas’ and an offensive know-how transfer from other European regions.
The results and consequences of the development of the via carpatica
(1) Economic and employment results:
Traditional economic sectors in the mountain regions, particularly agriculture (including sheep farming) are frequently, despite the high quality of their products, no longer able to compete. As long as there are no new work perspectives or ways to earn an income, the consequence is the migration of the residents from the Carpathians. New qualification concepts and the development of new employment fields for those concerned are therefore absolutely necessary. The impact will be:
strengthening of the local economy without dependence on foreign capital, because the
concept is based on available local structures and expands these as required, thus generating:
employment impacts in the region,
work and training prospects for the local population,
avoiding forced Labour migration and even return of imigrants to their home regions.
(2) Development of the region and the regional culture:

A sustainable form of tourism leads to a revaluation of the rural space because with this, not only are new employment opportunities in the service sector being created, which are attributed directly to tourism, but also other activities are being activated or reactivated. The development of via carpatica requires the ideas and imagination of the regional stakeholders, as well as the co- design and co-development. The consequences:
a rediscovery of the region by the local population because the residents themselves must get to know their region anew before they can make it approachable for strangers.
further development of traditions
and – finally - a reflexive modernisation. That means the "shaping" of a society by its members in a reflected, willful, deliberate , sensible and active way (as opposed to a mimetic,automatic, unreflected, forceful, passive way).
(3) Nature design and nature experience A person can only develop his understanding of nature when he is confronted with it, when he feels it by being one with it. The result is: Understanding nature by experiencing nature
(4) Last but not least, we have the impact of networking. Despite of the Carpathian Convention as an agreement for international cooperation, the Carpathian countries are still rather isolated. Limits are the borders, visas, but also language and tradition.So the international, national and regionalnetworking is very important in order to reach our goals. Proceeding in the construction of a via carpatica It can clearly be shown that the wide interest in transnational hiking trails is evident and is a basic prerequisite for the success of the future via carpatica project. Transnational hikers from the respective rim and aligning states and from other countries, primarily from CZ, PL, DE, FR will traverse the developed regions of the Carpathian bend. Since the interest in transnational hiking trails is steadily growing, a specific information policy for the transnational hikers, active in large numbers in other regions could also orientate them towards the Carpathians. With the construction of via carpatica, the paths and huts as well as the partners in the regions concerned should be completely reliant on the structures available in accordance with sustainable development. Available structures will be further developed and new necessities will be adapted (bottom-up-approach):
Some Examples:
marking existing paths, perhaps improving them;
renovating existing huts, raising their ecological quality (supply, disposal);
supporting existing organisations and initiatives in their ideas and networking, including
voluntary work.
These procedures create identification with via carpatica and they bring a contribution to the protection of local and regional stakeholders against the presumptions of foreign investors' largescale projects.

THE CHARACTERISTICS OF SKIING LANDS IN THE ROMANIAN CARPATHIANS

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Keywords: the Romanian Carpathians, winter tourism, skiing lands, skiing land arrangements, skiing slopes

The development of the touristic infrastructure from the Romanian Carpathians is strongly connected to the arrangement of skiing lands which are considered to be a strategic constitutive element for the winter tourism practice.
Comparing Romania with the alpine European countries, where the touristic winter sports practice holds an outstanding importance, there can be stated that its touristic component is characterized by an early stage, yet with important development perspectives, considering the growing interest in this domain. The most relevant indicator of the development of skiing lands in the Romanian Carpathians is tightly related to the total length of skiing paths, which, by the year 2010, has been around 167 km. Without any other references to the other constitutive elements of touristic groundwork (cable transportation equipment, accommodation infrastructure, road infrastructure etc.), there can be ascertained that the skiing lands from Romania are characterized by a scanty development of skiing slopes. In the last ten years, there has been noticed an increasing interest in the development of the Romanian skiing domain, the growth of the total length of the skiing tracks being of 37%, a value that means 62 km. The most compact skiing domain from Romania (40% of the total length of skiing slopes) is located in the Curvature Carpathians, in the Bucegi and Postăvaru mountain massifs, but also in Baiului mountains, situated in Prahova and Braşov counties. The management of this area was set working and maintained during the Communist regime with the help of the fitting up of some winter resorts of national interest, within which the total length of skiing slopes is a significant one (Sinaia-17 km, Poiana Braşov-15 km, Buşteni-14 km, Predeal-9 km). The main factor, that influenced the growth of the skiing domain in this area, is connected with the vicinity of the capital city and of other big cities, such as Braşov, Ploieşti and Piteşti that provide a considerable and constant flux of tourists. The capital of the country, Bucharest, plays a leading role in supplying the touristic flux, considering the fact that these tourists' income is larger than in other Romanian areas. In the last years, Romania has become characterized by an European manpower and, under its influence, there can be noticed a growing interest in the development of the skiing domain from other counties situated to a great distance from Bucharest. As a consequence, there can be remarked a noticeable increase in the total length of skiing slopes from Maramureş, Suceava, Harghita and Hunedoara counties, but also numerous mountain areas deprived of such arrangements.

In the years to come, the prospect of this domain is a considerable one, taking into account the increasing interest of Romanian tourists in the practice of winter sports, but also the availability of public authorities to use European funds and of investors who have the power to make a difference when it comes to the arrangement of new skiing slopes to the European standards.

THE RECENT DEVELOPMENT OF TOURISM IN THE ROMANIAN CARPATHIANS AREA AND SOME SOCIO-ECONOMIC CHANGES IN THE DOMESTIC TOURISTS' PERCEPTION

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Keywords: socio-economic changes, tourism development, Romanian Carpathians, tourists' perception

In the context of socio-economic changes in Romania after 1990, this study aims to identify the characteristics of tourism development in the Carpathian Mountains area, analyzed by assessing the perception of Romanian domestic tourists, applied in several destinations in a geographical overview of the issue, obtained by modelling global information. It can be considered a preliminary study for future projects, which tries to imply others ways of investigation in order to obtain an image of tourism from the main beneficiaries' view –tourists, in a background of a great amount of data upon a large area.
The main objectives consist in:
establishing of the key elements of tourism development and recent socio-economic changes taken of respondents' perception by ranking;
to draw a geographical overview about Carpathians tourism development using the selected key elements;
to analyse tourists' perception upon the several parameters for tourist establishments, types of tourism etc.
Besides consulting specific literature and empirical field observation, methods used are mostly quantitative, using statistical data and questionnaires.
There were two types of questionnaires one semi-structured, which was applied in Bucharest as the one of the main basin for domestic tourists, in order to select the key elements for tourism developments and recent socio-economic changes which are considered relevant for Romanian Carpathian area, (2009) followed by another structured, using Likert scale, applied in three mountain resorts, a village, one protected area, in 2010, on 200 respondents aiming in collecting and analysing the tourists' responses about tourism facilities development.
The first questionnaire was composed by ten questions and the respondents made a hierarchy in each answer, which help to build a geographical overview upon main issues of the theme.
The results show a general recognition of tourist accommodations blooming and a diversification of types of tourism in mountain area.
Among many socio-economic changes which affect or interact with tourism in mountain area are nominated: unemployment rate direct related to the work migration, rural-urban migration, the market economy which allows on the one hand spreading of second homes for vacation and business in tourism or merchandises, and on the other hand deforestation and the past closure of mines etc.
Tourists recognized themselves as main beneficiaries of tourism, then tourism owner business or stakeholders both responsible for tourism development beeing indirect beneficiaries, followed by local communities which can be involved as workforce in tourism industry etc.
Main types of tourism and the most specific areas in Carpathian Mountains remain: resorts tourism (Sinaia, Poiana Brasov, Baile Herculane); agri-tourism (Bran Corridor, Maramures and Northern Moldavia); ecotourism, mountaineering (Bucegi Natural Park, Retezat National Park).
Among the Governmental programs focused on tourism in mountain area, "Super schi in Carpati" is wide known, while the trend of sustainability is linked to agro-tourism and less to the increasing of protected area surface.
La last question revealed that the transport infrastructure has a negative impact in the Carpathians tourism development due to the lack of motorways which could allow a rapid access for the foreign tourists.
The second questionnaire was applied on tourists found in several Carpathian destinations in order to obtain the perception about mountain tourism infrastructure. The results demonstrate that the tourism offers partially meet the tourists' demands for accommodation, food, leisure or relaxation.
The development of tourism in Carpathians dates back since Roman times when the first establishments appeared in Baile Herculane and Geoagiu Bai, (Cianga, 2008). During the great migration period (III-IX centuries) and in Middle Age, mountain tourism almost disappeared. In the XVIIIth century health tourism in the Carpathians registered some areal development, followed by a diversification since the XIXth century, when mountain tourism appeared firstly in Bucegi Mountains. In the XXth century, tourism increases as types, establishments and tourists' flows, with stagnation or decreasing during the two World Wars. During the Communist regime mass and social tourism prevailed, but there statistics shows an increase of tourism infrastructures, favorised by transport (Surd, 2008) and energy industry development, but bears a wide industry spreading in the Carpathians: coal, metallurgy, lime quarries and cement factories etc. After 1990, tourism in the Carpathians entered in a new period regulated by the market economy and Govern acts (e.g. Law no. 755/2001). Agro-

tourism is the most attractive type of tourism in mountain areas, but mineral waters, winter sports potential keep health tourism in economy. Ecotourism begins to be also considered as a target.

Health tourism, as the oldest type, entered in a process of certification and functioning (H.G. no.101/1997; Government Decisions: no. 1122/2002; 432/2003; 876/2006, OM; 636/2008 etc.). Thus in the Carpathians in there are 16 health national interests, 28 resorts of local interests. In the same time, ski slopes in resorts or not increase the winter sports facilities and 90 sky slopes has been certified, totalizing 150 km in length (Tourism Ministry Statistics), spreading in altitude between around 600m in Sucevita up to 2000 m in Sinaia.

Accommodation statistics demonstrate that 20% of Romanian hotels as numbers are in mountain resorts, 60% of chalets and 35% of boarding houses (NIS, 2009). The tourists' accommodation capacity, by type of establishments reveals that hotels in mountain resorts represent 6% in the country total, while chalets 70% and agri-tourism boarding house 35% (NIS, 2009).

Carpathians resorts accommodation capacity in use (number of beds - days) is 16% of the Romania, but the net use indices of tourists capacity is 33.5% in hotels, 14% in boarding houses and 10. 8% in chalets, which represents a diminution of tourist activity (NIS, 2009) in comparison with 1989, 1998 data (Candea et all., 1998).

Agri-tourism and rural tourism registered a bloom as areas and accommodation. ¾ of accommodation capacity belongs to the Carpathians (Cianga, 2008). The National Association for Rural, Ecological and Cultural which helps the development of agro-tourism promoted only over 500 guest houses from all Romanian Carpathians both in resorts or villages, meanwhile 661 boarding houses were registered only in the Carpathian resorts (NIS, 2009). In the last years there were at least 11 areas of rural tourism concentration: Bran, Bucovina, Sibiu, Arieseni etc., which became local brands.

Environment protection are stimulated by several laws (Environmental Law 137/1995 with its subsequent changes and Law 5/2000), programs (2000 Nature), which lead the protected areas increasing as number, types, percentage etc. Thus, in the Carpathians there are 11 national parks, 6 natural parks and one geo-park, where eco-tourism, geo-tourism and nature tourism are in development (Smaranda, 2008), being enforced by covering with "Nature 2000 sites".

Extremes sports, caving, hiking, events tourism, biking diversify the tourism offers while the second residences continue to rise the urbanisation process, the use of wind energy (Semenic, Piatra Craiului etc.), local hydropower stations (Cerna Valley) etc.

The development of tourism interacts in a specific framework with socio-economic changes which have both positive and negative impact. Thus, taking into consideration the tourists' opinion, the most significant changes refer to: migration, employment, tourism industry, transport etc. The Carpathians' internal migration balance is positive in rural area; meanwhile the total migration is mostly negative, excepted Brasov and areas where outside the mountains big towns are located. This fact expresses the attraction of rural area and its suitability for agro-tourism. Net international migration balance is almost entirely negative and positive in areas with Hungary population or with small rate of unemployment.

In this landscape, employment in tourism is 1.8% from the total economy employment, but it varies between 3.5% in Brasov, a top destination for winter sports, rural tourism, and Bacau with 1%.

In conclusion, resorts of the Romanian Carpathians gather an explosion of tourism infrastructure including winter sports, favoured by local or abroad capital investments, an increase of interest for agro-tourism, an unprecedented urbanization process due to second home residences spreading, but also due to some socio-economic changes and Governmental programs which generated the occurrence of various businesses.

In sum, even there are limits in this study related to the large area, issues and amount and diverse statistical data it can be concluded that the tourism development characteristics expressed by geographical features have some similarities with the perception of tourists. The tourists' views can, with several limits, be considered a barometer in tourism research, a useful instrument to be included in.

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SECOND HOMES AND AMENITY MIGRATION AS THE FACTORS OF THE URBANISATION OF THE MOUNTAIN AREAS IN THE WESTERN CARPATHIANS

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Keywords: tourism urbanisation, second homes, Western Carpathians

The area of the Polish, Czech and Slovak Carpathians is where the intensive development of second homes is taking place. The phenomenon became common in these countries at the turn of the 1960s and 1970s, which was the time of intensive urbanisation and industrialisation. In the Czech Republic and Slovakia it resulted from systematic recreational investments meant for industrial societies of the communist era, whereas the second homes boom in Poland came in the 1990s, which was an effect of social and economic transformations as well as the introduction of land trade based on free market principles. At present, taking a rest in secondary residences is one of the leading courses of individual recreation development in Poland.

The purpose of this speech is to present the conditions, specific character, main courses of development as well as the spatial, environmental and social consequences of the second homes development in the Polish, Czech and Slovak Carpathians (Western Carpathians).

In the first place, second homes are built around cities - in the so-called suburban areas and those areas which are characterised by attractive environmental and landscape assets. Second homes constitute a particular case of land development in the Czech and Slovak Beskid, where a short-term tourist traffic related to weekend and holiday recreation is prevalent, being a widespread phenomenon in this part of the Carpathians. Czech and Slovak *chaty* and *chalupy* (cottages and cabins) serve to satisfy the need for individual and family recreation of those who inhabit the nearby urban agglomerations - Ostrava in the Czech Republic (with 300,000 residents) and Slovak towns situated in the Carpathian region. The receptive capacity of second homes in Czech localities frequently exceeds the number of vacancies available for total tourist traffic. At the outset of the 1990s there were approximately 11,500 of *chaty* and *chalupy* in the Czech Beskid, the number which remained relatively stable over the following 15 years. These recreation facilities are mostly used by the elderly. Many of them have not been modernised for years, which leads to serious problems related to their performance durability. It is estimated that approximately 80% of buildings used for individual recreation ought to be modernised. These are frequently seasonal buildings of modest size, with non-permanent foundations. Currently, there is a growing trend towards the construction of large all-year houses.

There are approximately 15,000 individual houses performing recreational function in the area of Polish Carpathians. These are mostly all-year buildings. The areas where most such buildings have been built are the Silesian Beskid, Beskid Żywiecki, Beskid Sądecki, Beskid Wyspowy, the Podhale and the Carpathian Foothills. A high concentration of such facilities is found in river valleys, e.g. the river valley of Raba, and around the water reservoirs on the Dunajec, Soła and San rivers. In recent years, a growing interest has been observed in the buyout of plots in the Bieszczady and the Low Beskid mountains, as well as other areas of The Carpathians and the Carpathian Foothills. Owners of secondary residences in the Polish Carpathians are primarily the residents of large conurbations situated in the Carpathian Foothills, i.e.: the Upper Silesia conurbation (2.8 million residents), the Rybnik agglomeration, the Kraków metropolitan area with its satellite towns. One of the fundamental factors determining such spatial distribution is good transport access.

The factors generating the public's demand for their own recreational residences in Poland are the same as those in highly developed countries, including deteriorating living conditions in large urban agglomerations, the development of individual motorization, higher amounts of free time, a generally greater wealth of the society, trends and other factors. One of the causes of the swift development of second homes in mountain areas in Poland is the fact that the sale of land provides rural residents with economic benefits. In the 1990s, which was a period of intensive economic transformations and transformations of rural areas, local population of some Carpathian villages struck with high unemployment rate saw the sale of recreational building plots as a quick and effortless means of providing income.

The characteristic features of the second homes phenomenon in Polish conditions are as follows: a) high dynamism and spontaneity, b) permanent character of development, c) high spatial concentration, d) spatial isolation, e) development in environmentally and scenically valuable areas, f) high rate of space consumption.

As a settlement phenomenon, second homes contribute to the urbanisation of rural areas of tourist interest. In some places, the development of the phenomenon is in conflict with the environmental protection function, e.g. in the neighbourhood of national parks (including the Babiogórski National Park). Development of secondary residences in higher mountain areas permanently affects their landscape features. Such buildings are often constructed in places where permanent residences are hardly ever built, e.g. on steep slopes, in the direct vicinity of water, at a large distance from residential areas, or in forest clearings. In some parts of Poland, the spread of recreational settlement and related changes in land uses have transformed the natural landscapes into urbanised to highly urbanised landscapes. In some places, "recreational conurbations" emerged consisting of up to several hundred facilities. Sometimes an excessive

concentration of buildings along with the architectural chaos destroy the harmony and aesthetic value of mountain scenery, thus lowering the quality of environmental assets of tourist localities.
The building of second homes in the Western Carpathians is constantly developing and is of permanent character. Despite rising land prices and the saturation of space with secondary residences, city residents are constantly looking for new, underinvested and attractive localisations. This is accompanied by the process of permanent moving away from cities to live in the country by those reaching the retirement age as well as the professionally active. The improvement of transport accessibility of mountain areas, resulting from the development of road network, lead to the emergence of apartment buildings in some Carpathian localities that began in the 2000s with a view to urban residents resettling permanently.
Undoubtedly, the second homes phenomenon is at present one of the most dynamic and spontaneous elements of the spatial, social and economic transformation of mountain regions in the Western Carpathians, particularly in Poland and the Czech Republic. In the Czech Beskids and Polish Western Beskids this is accompanied by a social phenomenon new to this part of Europe, defined as the „amenity migration" and related to the permanent resettlement of the residents of big cities.

A STRATEGY FOR SUSTAINABLE DEVELOPMENT OF TOURISM IN THE DEPRESSION OF GIURGEU-CIUC

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Keywords: sustainable development, depression, climate-touristic index, volcanic lake, hot springs.

The European Union strategy for sustainable development, adopted in Gothenburg (Sweden) in 2001 and then redesigned in Brussels (2009), redefines the development policy priorities in the economic and social fields, as well as in the protection of the environment. Among the priorities adopted are the "green growth" and the "environmental sustainability", and the fact that connecting the three basic elements of development (economic growth, social cohesion and environmental protection) can be defectively applied if full knowledge of all components is not taken into consideration.
Romania's Carpathian area enjoys the existence of a highly significant potential for tourism, whose exploitation enables the development of the most varied forms of tourism such as leisure and spa tourism, hunting and fishing, winter sports, ecotourism, rural tourism etc.
The main purpose of this study is to promote the Depression of Giurgeu-Ciuc as a tourist destination by highlighting sustainable tourism, by consciously controlling the exploitation of the attractions that tourism is based on, as well as by involving the local communities and those who must preserve the natural and anthropogenic heritage of the area.
To achieve the above goal the following objectives were proposed: the multiplication of the social and economic effects of tourism through a profound local integration of the tourist phenomenon; the increase of tourist traffic and, in particular, of accommodation in all destinations of the Giurgeu-Ciuc regional system; ecotourism and active tourism development, rural tourism diversification.
Our research methodology included: the collection and analysis of the existing data and information, field trips, observations, consultations and questionnaires in different locations of the area that was studied; the achievement of a SWOT analysis that, in addition to the good and weak points, allowed us to establish the major development opportunities and the apparent dangers.
Related to the objectives of the project, the results collected show:
a complex and efficient exploitation of natural and anthropogenic tourist resources;
the stimulation of tourist reception structures and of other related infrastructure;
the improvement of the conditions for training the human capital employed in tourism.
Despite the existing potential in the Depression of Giurgeu-Ciuc, we can say that tourism is less developed here than in other parts of the country, namely the Prahova Valley, southern Transylvania, the Black Sea Coast or Bukovina.
The slow development of tourism in the Giurgeu-Ciuc Depression is attributed to factors such as: the relatively low population density in the area, poor and underdeveloped access infrastructure (road and rail) to tourist attractions, the active population's lack of interest in developing tourist services, the high prices of the existing tourist services.
The strategy for sustainable tourism development in the region proposes the increase of the economic impact of tourist activities on the local communities through the following:
the dispersion of the current tourists that are aggregated in the main tourist county destinations through thematic itineraries;
attracting potential tourists from the main areas of origin of current tourists, and from other areas of the country and from abroad, both through themed itineraries, camps, regional themed parks or events and through linking them to the national and European areas.
After processing and analysing the information collected, we identified the motivating tourist attractions, and we established the following thematic clusters: Nature - Culture - Wellness, both in the Giurgeu-Ciuc Depression and in the surrounding area at Borsec, Red Lake or Praid.
To promote sustainable tourism in the Carpathian depression, we propose to increase the development of mountain tourism in all its forms, health tourism in its new international vision - SPA, cultural tourism, rural tourism (gastronomy,

traditions, customs and festival promoting) ecotourism or business tourism. The current reality of mountain tourism requires an increasingly substantial participation of foreign capital investments in this area, thus contributing to the exploitation of the rich potential of the area and to increasing the quality of all tourism activities in the central region of the Oriental Carpathians.

PROBLEMS OF TOURISM DEVELOPMENT IN THE PROTECTED AREAS OF THE POLISH CARPATHIANS

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Keywords: tourism, protected areas, Carpathians

The Carpathians are one of the most attractive and most frequently visited tourist regions in the country. Its popularity is a result of many factors including: high tourist values the deficit of mountain areas in Poland (areas located above 500 m above sea level occupies only 3.1% of the territory), small distance from the Upper Silesian Industrial Region and Krakow, good transport accessibility, developed tourist infrastructure, as well as the long tradition of tourism in the region.
The Carpathians contain very valuable areas in terms of natural, landscape and cultural heritage, what is the reason why a significant part of their area has been protected by law. Protected areas encompasses approximately 70% of the Polish Carpathians. The most valuable parts of the mountains are protected within six national parks, covering a total area of 826 km^2. In the Carpathians there are also 13 landscape parks (of a total area of 4 385 km^2), 11 areas of protected landscape and many nature reserves, documentation sites, ecological arable lands and landscape-nature complexes. Moreover, some areas received the international status by inclusion in the Natura 2000 network and the network of UNESCO biosphere reserves.
For tourism development the most important are the national and landscape parks. There are significant differences in the extent of tourist use of the individual parks, as well as disparities in the development of tourism in different parts of the parks. Differences are also evident in terms of the tourism function significance within the economy of the localities belonging to the parks' respective local administration units.
Some national and landscape parks have been created in the areas which since the nineteenth century are often visited by tourists. The Tatra, Pieniny, Babia Gora National Parks and Landscape Parks of Silesian Beskid and Poprad have the longest tradition of tourism development. In these parks tourist traffic is the highest. There are also protected areas covering parts of the Carpathians, where tourism has never developed, and even now tourists are rare.
In 2008, the Carpathians national parks, were visited by 5.6 million tourists, which means that more than half of the total tourist traffic recorded in the Polish national parks concentrates in the Carpathian' parks. The Tatra NP is characterized by the highest volume of tourist traffic – it is visited by more than 2 million tourists a year. The largest intensity of tourism traffic takes place in a small area of Pieniny NP, where annually per 1 km^2 falls as many as 32 thousand tourists, and per 1 km of hiking trails 22 thousand tourists. The volume of tourist traffic in the areas of landscape parks is difficult to assess, but clearly the highest tourism traffic occurred in the Silesian Beskid and Poprad Landscape Parks. Unfavorable phenomenon is the strong temporal and spatial concentration of tourist traffic, which causes a major damage to the natural environment.
All national parks have a dense network of marked hiking trails, some parks developed also the bike, skiing and horse riding trails. The largest concentration of hiking trails is located in Babia Gora NP (1.6 km/km^2) and Pieniny (1.5 km/km^2), there is high density of trails also in Gorce and Tatra NPs and Silesian Beskid LP. Some of the Carpathian's protected areas are also equipped with the ski facilities, including the facilities for alpine skiing. Skiing has developed on a significant scale in the Tatra NP and the Landscape Parks of Silesian Beskid, Żywiec and Poprad. The development of ski resorts in the Polish Carpathians, especially within the protected areas, is a serious problem and is a source of conflict between tourism and nature conservation.
In addition to tourist trails, in national and landscape parks about 100 didactic routes, has been created. Moreover the attractiveness of the parks is raised by their museums and the educational centers, as well as didactic programs conducted by the parks' staff. The most popular is the museum of Pieniny NP, which in 2008 was visited by 433 thousand tourists.
There are also accommodation establishments within some of the national parks, but most of them are mountain huts. The heavily developed accommodation facilities occurs in some landscape parks, especially within the Poprad LP, where a large tourist and spa towns are located within the park boundaries (including Krynica and Muszyna). There is more than 400 accommodation establishments with 17,3 thousand beds (32 beds/km^2). The attention should be also paid to the areas neighbouring the parks, because in some cases parks are surrounded by the intensively developed or even urbanized territories.This situation is visible for example in the vicinity of the Tatra NP and the Landscape Parks of the Silesian Beskid and Beskid Mały.
Diversity of natural and cultural values in national and landscapes parks gives the possibility of creating a wide range of the original tourist products, and provides the basis for the development of many forms of tourism, mainly active tourism. Currently, the structure of tourist arrivals is dominated by traditional forms of recreation and hiking. However, a process of diversification of tourism forms is visible, as well as the number of people engaged in less common forms of tourism activities (including eco-tourism) increase rapidly.

The aim of this paper is to show the main directions, trends and problems of tourism development in protected areas of the Polish Carpathians. The article is based on the author's own research conducted since 2003.

POLITICAL ECOLOGY OF MOUNTAIN TOURISM DEVELOPMENT AND SUSTAINABILITY: A CASE STUDY OF 'EVEREST TOURISM' IN NEPAL

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Keywords: Political ecology, equitable tourism, indigenous people, sustainable mountain development

This paper has explored the contribution of tourism interventions to the development of Everest region and its indigenous people. The tourism intervention and its impacts have been analyzed on the theoretical base of political ecology framework. It has assessed the impacts of tourism interventions to landscape and ecology, culture, livelihood of the indigenous people and overall socioeconomic power relations of the people in this region. The distribution pattern of the economic benefits from Everest tourism is found to be unequal and unjust towards low income classes of indigenous people of this region. The commercialization aspect of Everest tourism has found to be a controversy among the environment researchers, development organizations and policy makers. The analysis has been linked to the effectiveness of sustainable tourism development strategies in reference to the sustainable mountain development policies. It is found that 'without equity considerations in terms of the revenue distribution to the local peoples and without devolution of local governance rights on local resources, the sustainability of 'Everest Tourism' is impossible'.

POSTER PRESENTATIONS

ASPECTS REGARDING ONLINE APPLICATION TOOLS FOR MONITORING THE TOURISM SERVICES USING

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Keywords: online instruments, visitors, tourism, accommodation, car rental

The paper presents the possibilities of using toolsfor monitoring the worldwide clients interested in tourism services. Several aspects regarding the working of google analytics are reveled as well as the results obtained with this tool in accommodation and car rental services.

The online instruments are very useful in monitoring the clients for tourism services. Using Google Analytics a completed package of information regarding clients can be obtained. Goals are useful because they enable the measure of a site success and failure, too, when people start a funnel and don't finish. The Traffic Sources reports all have tabs that enable you to look at Traffic Source by goal achievement. They help to learn what turned into successes - whether sources or campaigns, or other ways of defining traffic. Knowing it is possible to do more of what works and less of what fails.

There are other reports in Google Analytics that use goals, too. You can segment your on-site search by goals, for example. You can even segment some of your visitor information (browser type and user defined variable) by goal achievement. Note that there is *not* a report that enables you to look at goal by traffic, or goal by on-site keyword term. It is always the other way around: traffic by goal, keyword term by goal, on-site search term by goal, etc.

Content Overview displays information about individual pages on a website. General information on this view includes drill-downs for top content by page hits, navigation information, landing page analysis and click patterns. By clicking on the link for any specific page, the same drill-down information is available, but limited to only that particular web page. Visitors Overview provides data about site guests, including number of visits during a specified date range, absolute unique visitors, page views, average page views, time spent on the site, bounce rate and new visits. Additional information includes web browsers used to access the site and the visitor's connection speed. Also available is information about language, network locations, visitor operating system, screen colors, screen resolutions, java support and Flash versions.

Traffic Sources displays data about how visitors access the website and which keywords were used in search engines to find the site. Detailed drill-downs are available for the sources and keywords.

Unlike many other website traffic analysis tools, Google Analytics (GA) is positioned as a resource for marketers instead of webmasters. Google Analytics tracks visitor information from all referrers including search engines, advertisements, email marketing and other websites.

MOUNTAIN RIDGE GEOGRAPHIC ENVIRONMENT IN RELATION TO TOURIST FOOTPATHS IN BUCEGI MOUNTAINS AND WESTERN TATRA MOUNTAINS

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Mountain ridges are characterized by various levels of tourist attractiveness as well as accessibility by different means of transportation, which influence types of tourist usage. The ridge systems of Bucegi and Western Tatra Mountains are characterized by diverse relief and geological conditions. These differences result in the development of numerous and often distinctive polygenetic forms.
The goal of this research was to take inventory of those forms and of degraded areas in two distinctive high mountain ridge systems and propose protective measures for degraded areas. Geomorphological mapping along the most intensively utilized trails was used in order to determine the level of relief transformation in ridge areas.
Research has shown that due to different usage patterns in each research area a bigger percentage of linearly damaged areas, with deterioration initiated by tourist foot traffic and natural causes, is located in the Tatra Mountains. On the other hand, the forms within the ridge area of the Bucegi Mountains, forming a plateau elevated over 2000 m. a.s.l., are frequently transformed into surface areas whose development is related to tourist traffic, automobile traffic and intensive sheep grazing.

TRUE-3D IMAGING OF MOUNTAINOUS REGIONS – AN EXAMPLE FROM POLISH TATRA MOUNTAINS

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Keywords: lenticular foil, true-3d, maps, mountains, hiking, climbing

Going into the mountains demand getting to know the terrain and its surroundings. The higher and more difficult the mountains are, the more important it is. Worldwide tourists use classical maps or special schemas to acquaint themselves with the region. Such an illustration can tell a lot about a track, however the flat image cannot describe it completely. An alternative is to create 3-dimensional maps, showing the whole mountain ridge, one valley or even a particular rock wall with the climbing route, that is overlaid on the spatial model. GIS software enables creating 3D views on the screen, however it is not a sufficient solution to the problem, as the map would be used mostly in the field. In this work a lenticular foil technology is utilized to produce true-3D analogue maps and images of tourist and climbing routs in polish Tatra Mountains. Space can be there perceived with unaided eye. Guidebooks can take advantage of the approach to produce more real and visually interesting illustrations. It can also be used to promote the region in broad community, by showing it in an attractive way. Steep slopes and deep valleys show their full beauty in reality, so one should try to portray it as truly as it is only possible.

THE ACCEPTABLE LIMITS OF CHANGE IN ECOTOURISM

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Keywords: tourism, destination, ecotourism, economic, benefits, promotion

The sustainable development of the tourism depends directly or indirectly on the sustainable development of other sectors (Mc Kercher 1993). The general improvement of the infrastructure, diminution of the corruption, economic growth with direct implications into the standard of life etc will generate the necessary conditions for the sustainable development of the Romanian tourism.
Or, it is the interest of the tourism to be active in the issue of the sustainable development and work together with the other industries in order to assure the quality of the resources and its survival.
It must not be forgotten the fact that the tourism must be politically accepted as a priority without compromising its sustainability. With no political engagement and support for the sustainable tourism, the tourism programmes based on the principles of the sustainable tourism will no longer be possible to be implemented.
It is already known the fact that the tourism in general creates economical benefits for the destination countries and

regions and as well for the issuing counties. The development of the eco-touristic sector will simultaneously generate the prosperity of the other sectors of the economy (the alimentary industry, trade, transportation etc). Due to the fact that the request for the ecologic tourism is in permanent growth in the whole world and in order to maintain this influence in tourism and local communities, it is important to continue the promotion of the models of sustainable development.
It is a well-known fact that tourism, in general, generates economic benefits for the destination countries and regions as well as for the issuing countries. The development of the eco-tourist sector will engage simultaneously the prosperity of other sectors of economy (the food industry, the commerce, the transportation etc.). Because the request for ecologic tourism is constantly rising (at a world level), the continuity of promoting the sustainable development models is very interesting as a tendency to maintain this influence on the tourism and local communities markets.
In order to adjust the notion to the practical reality of our country, regarding the enrolling of this type of activity, we suggest the following definition: ecotourism is a form of tourism, practised according to the principles of sustainable development, contributing to the preservation of bio-diversity, to the preservation of cultural and social values of the community, to the ensuring of benefits for the host community and to the satisfaction of tourists' requests. This definition refers to any kind of tourist activity, starting with a simple seating in a natural area and ending with the care for the environment.
After having studied the notions of ecotourism from the literature, we have noticed that the interpretations for "ecotourism" and "ecologic tourism", from the notion's content point of view, are analogical.

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IMPACT OF TOURIST'S EMOTIONAL STATES ON THEIR SATISFACTION REGARDING WATER-BASED TOURIST ATTRACTIONS IN MOUNTAINOUS LANDSCAPES

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Keywords: tourism, satisfaction, water, Czech Republic

With regard to the frequent collisions of interests between nature protection and tourism, the understanding of visitors' relationships with the, at once vulnerable and highly attractive locations, which is what the water and wetland biotopes of mountain regions undoubtedly are, makes a fundamental contribution to their successful management. One of the basic elements of this relationship is satisfaction. (Yoon & Uysal 2005. *Tourism Management* 26: 45-56.).
Factors of tourist satisfaction were studied by data collected by on-site questionnaire surveys. Satisfaction with travel experiences was measured on a 5-point scale of answers to the following questions: How does this site rate compared to what you expected? Was this visit worth your time, money, and effort? Emotional states were measured by both Mehrabian-Russell semantic differential 7-point scales of pleasure-arousal-dominance and information-rate measures. Data was gathered on 26 water-based mountainous and submontane localities of 10 types: stony rivers in deep valleys; rivers in flat broad mountain valleys; canals; water-falls; lakes; ponds; peat lakes; peat lands; water closely linked with an historical monument; view of the watercourse in deep woody valleys; wide views of the dominant water-levels. 64 interviews were performed in each of the cited localities.
Differences were found among the types of locality in case of both all surveyed attributes of an emotional component of feeling and their confirmative tool (One-way ANOVA, $p<0,05$).
Factor analysis of the emotional component of feeling (principal component analysis, eigenvalue > 1, Varimax rotation) confirmed the original dimensions: pleasure (28% variability), arousal (13% variability), dominance (9% variability). The same method was used to specify four factors of the environmental perception: complexity (23% variability), regularity (12% variability), novelty (10% variability) a density (7% variability).
The application of multiple linear regression pointed out the dimensions, 'pleasure' (beta -.17) and 'perceived complexity of environment' (beta .15) to be the most important factors of satisfaction by location in relation to the locality and the dimension, 'pleasure' to be a factor of the value assessment (beta .41).
This research was conducted with the financial support of the Czech Science Foundation – GACR 403/09/P053 "The typology of tourists' attitudes towards the environment, the case of waters in the landscape."

GIS-BASED ANALYSIS FOR NATURE-BASED TOURISM AND RECREATION

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Keywords: GIS; spatial analysis; nature-based tourism; recreation; visitor flows

In the last two decades the Geographic Information Systems (GIS) framework has become a well-established tool supporting management of natural resources and protected areas. However, the collection of methods used to store, analyse, model and visualise the visitor flows in natural sites has not yet been exhaustively documented within this application domain. This presentation reviews main GIS analytical approaches and discusses their utility for studying visitor flows in recreational areas. The presented overview of methods is illustrated using examples based on empirical data obtained from recent visitor monitoring projects carried out in selected Austrian study areas, by the Institute of Landscape Development, Recreation and Conservation Planning - BOKU University, Vienna, Austria. The presented study areas do not belong to the Carpathian region, but the methodology concerning data collection, data models, analytical tools and visualization methods can be easily transferred to investigate the spatial and spatiotemporal dimension of nature-based tourism and recreation in the Carpathians.

TOURISM IN UKRAINIAN CARPATHIANS: ECOTERRORISM OR SUSTAINABLE TOURISM?

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Keywords: sustainable tourism, the Carpathian region, types of tourism, rural tourism, agrotourism, ecotourism.

The article considers institutional, planning and spatial aspects of the development of sustainable tourism in the Ukrainian Carpathians. The elements of sustainable tourism for different types of tourist activity, such as recovery and rest tourism, alpine skiing, cultural, rural and ecotourism have been analyzed. Principal directions and marketing policy of the introduction of sustainable forms of tourism for the nearest future have been suggested.
The Ukrainian Carpathians have natural, social and cultural, economic preconditions for sustainable development policy introduction into tourist industry of this region. The main components of this policy shall become:
decrease of negative influence produced by tourist infrastructure and dominating types of tourist activity (mountain skiing, hiking);
as program and project development proves the Carpathians region administrative districts have opportunities for more efficient use of natural and historical, cultural resources and infrastructure improvement with the aim of sustainable development elements introduction into traditional tourist activity (recreational and rest, mountain skiing, hiking) and broader new tourist products introduction related to ecological, ethnographic and rural tourism;
Ecological tourism development with broad use of the potential of National parks, biosphere preserves and rural tourism based on rich ethnic and cultural heritage shall be recognized as the priority in sustainable tourism policy in the Ukrainians Carpathians.
Agro-tourist services marketing through the intermediaries, mostly, tourist companies. There is a number of tourist companies, which have chosen agro-tourist product as an image product for their companies, for example, tour operating companies – the recipients from Crimea and the Carpathians. Though most companies consider this product as an additional and often cooperate with the owners through making reservations on agro-tourist farms during the peak of tourist season or use them farms accommodation during subject tours. Experience of cooperation between tourist companies' and agro-tourist farm owners when marketing agro-tourist products proves that mechanism of their interaction is insufficient which results in mutual claims between the participants of this process.

Thematic session: Traditional Knowledge
Chairs: ***Alain Bouras (French Ministry of Culture, France)*** ***Zsolt Molnar (Hungarian Academy of Sciences, Hungary)***
The session aims at collecting examples from various studies dealing with local people and cultural heritage, acknowledging the interdisciplinary approach required to gain a comprehensive view on cultural heritage and diversity. It includes studies on the following disciplines: historical, economic, medical ethnobiology; ethnobotany; management practices of agriculture, pasture and forest; local perceptions and knowledge on climate change; ethical and philosophical aspects of research and development interventions. This session invites research presentations on specific tools and modalities applied to realize an effective interdisciplinary team work which could be further applied by the local communities and decision-makers and therefore, contribute to the sustainable land planning and development in the Carpathian region. Cultural heritage and diversity – a broad variety of traditional knowledge, practices and skills, is increasingly confronted with and threatened by global trends.

ORAL PRESENTATIONS

THIS OLD EPISTEMOLOGICAL LIE

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Results : This old epistemological lie :

"There is an evolution from a Plato's or a Confucius's time plough up to now. When there is no evolution among *Homo sapiens sapiens's* thought and brain from this period to ours".

But it is taught in the engineering schools that there is an evolution.

This ideology leads people of our civilisation to think that our way of life and our society knowledge are better than a gather-hunter's, or a traditional farmer's way of life.

The persons in charge of land planning think that what we call "progress" is intrinsically better than what was already existing.

The ten years around 1860, took place the worst genocide of Human History, and maybe the less well known.

Steam machine recently becoming secure, the oceans suddenly were covered with steam freight boats, carrying goods from the colonized countries toward the colonizing countries. Continents were covered by steam freight trains, carrying the same goods toward the harbours.

Within ten years, all the "foodproducing agriculture species" were replaced by tropical colonialist species : but these species did not feed the local population as the foodproducing did before.

This caused a famine that killed between 60 to 80 millions of human beings.

Traditional trade nets, initial biodiversity and social regulation means disappeared.

This step has a name: it is called "progress", or modernity.

In France, an author became well known writing novels, as" Twenty Thousand Leagues Under the Sea" in 1870, in which all the good personages where conquerors, European or North American, using sophisticated technology, and the stupid personages were natives using traditional technologies.

Then, the pupils – usually boys – identified themselves to Jules Verne's heroes. The "prizes" at the end of the school year were typically Jules Verne novels.

Since this period, we – the inhabitants of former colonial or dominating nations – are convinced that this great change caused wealth and a better food and way of life all over the traditional farmers, including the European ones.

Which is one of the most insolent lie ever pronounced.

This ideology is deeply anchored and – in 2010 – it is almost impossible to influence the land planning programs upon zones where the traditional ways of farming still exist … like in the Carpathians.

The excellence of Traditional Knowledge

Local knowledge are able to associate specific species to specific soils or weathering conditions, within the same small area, in order to get better crops and dietetically better quality food.

As an example, the biodiversity created with sickle is totally different from the one built with a scythe, or with mechanised or motorized agriculture. And sickle is used all over the world.

With a sickle, you identify in a glance a tinctural plant or a medicinal herb. You avoid the plant, that can have its reproduction cycle completed. The biodiversity gets richer.

Local knowledge and traditional technology were linked to solidarity.

Concerning the Carpathians, the works of H. H. Stahl, and from "Romanian School of Sociology" show how the agro-pastoral populations knew heterocracy in their community villages, and democracy through a wise old persons assembly.

Assertion : Why we imperatively must know and use the Traditional Knowledge within the sustainable land planning programs

Specialists who study living realities work mostly with books.

Specialists who are working upon living realities : horse breeders, herders, gardeners, wood carvers … are quite ready to work from experimental facts, information collected among generations.

The first hypothetico-deductive reasoning is known as superior than the second one : empirical approach.

We just propose that the empirical knowledge be placed beside scientific reasoning.

For instance there is no work upon dowsers, because it is said that "dowsering does not work".

There are no works upon moon phases, because "it is a superstition".

When all the herders take care of the moon phases for their cattle reproduction, the gardeners about plantation, the wood workers about cutting trees moments.

The argument that pleads for the defence of aboriginal « languages »

This vernacular knowledge is transmitted within specific and local dialects, corresponding to specific species, into specific contexts. Any approximate translation would "reduce" the contents of the collected information, and will turn it into a useless data.

If so, this data will appears as unstructured material, as a vague and non credible information, and finally as "superstitions".

Among many other examples, I will mention the case of the date, settled to cut down a tree in order to build a durable house:

When working in the Carpathians, an informer can tell you "to keep your house free of xylophages insects, you must cut (*such specie)* two weeks before Easter".

If he is a Catholic, Easter will mean "first Sunday right after full moon following Spring equinox". If he is Orthodox, "moon comput" is different, and Easter is another day in the year.

Beside, Greco-Catholics can look like Orthodox, but they are not.

And if you are with a Hutsul, the religious dates from Bucharest Patriarchate are not the same with Moscow Patriarchate. This is why you need a native speaking person.

In few words, it is impossible to practice applied ethno-ecology without figuring altogether a research for funds dedicated to translations.

It is our responsibility to become militant for this effort of translation.

Several advantages:

- Most of the "small languages" are in danger to be replaced by English or this "PEE" (read below). These languages are cultural treasures, and it is a necessity to use them and to refer to them.
- These works will create jobs.
- E. U. services in Brussels count 25 000 functionary positions. More that 50% are translators. 200 are in Rights and Laws. This underlines the importance of native languages when there is a will to respect local mentalities. The field of sustainable development can become the same important.

About PEE: formerly, scientists were speaking Latin. In other places it was Arab, Chinese … The thing is they had a common REAL language to communicate accurate, which grammar and lexicon allowed nuances and subtleties.

In Europe we have "P E E": Pan European English: a very approximate idiom, an Under-Esperanto, a Sub-Volapük. Few of us speak "real English".

Sustainable land planning in the Carpathians. Propositions, Debates:

Carpathians have not been collectivised during the communist period. Central power did not bother about the mountain villages.

This … "mistake" brought out the fact that social relationships and mentalities stayed quite the same.

But the destruction of traditional ways of production started with the attraction of making money through emigration, according to the new Divinity : "Profit", And "Profit inhibits reflexion and creativity in the fields of politic and economy".

We now are front of the following situation:

- we have on our disposal in the Carpathians, golden knowledge about environment.
- we have on our disposal golden hands, women and men's, to work on wood, on stone, on horses1, sheep, on the hedges and pastures … And we let these golden hands go to the rich countries of E.U to cast "reinforced concrete", for the lowest salary!

Is it reasonable?

And if we do not ring the bell about this situation, if we do not give its right place to this traditional knowledge, if we do not include adapted measures in our prescriptions, we will be guilty for the ruin of both the Carpathians biodiversity, and economical sustainable development.

THE ROLE OF TRADITIONAL VILLAGE SYSTEMS FOR SUSTAINABLE MANAGEMENT OF FOREST LANDSCAPES IN UKRAINE'S CARPATHIAN MOUNTAINS

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Keywords: forest and woodland landscape, social and cultural sustainability, rural development, traditional land use, cultural landscape, forest policy

Maintenance of socio-cultural values and biodiversity at local and regional levels are new important additional criteria for the implementation of sustainable forest management. Ukraine's forest sector is in transition from planned socialist to market economy. We evaluated the role of the traditional village system, which was successful for centuries for achieving both economic as well as these new dimensions of sustainable forest management in Ukraine's Carpathian Mountains. We used the Skole district as a case study that represents one of the most forested areas (70%) in Ukraine, and is a part of Boiko people's ethnographic area. The village is a social–ecological system defined by local governance, traditional land use of pre-industrial cultural landscapes, and a spatial structure with land use zones satisfying different needs. Using documents on regional land use history, analysis of socio-economic statistics, and interviews with local land users, we evaluated the extent to which the traditional village system supports socio-cultural dimensions of sustainable management of forest landscapes. Our review of land use history indicates that after different phases of cultural landscape development during several 100 years, the traditional village system is still a basic unit of the Skole district's forest landscapes. However, data and interviews show that the traditional village system is endangered. Making use of the total economic value of forest landscape resources, including wood and non-wood products and services based on cultural values and biodiversity, is an urgent task. Support of traditional village governance and socio-cultural functions and land use systems including fields, wooded grasslands and forests should be milestones in a regional program of sustainable forest management. Traditional village system zoning and land use systems would be good indicators of sustainable forest landscapes.

STUDY ON THE ESTABLISHMENT OF QUALITY SYSTEM PINCIPLES (QS) APPLIED TO TRADITIONAL TECHNIQUES OF CHEESE PRODUCTION IN THE TRANSLVANIAN CARPATHIANS

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Keywords: cheese, the Carpathian area, traditionality, quality system

The purpose of the study is to establish quality system principles (QS) applied to traditional techniques for manufacturing traditional Transylvanian cheese, within the context of current requirements oriented towards ecological principles and mountain agri-tourism development. We refer to several types of cheese, but especially to sheep and buffalo cow cheese, which are specific to the area called "Center of Transylvanian Carpathian Arc" (CTCA), which cover mountainous and hilly area of Southern and South-Eastern Transylvania from the Curvature Carpathiana, Barsa and Fagaras areas, to Sibiu areas and highest Carpathian Mountains.
The paper aims to identify and define the traditional Transylvanian types of cheese as well as to characterize the QS methods and procedures in traditional manufacturing techniques of cheese within the CTCA area.
The methodology applied undertakes the collection and systematization of the types of cheese and traditional production chain in various regions within the CTCA area, using statistics and comparison-based methods as well as physical-chemical and microbiological analyses.
The results of the paper reveal the types of cheese within the CTCA area: ewe's milk cheese in pine bark, Transylvanian cottage cheese, Transylvanian soft cow cheese, Transylvanian pressed buffalo cow cheese. Likewise, the characteristics, qualities and defects are analyzed and the "traditional" elements describing the types of cheese are established according to their geographical provenience. The paper lays the groundwork for the standardization principle of quality assurance system of traditional Transylvanian cheese through laboratory analyses, so as to emphasize the characteristics of traditional products.
The study is intended to meet the current requirements of the European single market, which means quality and originality of products competing on this market. Therefore the project identifies solutions for recognition of these products quality that is sustained by the traditional and ecological nature on the one hand, and by quality maintenance sustained by the quality assurance system of farms and manufacturing units (in certain cases) as well as of products, on the other hand. The beneficiaries of the research results are the factories manufacturing traditional Transylvanian cheese (cattle and buffalo breeders, agri-tourist and agri-husbandry manufacturers) commercial companies and, the last but not least, the consumer population of these traditional products.

The main conclusions show that the products are essentially traditional and original on the cheese market, and, furthermore, the standardization of quality assurance system of traditional Transylvanian cheese through laboratory analyses to emphasize the characteristics of traditional products appears as opportune.

PERCEPTION OF VEGETATION AND LANDSCAPE BY CSÁNGÓ PEOPLE (EASTERN CARPATHIANS) – A NEW INFORMATION SOURCE FOR NATURE CONSERVATION

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Motivation of ethnoecological research by a botanist: Ecological, historical and land-use data are crucial in understanding landscape dynamics and in planning nature conservation management. The present knowledge of botanists, ecologists, nature conservationists, farmers and foresters, however, seems to be insufficient for reliable planning and realization of nature conservation management in Europe. One reason for this is that we know little about the traditional relationship between nature and humans. In the past, knowledge of people working in nature was ample for sustainability, since they managed their environment in order to sustain their communities for the long run. Although this knowledge is decaying rapidly with modernization, it still exists in Central-Europe. It exists in such a quantity that there will not likely be enough ecologists and botanists in our countries to collect, "sustain" and use the related scientific ecological, botanical knowledge, which is commensurable in quantity to traditional ecological local knowledge.
Although a portion of the traditional ecological knowledge has been collected by ethnographers, anthropologists and geographers interested in ecological issues, it is not documented and published sufficiently due to the obligate limits of theoretical and personal field e.g. botanical knowledge and, also, due to the varying range of scientific interests. We would like to argue that only a botanist can accomplish an effective collection of traditional botanical knowledge. To collect this knowledge, we need ethnoecological and anthropological approaches in addition to botanical approaches, as botanical methods are insufficient for this. We have to learn the methodology and methods of social sciences, and work together, to understand one of the most crucial questions: relation of nature and man. If we do not undertake this job we will have to rely upon the collection and publications of social scientists and probably would not notice accidental false data, misconceptions and, particularly, thematic and lexical gaps in the collection. And we have to face the problem, that biologists alone can not solve the problem (conserving nature) without knowing those who live and „manage" our landscapes.
Area and methods: Having been isolated from the main Hungarian population of the west, Csángó people preserved a culture rich in archaic elements (e.g. ca. 80% of the food is self-produced; Csángó people spend about 210 days annually outdoor in the woodlands and on the meadows and pastures). Local names of plants and habitats were recorded, by interviewing cca. 50 people. This knowledge was also compared with the scientific botanical knowledge.
Results: Since Csángó people still depend chiefly on the biomass production of the landscape, their knowledge on plants, animals and the landscape is astonishingly wide. Knowledge of plants is very detailed and accurate. We collected 235 plant names, determined 172 ethnotaxa (these cover 280 wild plant species out of the occuring 450 species (62 %)). An „average" Csángó person recognizes 75-80 % of these ethnotaxa (people with the highest knowlegde recognize 90 %, children under 12, only ca. half of it). Species with higher frequency and higher cover are better known, than rare species. People can name ca. 80-95 % of the „biomass" in different vegetation types. Local plant names are highly endemic: similarity of the local plant names with the neighbouring areas is 40-72 % (10-15 km), with areas farther away (70-200 km) only 17-30 %. Folk taxonomy of grasses, sedges, Salix species, Urtica/Lamium species, ferns, Gentiana and Trifolium species etc. is special.

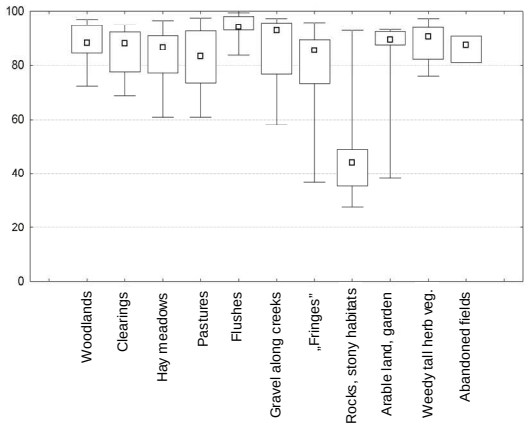

Figure 1. Csángó people can name ca. 80-95% of the „biomass" of different habitats

Csángó people - though at least 131 habitat types are distinguished (see the abstract by Babai and Molnár) - seldom use names of habitat types for orientation in the landscape (the most often used terms are 'woodland', 'pasture', 'potato field', and 'river bank'). They mostly use geographical names or the name of the owner of a property ('Maria's pasture in Jávárdi valley'). Csángós often orientate themselves in the landscape using expressions such as closer or farther from the stream ('in' and 'out'), and up and down in the valleys ('up' and 'down') similarly to the Gitksan people living in similar mountainous landscape with coniferous woodlands in NW Canada. When they mention a habitat name, they do not use the phrases in a general meaning, but they speak about a concrete location such as a parcel or an area in the landscape and about their current or possible use.
To understand some aspects of the landscape perception of the Csángós (e.g. do Csángós use the 'species composition-based' concept of a plant community?), we raised the question of 'what species occur in habitat A?'. People very often listed no or only a few species, though if we asked what places species A prefers, they answered: 'habitat X' (22% of the answers contained no plant names, and only 36% contained more than 2, but maximum of 7 plant names). We presume that they do not have compiled species lists in their mind as botanists do. They know many(!) occurrences of useful plants by their locality and not by habitat types. In contrast to botanists, they do not have an imaginary vegetation map in their mind either. They were born and grown up within a relatively small area (ca. 100 km2), and know the history, the owners and the economic quality of nearly all the parcels, but not their species composition or the naturalness, which is out of importance to them. The landscape is their home and the most important natural resource for them. It is the property of the Csángó people. They know it in a more holistic way, as botanists do.
Though Csángós live a deeply Christian (Catholic) life, and regard everything as given by God and therefore must not be wasted, we did not find such a sacred connection to the landscape as that found among the Koyukon, Cree and Gitksan people. Taboos regulating vegetation use were not identified, either. The collections of the Csángó beliefs and legends (ca. 2000 stories) do not contain such stories, either. One explanation could be the very strict ownership system. In Csángó territories, nearly all square meters of land are privately owned by the members of the same family often 'since time immemorial', so the consequences of over- or improper use are well known (they have many technics to improve the quality of a hay meadows, e.g. by sowing seeds collected in the barn – c.f. maintenance of biodiversity). Only water of rivers and springs, gravel, mushrooms, berries, medicinal herbs, and resin belong to the common property of the community.
We hope that our studies will contribute to the adaptive management of this beautiful landscape, and Csángó people will find their way of living under the new and strange constraints of the European Union. Szabó and Péntek (1976) emphasized that the ethnobotanical knowledge is degrading much faster than natural vegetation itself. It is also our task to protect and maintain this knowledge for the future.

THE PLACE AND THE PAST. THE CARPATHIAN MOUNTAINS IN THE DISCOURSE OF SPACE AND MEMORY OF THE LEMKOS IN POLAND AND UKRAINE

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Keywords: Lemkos, space, past, memory, cultural practice

The presentation will focus on the discourse of social memory and the idea of space of Lemkos – one of the Carpathian ethnic group, living in their indigenous territory of Lower Beskid (Lemkivshchyna), but also in the western Poland and in the western part of Ukraine. Many Lemkos were forced tho leave their fatherland during the Second World War in 1944-1946 and due to the post war circumstances. The last action was conducted in 1947 under the name 'Vistula Operation' (Akcja 'Wisła'). The Lemkos were deported from their historic lands because of their ethnicity. Many of them – especially those, who were resettled in Poland – returned to their abandoned places in the Carpathian Mountains but the majority stayed far away from this territory. I would show the conception of the space of people who had decided to return to Lemkivshchyna and of those who had not returned. I decided to choose the example of Komańcza village.
Staying far away from their ethnic territory, the Lemkos developed many important strategies of remembering the past and the place where they had been born. Mostly they use the general name of the region – 'Carpathian Mountains' – instead of the name of the village or 'Lower Beskid' (these are the non reactive reserach and in-depth-interviews that show it). It is not obvious that they try to visit the place as often as possible. Especially living in Ukraine they have little oportunities to go to Komańcza and it is not rare that they has not been able to come to Poland for over sixty years. Nevertheless, they cannot forget about their place, even if they were born somewhere else. In many cases Lemkivshchyna 'lives' only as an idea.
So how the Carpathian Mountains are still vivid in the Lemkos' memory? Nowadays the anthropologists agree that the discourse of the past and the memory are important forms of cultural practice. As far as the Lemkos are concerned, this phenomenon is composed of the experience of both biographical (individual) and social time and reflects the individual and collective dimension of the memory. Space is one of the most important conceptual frame around which people organize their reality and activity. Not only is the space (and the way it is reflected or presented in language) in Lemkos' culture axiologically and emotionally marked, but also it has been sacralized and included into a value system of ethnic or often

national dimension of their identity. Cultural meaning of Carpathian Mountains determined life choices and decisions of hundreds of people. It also impacts on their personal attitude to the ethnic past.
During my ethnographical field research in the south-eastern part of Poland (on the border of Lower Beskidy and Bieszczady Mountains) and in Ukraine I have been interviewing Lemkos, who share the experience of historical events but often they have extremally different interpretations of the time of 1940s. at their disposal. The attempts to regain the space and the past, which now has been only the visualization in their minds, are also culturally and socially conditioned and depend on the extent of the asymilation as well. Remembering that the condition of Lemkos in Poland is the condition of ethnic minority that determines life patterns, it is worth noting that in Ukraine the Lemkos are treated as an etnographical group, one of the tree main groups of Ukrainian Carpathian mountainers.
Using the perspective of the anthropological approach, I would try to show and to point out the variety of meaning the Lemkos apply that are focused on the retrieving the space and the past of Lemkivshchyna, such as ethnic documentary literature, folk festivals, religious ceremonies, journeys to the place of origin etc. In the same time, I plan to present culturally formed abilities of building, shaping and modyfing the relationship to space as well as the social memory issue as an important mental mechanism of the attempt of protection of Lemkos' cultural heritage.

POSTER PRESENTATIONS

HABITAT TYPE NAMES USED BY CSÁNGÓ PEOPLE (EASTERN CARPATHIANS)

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Goals
Vegetation science, and landscape planning in Europe surprisingly rarely take advantage of the traditional ecological knowledge of peasants. Without knowing the knowledge, motivation and long-term interest of local people "sustainable" landscape management can not reach its long-term goals, actions will often end up in conflicts.
We studied the characteristics of habitat-related knowledge in an Eastern Carpathian Csángó (tsangow) community (Gyimesközéplok, Lunca de Jos, Romania).
Methods
Local names of plants and habitats used were recorded, by interviewing cca. 50 people. This knowledge was also compared with the scientific botanical knowledge.
Results
A surprisingly high number (at least 131) of habitat types are distinguished (see below). The Csángó habitat classification is roughly as detailed as scientific habitat classifications. 9% of the Csángó habitat names was used very often, 22% often, 34 % less often, and 22 % only rarely. Of the names, 11% survived only as a geographical name. The knowledge on site preferences of wild plant species is also very detailed. Great similarity between traditional and scientific knowledge was found.
Conclusions
Following the North American (indian, inuit etc.) and tropical examples, it would be fundamentally important also in Europe that the still existing traditional ecological knowledge be collected and incorporated in ecology, conservation biology and landscape planning.

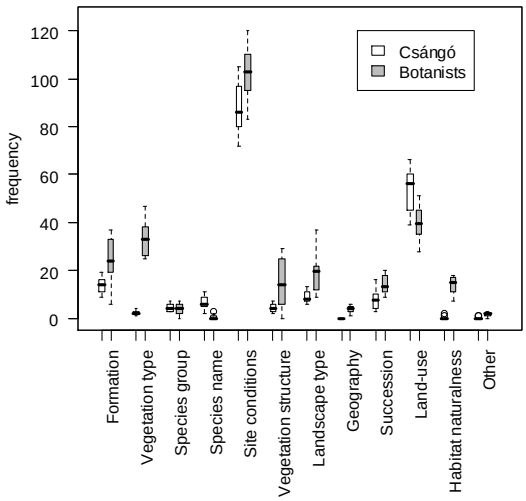

Figure 1. Quantitative comparison of phrases used by botanists and Csángó people to describe habitat preferences of wild plant species

Most important habitat names used by Csángó people

Csángó terms - word-to-word translation / Approximate English equivalent

Woodlands and related habitat types

Erdő - Woodland/ Woodland
Fenyőerdő, fenyveserdő - Spruce woodland /Spruce woodland
Bükkös, bükkfás, bikkfás, bükkerdő, bükkfaerdő - Beech woodland /Beech woodland
Leveles erdő - Woodland with leaves /Broad-leaved woodland
Vad hely - Wild place /Where vegetation is not controlled by humans
Aszalás - Desiccated /An area where spruce tress were ring-barked
Irtás - Clearing /Cleared area, often turned into a grassland
Perzselés - Singeing /A singed area, usually *Nardus* or *Juniperus* is singed
Égés, égetés - Burning /A burnt area, usually woodland
Erdőszél - Forest fringe /Forest fringe
Vágtér - Clear cut area /Clear cut area
Csutakos, csutak - With stumps /A cleared area with stumps
Vész, veszes - Dangerous /Clear cut area (usually with twigs all over)
Mánás, málnás, mánavész, málnavész - Having *Rubus idaeus* /An area with *Rubus idaeus* on clear cuts
Epervész, eper-vágtér - Having *Fragaria* /An area with *Fragaria* on clear cuts
Rakottyás - Having *Salix caprea* /An area with *Salix caprea*
Apróbojtos - Young tassels /Young spruce woodland (height less than 1 m)
Bezseny, bezsenyes erdő - ? /Dense, young spruce woodland
Cseplesz - Something small? /Less dense, a bit older (?) spruce woodland than 'bezseny'
Bokros - Bushy place /An area covered with bushes, often only by one species
Bozót - Thicket, scrub /Bushy area, but more diverse, often also small trees
Bojtos - Tassels /Very sparse spruce stand
Fiatal erdő - Young woodland /Young spruce woodland (cca. 10 year old)
Karós erdő - Staked woodland /Woodland with stake sized trees
Szelhás erdő, szálas erdő - ? /Woodland with straight trees
Kinőtt erdő - Adult woodland /Old woodland (above 70-100 years)
Nagy erdő - Large woodland /Old and large woodland
Gyéres erdő - Sparse woodland /Thinly-grown or partly cleared woodland
Tömör erdő - Dense woodland /Dense woodland
Lúcsos, lúcsfás - Having *Pinus sylvestris* /An area with *Pinus sylvestris*
Tiszás - Having *Taxus* /An area with *Taxus*
Nyírfás, nyírfaerdő, nyires - Having *Betula* /An area with *Betula*
Nyárfás - Having *Populus* /An area with *Populus*
Cserfás, cserés - Having *Alnus* /An area with *Alnus*
Jáhoros - Having *Acer* /An area with *Acer*
Kőrösös - Having *Fraxinus* /An area with *Fraxinus*
Füzes, ficfás - Having *Salix* /An area with *Salix* trees

Borsikás - Having *Juniperus* /An area with *Juniperus*
Magyarós - Having *Corylus* /An area with *Corylus*
Kórusos, kórusfás - Having *Sorbus aucuparia* /An area having *Sorbus aucuparia*
Csigolyás - Having *Salix* /An area with bushy *Salix* species
Fügés - Having *Ribes* /An area with *Ribes*
Kokojzás - Having *Vaccinium* /An area with *Vaccicium*
Menisorás - Having *Vaccinium vitis-idaea* /An area with *Vaccicium vitis-idaea*
Fehérkokojzás, takonykokojzás - Having *Vaccinium uliginosum* /An area with *Vaccicium uliginosum*
Bojzás - Having *Sambucus* /An area with *Sambucus*
Gyüngyemény(es) - Having *Spiraea* /An area with *Spiraea*
Hecsellis - Having *Rosa* /An area with *Rosa*
Grasslands and related habitat types
Mező - ? /Grassland in open, relatively flat landscape
Puszta - Bare /Mountain top without woodlands, often not inhabited, large opening in a woodland
Lik - Hole /A smaller opening in a woodland
Pázsit, pázsint, pást, pástos hely - Lawn /Area covered with grasses, often on a layer of gravel
Kaszáló - Hay meadow /Hay meadow
Bennvaló kaszáló - Inner meadow /Meadow close to settlement, regularly fertilized
Künnvaló kaszáló - Outer meadow /Meadow far from settlements
Hegyi kaszáló - Meadow in the mountains /Meadow in the mountains
Erdőközeli, erdőközötti kaszáló - Meadows close/among woodlands /Meadows close/among woodlands
Imolás kaszáló - Hay meadow with tall grasses /Fertilized hay meadow with the dominance of *Trisetum* and other tall grasses
Vadlóherés (kaszáló) - Hay meadow with wild *Trifolium* /Hay meadow with wild *Trifolium* at higher elevation
Bartacines - Having *Onobrychis* /An area with oversown *Onobrychis*
Zableveles - Having oat-leaved species /An area with grasses like *Brachypodium*, *Dactylis*, *Festuca pratensis*
Kecskekapros, kapros - Having *Laser* /An area with *Laser*
Nyáraló - To spend the summer /Pasture used in summer
Őszölő - To spend the autumn /Meadow where the aftermath is grazed in the autumn
Reglő, legelő - Pasture /Pasture
Csipkés, szamárcsipkés - Having *Carduus*/*Cirsium* /An area with *Carduus*/*Cirsium*
Szőrcsés, szőrfüves - Having *Nardus* /*Nardus* grassland
Zsanikás - Having *Alchemilla* /An area with *Alchemilla*
Ördögbordás - Having *Pteridium* /An area with *Pteridium*
Ászpás - Having *Veratrum* /An area with *Veratrum*
Esztenás hely - Place with a mountain farm /A nutrient rich area around the mountain farms, on the place of sheep pens
Lósósdis - Having *Rumex* /An area with *Rumex*
Bundzsákos - ? /Surface covered with mosses
Mohos, muhos - Having *Sphagnum* /Area covered with *Sphagnum*
Szalamás - Having *Allium ursinum* /An area with *Allium ursinum*
Hagymás - Having *Allium* /An area with *Allium*
Danciás - Having *Gentiana lutea* /An area with *Gentiana lutea*
Csúf hely - Ugly place /Area not mown or grazed, stony or with twigs, or steep, difficult to walk through
Mocskos hely - Dirty place /Area full of rubbish (communal and/or twigs)
Wetlands and other abiotic habitat types
Kő, szikla - Rock, cliff /Rock, cliff
Nagy víz, porond vize - Big water, water of the river banks /Larger creek
Patak - Creek /Smaller creek
Patak mente - Along creeks /Along creeks
Porond - River banks /Young and old river banks with gravel
Leszakadás, süllyedés, szakadék - Fallen down /A loamy slope eroded by a stream
Podbállapis - Having *Tussilago* /An area with *Tussilago*
Forrás - Spring /Spring
Taploca - Warm spring water /Spring and its creek, that never freezes
Sátés, sásos - Having *Carex* /Fens around flushes
Selymék, selymékes hely, selyke hely - A sinking area /Fens around flushes
Surlós, békalábas - Having *Equisetum* /A wet area with *Equisetum*
Keptelános - Having *Petasites* /An area with *Petasites*
Nádas - Having *Phragmites* /Reedbed, a marshy area with *Phragmites*
Other habitat types
Épületek mellett, udvar - Close to houses, in gardens /Close to houses, in gardens
Szántóföld, pityókaföld - Arable field, potato field /Arable field, potato field

Kert mellett - Along a fence /Along a fence
Utak mellett - On road verges /On road verges
Csihányos - Having *Urtica* /An area with *Urtica*

PASTURING IN THE CARPATHIAN-BALKAN SPACE, BASED ON ROMANIAN NAMES

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Keywords: pasturing, Carpathian-Balkan space, Romanian names, shepherd, Thracian-Dacians

Introduction
This paper aims to highlight the spatial distribution of past shepherding on place names and Romanian anthrop names: *baci, shepherd/cioban, shepherd/păcurar, sheepfold, stânar, sheepfold/târlă, fold/strungă, etc*.

Problematic
First is to distinguish, comparatively, the spatial distribution of anthrop names and the place names and words derived from Latin roots in the European area which belonged to the Roman Empire. Are present, as an example, words of Latin origin like *peccorarius* and *vervecarius*/*berbecarius*. Subsequently, the analysis is restricted only to the area that either was and / or living descendants of Romanized Thracian-Dacians or experienced a lexical-occupational influence from them.

Problems
First, note the difficulty of finding a uniform level of cartographic representation of these features in the states considered in studies. In general, we used national administrative units at NUTS level 3, both for the Member States of the European Union, the European Economic Area and candidate countries in EU and for some countries are not in this situation (R. Moldova, where we used the former counties of up to 2005, Bosnia-Herzegovina, Serbia, including Kosovo). In other situations, we used a more detailed level (Montenegro, Albania) or one less detailed (Ukraine, the Republic of Belarus).
Also, one problem was the access to information for family names. Thus, our study related family names collection, for some countries (Republic of Belarus, Bulgaria partially or/and Poland) had to use mostly existing information of subscribers at such firms and/or companies or existing information was accessible only to the capital (Sofia in Bulgaria). Moreover, topographic maps on which we had access were on large scale only at an important part of the Carpatho-Balkan space, so microtoponimy reviewed hasn't the same degree of detail.

Toponyms and related shepherds anthroponyms used by Romanians
First we displayed the spatial distribution of place names and / or results from changes anthroponomical terms of Latin origin related to that activity. Thus it appears that *peccorarius* gave rise to place names in Portugal (derived from *pegureiro*), southern France (from the appellation *pégoulier*), Bosnia-Herzegovina and Romania (forms derived from the *shepherd/păcurar*) and led to several anthroponomical in Spain - *Pegorar*, *Pecoraro*, Italy, southern Switzerland - *Pecoraro*, Hungary, Serbia, Greece, Romania and Moldova. Toponymy in Bosnia-Herzegovina (*Paklarič*) and family names reviewed in Hungary (*Pakular*), Serbia (*Pakurar*), Croatia *(Paklar)* and Greece (*Pakoulieris*) show that the origin lies Romanian version, *shepherd/păcurar*. Note that, in areas inhabited by Macedo-romanians/Aromanians in R. of Macedonia and Greece is used in normal speech and folklore appellation *picurar*, which, at least at this stage of our research is not reflected in the family names and place names. Mention that the form will be derived, and the Daco-Romanian/Macedo-Romanian, Romanian common form of an old, **pecurar*, created and used before the Xth Century (the link between ancestors and those of Daco-Romanian, Aromanians/Macedo-romanians finally broke).
Onomastics derived from *vervecarius/berbecarius* is present, however, only in French-speaking area (France, southern Belgium, Luxembourg, western Switzerland) and in the Romanian or/and Romanian influence. Thus, the French space used place names and anthroponomical appellation derived from *berger*. In the space of Occitan language in southern France noted anthroponomical derived from *bergier* form. However, in the Romanian space we are noted family names derived from *berbecar* and short forms, derived from a *ber(be)car*. This appellation seems to have existed since time later popular Latin, probably in a form **bercariu(s*) from which it derives the Romanian *bercar*, the French *berger* and the Occitan *bergier*. Also stated that, following the Norman conquest, the British space developed as *barker* (derived from the French *berger*), which was very productive in English-speaking anthroponomical.
Very common is the appellation shepherd/baci, whose origin has been evolved several opinions. We believe that this is Dacian, both by his great spatial extension, the onomastics, but above all by the set of derivatives, created in Romanian (the proof than the word length). Thus, we noticed a lot of place names and anthroponomical derived from it, especially present in areas where the Daco-Romanians and better resist assimilation Aromanians from neighboring peoples.
Another term of Dacian origin is *ravine/strungă*, also the Daco-Romanian and the areas within which they lived and/or Balkan Romanians living today. It is noted in all the Carpathian area, in southern Poland to the Southern Carpathians and the Apuseni (being present in hilly areas, for example, in the Moldavian Plateau), but also in the south of the Danube, to Albania and northern Greece. It gave anthroponimical derived words, of which we mention *Strungar* meaning a user of *strungă.*

As a reflection of the Thracian-Dacian romanization element of Balkan-Carpathian area, Thracian appellation, *stână*, evolved to another term, *stânar*, equivalent to *shepherd/baci, shepherd/păcurar, shepherd/cioban,* which preceded it, with professional sense is of Latin origin. Appellation was very productive especially south of the Danube, namely in Slovenia, Croatia, Bosnia-Herzegovina, Montenegro and Serbia. North of the river is less present, noting, that the use was, as a geographical term popular in south-western Romania (a fact attested by the inclusion of the form *stâner* in the Romanian Toponymical Dictionary. Oltenia/Dicționarul Toponimic al României. Oltenia).
Appellation *sheepfold/târlă* is of Slavic origin. It is present in many place names, both in Romania (Carpathian area), Republic of Moldova and Bulgaria, Serbia, Republic of Macedonia and northern Greece.
Of Slavic origin is also *shelter/sălaş*, derived from a *selo*, with a sense of settlement, village, inhabited point. The Romanian language was not very productive, but created a lot of place names, recorded both in Poland and in Hungary, western Romania, Serbia, northwestern Bulgaria and the Republic of Macedonia. Assertions that the term is a Hungarian creation and taken by Romanians from the Hungarians is not justified, because it is very difficult to explain the presence of place names derived from this in Poland, Bulgaria and Republic of Macedonia, where the Hungarian presence was more than isolated, episodic but where they were or/and there are certified large communities of Romanians. The sense of small village with pastoral character, *stână,* for this purpose in winter - which would also have been used in dozens of points of Pannonia - seems to be a Romanian creation. Supported this approach relying on the terms related to grazing poverty of Hungarian terms, and, especially, the great wealth of such terms, used by the Romanians.
And for the so called *shepherd/cioban* were evolved many assumptions about the origin, many experts saying that it is Turkey. Even if the idea is credible, we consider that, it may be a word of cumanic origin. The Romanians had an experience of living together with them, beginning at the turn of the first and second millennium of the Christian era and extends over at least two or three centuries. By assimilating Cuman communities by Romanian element, or precisely because of this process, both terms have entered the Romanian cuman origin (*Bugeac/Bucecea*, *shepherd/cioban*/*ciobar*, etc.) and many names, places and/or the person used by this türcic people. The age and cuman origin of the term in romanian seem to be proved by "takeover" in Romanian, by this appellation, the two Romanian language-specific phonological phenomena: the transformation of the vowel *o* in *u* ("legacy" in latin: see developments *Mons/Montis>munte/mountain*, *frons/frontis>frunte/forehead*, *pons/pontis>punte/deck*, *ponere>punere/release, exhibits/expunere>spunere/says, potere>putere/power dolor>durere/pain, tornar>turnare/fount, Romanus>Rumân/Romanian, sleep/dormire>durmire/slept*, the Toponyms **Mores>Mureş, Donaris>Dunăre/Danube, Salona>Sărună/Thessaloniki* etc.) and the rhotacisation of intervocalic phonem "n" (present in other Romanian words of Latin origin: *măra, bire* - to Istro-Romanians, *gerunche, bură, rărunchi, irimă* – labeled either the Moți, in the Apuseni Mountains and in Maramureş).
The fact that this development *o>u* seen since the late popular Latin is explained by the presence of the same phonetic changes in other peripheric roman areas: in portuguese (eg *peccorarius> pegureiro*, with an evolution of forms identical with Romanian shepherd/dribble *păcurar/picurar*), in western Europe and Occitan (and here is a form *pégoulier*), in French, formerly "edge" north-west of the Roman Empire (that is, from the Latin *tornar*, verb *tourner*, to cast like the romanian *a turna/turnare*), the Sardinians (where we note a *Monte Petrosu* almost identical in shape with numerous peaks of the Carpathians called *Pietrosul*), but also Raeto-Romans (who called *Rumantsch* language, as in the Middle Ages, descendants of Thracian - Daco-Romanian speakers/speaking rumâneşte/romanian).
The three areas are those in which occurred also rhotacism (in Portuguese arise terms such as: *branco, escrava, dor, igreja* - the last being present in the galician and french onomatology retain names like *Le Havre*, derived from german *haven* and *Londres*, resulting in novel celto-roman *Londinium*). Rhotacism occurred in Sardinia, also peripheral area to the Rome, the insular position (where the word *cresia* is derived from the *ecclesia* or *crai*, resulting in *clave*). Linguistic innovations, presented mostly in marginal areas, which will be circulated for a time in parallel with official forms, from "literary" latin is explained by the weakening of central authority in IIIth-Vth centuries, emerged amid internal crisis and repeated attacks outside of the various groups of migrants.
That is around, in the onomatology, on the one hand, family names and place names derived from anthroponomical *ciuban*, and on the other - name of *Ciobar* form. The phenomenon of change *o>u* is still used widely by the Balkan Romanians and the romanian-speaking *băieşi/boiash* in Hungary. Attested isolated these latter forms is the fact that, for the year 1000 in most of the living space at the time of the Romanian rhotacisation not been used, remaining to be used only by the Western Romanians (represented, until today, only Istro-Romanians, moți and the inhabitants of Maramureş). The very name of the cuman people this influence seems iar e neclar to have suffered *a>u*, a **coman* - which has many place names and family names, unchanged to this day (*Comana, Comăna, Comani, Comanca, Comănescu Comanici,* etc.), passing is, in the Romanian *cuman* (less productive in the plan of onomatology, just because it occurred more recently – we have noted, for example, a family name *Cumeneanu*). The name was submitted, then, and neighbors to the west and south, Hungarians calling the Cumans with the appellation *kun*, derived from *cu(ma)n* (this form creating numerous toponyms and family names), while in the Balkans to the Slavs which created the name of city *Kumanovo*.

Conclusions

Based on the above statements, we consider that grazing as an activity with roots in the period of the Thracian-Dacian and of the Romanization of ancestors of Romanians, activity present in other regions of the Roman Empire, left a rich legacy in the Romanian terminology reflected in the onomatology. Also, the area inhabited by descendants of Romanized Thracian-Dacians or influenced by their presence kept many onomastic evidence of the practice of this activity in the Carpathian-Balkanic space.

Thematic session: Urban and Rural Development – Opportunities and Challenges

Chair: Robert Guzik (Jagiellonian University, Poland)

The session addresses present and future challenges and opportunities for urban and rural development in the Carpathian Mountains. It investigates and identifies important cross-cutting factors influencing contemporary and future socio-economic change and development. Thus, it covers themes such as: accessibility, impact of European Union policies, sustainable transport, regional and sub-regional cooperation, quality of living, and business opportunities. Especially valuable would be comparative cross-border studies.

ORAL PRESENTATIONS

SUSTAINABLE CARPATHIAN LANDSCAPES FROM POLICY TO PRACTICE, AND BACK AGAIN: LANDSCAPES AS LABORATORIES FOR KNOWLEDGE PRODUCTION AND LEARNING IN THE CARPATHIAN MOUNTAINS

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Keywords: landscape approach, governance, sustainability, rural development, knowledge production, social learning, education

According to the Carpathian Convention from 2003 the Carpathian Mountains are “a unique natural treasure of great beauty and ecological value, an important reservoir of biodiversity, the headwaters of major rivers, an essential habitat and refuge for many endangered species of plants and animals and Europe's largest area of virgin forests”. In addition the Convention states that “the Carpathians constitute a major ecological, economic, cultural, recreational and living environment in the heart of Europe, shared by numerous peoples and countries”.

Since the appearance of the sustainability discourse during the late 1980s, a range of international and national policies related to ecologically, economically, socially and culturally sustainable use of renewable natural resources have been formulated. Actors and stakeholders involved with management and governance of natural forests and cultural woodlands in rural regions are thus subject to the challenges of implementing sustainability policies on the ground in actual landscapes. Traditional sustained yield forestry and agriculture systems are thus challenged with demands of supplying a broader range of goods, ecosystem services and landscape values than wood, fibres, energy and food.

Implementing these ecological and socio-cultural dimensions of sustainability is consistent with the view that a landscape is an integrated social-ecological system, with components, structures and processes at different scales and different levels of organisation. At the Pan-European policy level the European Landscape Convention captures this. At the same time there is a strong desire to satisfy market demands by increased production of goods, rather than ecosystem services and ecological and socio-cultural values. On top of this there is a need of considering uncertainties relating to climate change and economic globalisation. Dealing with this complexity is a paramount challenge for society in the quest for genuine progress.

With regard to natural forest and cultural woodland landscapes sustainable development as a process and sustainability as a long-term goal have thus started to engage new actors and stakeholders concerning the use of goods, ecosystem services and landscape values, and the identification and development of products from these natural resources. To implement visions of sustainable landscapes it is necessary to continue with efficient wood and food production, and at the same time expand beyond traditional sectors to include also other sectors involved with for example rural development, and conservation of biodiversity and cultural heritage. This implies a need to plan and manage not only at stand and local spatial scales, but also at regional as well as national and even international levels. A key challenge is thus to build bridges in a geographical area among actors involved with different SFM dimensions, actors in different sectors at different societal levels, and different disciplines to facilitate knowledge production and mutual exchange of experiences. Communication, education and public awareness are therefore important to support implementation of SFM, as is the case for its different criteria including ecological, socio-cultural ones and spiritual ones. The term landscape approach captures the need for knowledge production and learning for sustainable development and sustainability.

A paramount challenge is to translate to practice the landscape approach as a tool to implement the principles of SFM via policy level criteria and indicators to management practices in actual landscapes on the one hand, and how innovations that appear locally and regionally can be extracted and affect policy on the other. There are two important challenges that actors and stakeholders at multiple levels (i.e., local, regional, national and global) are faced with. First, there must be transparent information about both states and trends of different sustainability criteria (economic, ecological, social, cultural) based on suites of indicators that make it possible to operationalise the SFM principle within a management unit. To assure sustainability as defined in official and company policies performance targets for indicators often need to be formulated for different forest and societal contexts. Second, tools for adaptive governance and spatial planning

are needed at multiple spatial and temporal scales in a geographical area (e.g., forest management unit, geographical landscape, administrative unit, catchment) with multiple actors and stakeholders representing private, public and the civil sectors of society.
In this paper we focus on how knowledge production and problem-based learning approaches in education and vocational training can be developed using landscapes with different histories in the Carpathian Mountains as natural experiments and laboratories for knowledge production and learning to support communication, education and public awareness. We present the range of issues local challenges stakeholders are faced in the Carpathians Mountains. To implement a landscape approach in practice we summarise the main challenges in terms of knowledge about the state and trends of different sustainability dimensions, and the development of platforms for local and regional governance. Further, responding to the need for applying new approaches to knowledge production and learning, we describe a systematic step-wise integrative research approach in seven steps towards realising the vision of sustainable natural forest and cultural woodland landscape management and governance. The empirical base should be a suite of existing local and regional development initiatives as case studies, or landscape laboratories. Finally, as an example of developing learning, we describe the contents of the ongoing development co-operation about how to translate SFM policies to practice by mutual learning. The discussion focuses on the need to bridge existing gaps between practice, policy, education as well as research in human and natural sciences.

LARGE ENTERPRISES VS. DEVELOPMENT OF RURAL MOUNTAINOUS AREAS: CASE OF CARPATHIAN COMMUNES

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Keywords: Carpathians, large enterprises, rural areas, local development

Impact of large enterprises on local development is an interesting subject matter of numerous spatial analyses. Most frequently, the impact of large enterprises ononto development of municipal centres is analysed. In post-socialist countries, the confinement of such centres on the negative path of dependencies with respect to the dominant economic entity is often indicated. Their mono-functionality and sometimes even mono-production is believed to be an important barrier thwarting development of numerous municipal centres. Operation of large enterprises in rural areas may constitute a stimulus for development of such areas.
In this research, the impact of dominant companies onto local milieu has been analysed in the rural areas of the Polish part of the Carpathian Mountains. Low attractiveness of this region is evidenced by low number of foreign investments – for example in the part of the Carpathians within the Province of Małopolska, no investment above USD 2 million has been located.
The authors make an attempt at evaluating the degree in which the presence of large enterprises in the peripheral area influences economic development of this area. It is interesting to note that majority of such enterprises are companies with several years of history, which were forced to significantly reduce employment in the recent years.
Concerning the methods, 137 non-metropolitan rural communes located in the Polish Carpathians were selected for the analysis. Subsequently, communes where the majority of area lies within an 8 km radius from a city were excluded from analysis. In the group of Carpathian communes, 27 communes were identified where one dominant company operates in the local economy, employing at least 100 persons. A comparative analysis was performed with respect to the indices of local development for communes with a dominant investment and for other rural Carpathian communes. Dynamics and level of development of all communes with respect to entrepreneurship, investments, revenues of local government and local labour market were analysed.
What are the differences between communes with a dominant enterprise and other communes? With respect to the level of development, statistically significant differences were identified only for two variables: the European Union funds obtained by local governments for investments and the number of people commuting to work per 1,000 inhabitants. The communes characterised by the presence of a large enterprise obtained much higher EU funds (PLN 223 in comparison to PLN 113 procured per inhabitant). With respect to procurement of EU funds, the first place is occupied by the Silesian commune of Czernichów, where over PLN 2,500 per inhabitant was acquired. The largest number of people commuting to work in the Carpathian communes (over 100 commuters per 1,000 commune inhabitants) was in the commune of Jeleśnia (production of automotive parts) and Tymbark (production of juices).
With respect to the development dynamics of rural Carpathian communes between 2003 and 2008, one statistically significant difference has been identified (significance level of 0.9). The growth dynamics of local government revenues from personal income tax was slightly lower in communes with a dominant enterprise. This is the reflection of the crisis of large production companies in the analysed communes. On the other hand, the synthetic dynamics growth index was slightly higher in communes with a dominant enterprise (statistically significant difference on a level of 0.9). Therefore, it can be concluded that the communes with dominant enterprises develop slightly better than other peripheral communes. The analysis also referred to the impact of accessibility on development of rural communes. Road accessibility seems to be an important factor influencing local development.

With respect to the value of the synthetic index of growth dynamics (construed on the basis of 10 partial variables), the top five developing communes included two communes with a dominant enterprise (Czernichów and Jeleśnia). The worst with respect to growth dynamics was the commune of Jasienica Rosielna (122 place). Only nine communes with a dominant enterprise are characterised by lower than average values of the synthetic index.
The results of conducted studies in the case of two dominant enterprises provided support for the argument on the important impact of large enterprises on local development. In contrast to the statistical analysis, they allowed for capturing the direct impact of large companies onto local development. These communes, which are characterised by greatest dominance of an enterprise (employment in a dominant entity exceeds employment in the commune 2.5 times), were selected for examination. In case studies, the following forms of impact were analysed: cooperation with local economic entities, value of taxes collected by local governments, shaping of the labour market, commuting to work, activity for the sake of local communities. Furthermore, opinions of inhabitants of selected communes were analysed with respect to the role which they ascribe to a large enterprise regarding local development of their own localities. The conducted field research has shown that in spite of low values of the synthetic index of growth dynamics in these communes, large enterprises located in their areas do not constitute a barrier, but may have a positive impact on local development. Undoubtedly, large enterprises located in rural peripheral areas may become a stimulus for economic growth, provided they stimulate endogenous development by encouraging local entrepreneurship and not by treating their place of localisation solely as a source of inexpensive work force.

SPATIAL ACCESSIBILITY AND URBAN-RURAL PUBLIC TRANSPORTATION LINKAGES IN THE WESTERN CARPATHIANS

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Keywords: spatial accessibility, rural accessibility, spatial equity, public transport, Western Carpathians

In a contemporary globalized, hyper-mobile world one of the most important narrative in discourse on development of rural and peripheral areas is their accessibility. An adequate access to spatially and temporally dispersed resources and opportunities is an important issue undermining people's life chances (especially access to education and to health care) as well as a prospect for an economic growth and prosperity of regions and localities. More and more often the idea of accessibility become part of political agenda settled in the social justice and social inclusion rhetoric. It is because accessibility counts more for those underprivileged in terms of car enhanced mobility – namely poor, school age children, elderly, disabled etc. In the mountains areas other group which may depend on public transportation accessibility are tourists, especially if a greater sustainability with promotion of public transportation (instead of private cars) is highlighted as a goal.
The aim of this study is to examine variations in spatial accessibility of rural mountain areas to service towns (both lower and middle level in settlement hierarchy) with use of the public transportation. Indices of accessibility in terms of time (time distance derived from timetables of public transportation operators), opportunity and convenience (scheduled frequency of bus/train services) are calculated for each village within 25 provinces (NUTS 4) of Western Carpathians. The choice of the studied provinces takes into account representation of different types of mountain environment, peripherality, population density, economic functions, GDP level and state belonging (Poland, Czech Republic, Slovakia) as a contributory factors accounting for accessibility. Although accessibility is calculated for single villages it has to also be interpreted in terms of urban-rural linkages determining development prospect of the whole region – much better in areas with strong and dense linkages. It is because better accessibility strongly influences to human and market potential of the studied area. This relation is an example of the cumulative causation model because better market potential and economic development in turn enhances better accessibility. An additional purpose of this study is to evaluate effects of deregulation of public transportation and differences between studied post-socialist countries.

USING FUA TO MANAGE ECONOMIC GROWTH

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Keywords: FUA, LAU 2, economic disparities, urban growth

By its recent suburbanization and accelerated economic convergence, despite the actual economic crisis, Romania is rapidly recovering the lack of urban modernity, separating this country from other members of the European Union. Used to a context of constant economic growth, Romania was either not inspired to check how this economic welfare is distributed within the territory. This aspect was an unfortunate opportunity to let the door opened for the inquiring installation of development disparities. When these discontinuities intersect structural and heritage territorial gradients (West –East

opposition, core-periphery in the proximity of the growth engines and the rigid hierarchical one), the negative effects on the inner spatial cohesion are multiplied.

The main engines of economic growth in Romania are some "favored" cities (their luck being induced by a good position in report with the mentioned gradients), even if the concept of city in this country might not be so appropriate in order to correct the inequalities and properly pilot the "age" of welfare. Much more flexible, a concept such as FUA (Functional Urban Area according to ESPON) could be, in the special case of Romania, an useful tool of territorial therapeutics. However, the Romanian FUA is nothing more but a single and ordinary LAU 2 unit (Local Administrative Unit), mostly overlapping the core area of the urban (functional) agglomerations. This should not surprise, when thinking that the lack of paradigmatic convergence in the field of territorial planning, concerning the Romanian stakeholders, is not easy to dislocate. One of the direct consequences of this situation is the fact that the Romanian FUA is frequently declassed in the European top of FUA (Fig. 1).

Reconsidering these spatial limits is not only a matter of national *esteem*, but also an unexplored scientific challenge, in Romania. Why an abrupt and ancient (from 1968) limit of LAU 2 units should be considered a FUA demarcation, especially when we take into account all the stakes concerning the territorial cohesion. In this paper, we shall reconsider this issue of spatial discontinuity, trying to push it a little bit further on the map, contextualized by some actual dynamics of the urban territory.

Redefining the limits involves a double set of demarcation criteria. The first one consists in the mobilization of the morphological analysis of the potential FUA. The second one focus on the functional coherence at local scale and by coherence we mean mapping the degree of economic and demographic homogeneity in the proximity of these LAU 2 FUA. Coping with the morphological issue is the direct lane towards the problem of the built up space in the neighborhood of the core areas of the urban agglomerations. Using a grid system in order to collect the information on the morphological urban tissue seems to be the right solution when taking into account the huge number of polygons to be analyzed (more than 14 000 built-up areas, according to CLC 2000 and recent satellite images). Filtering this information forces us also to use the road network density as an indicator for the eventual delimitation of FUA.

Urban areas being already morphologically delimited at the first step, we need to attach the functional dimension to the potential urban forms. Indicators such as the number of businesses, the number of employed personnel, the local turnover, the density of population and the migratory ratio, should provide us the main characteristics of potential FUA, when filtered by the distance decay, the concept of discontinuity and the local autocorrelation of these indicators. The option for this set of variables was made taking into account their chronological harmonization for the period of our study (1990 – 2008) and their ability to emphasize how the economic growth diffuses in the territory.

Crossing these two kinds of analysis might offer new limits of FUA, maybe not the ideal one, but certainly more efficient than the actual LAU 2 FUA demarcation. We also consider that the proposed methodology (the morphological and the functional one) could be an alternative to the tools actually used by the planning authorities in Romania, when dealing with issues such as mapping metropolitan areas or highlighting of the intermediate spaces.

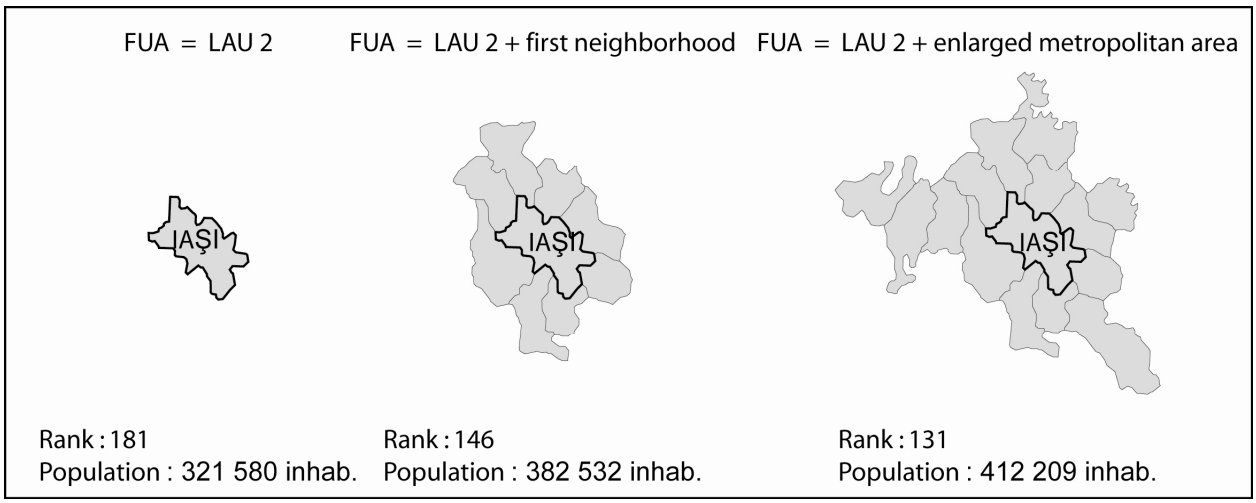

Figure 1. Enlarging Romanian FUA – the case of Iasi (the rank indicates the relative position in the ESPON hierarchy, according to different spatial limits)

EVOLUTION OF CITIES IN THE POLISH CARPATHIANS OVER TURN OF 20TH AND 21ST CENTURIES

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Keywords: Carpathian towns, functional classification of cities, internal structure

The aim of authors' investigation was to identify processes shaping urban network of the Polish Carpathians, basic factors and relations included, and to show regularities, especially the spatial ones (an attempt to regionalization of the discussed network).
Carpathians are less urbanized region of Poland – 66 cities have some 1 million inhabitants, while in rural settlements live 1,5 mln, thus the urbanization index amounts 40% (in Poland 61%). Most of those cities (60%) has obtained urban charts 500 years ago, but there are 6 ones, to which this status was given after 1990. The oldest cities have interesting historic cores.
The greatest urban centre of the Polish Carpathians is Bielsko-Biała (176 th. inhabitants), the second greatest – that of Nowy Sącz (85 th.), while 3 smallest towns have below 2000 inhabitants each.
Since 1990 a demographical growth of Carpathian cities has become weaker than before. But only some 15 (of 66) have lesser population than 20 years ago. A growth rate depended on functional structure and a site of particular cities. Those lying close to the greater urban centers, like Cracow and Rzeszów, continued their demographical growth, the same refers to polyfunctional tertiary centers, especially those of tourism, although spas showed a considerably crisis. The industrial centers have less inhabitants – even quite great cities, i.e. Bielsko-Biała. In 1999 the reform of administrative division of Poland was introduced – and influenced the situation of 3 cities, which lost their position as voivodeship (province) centres, while 20 regained their functions as poviat (district) centres.
As regards the functions, analyzed by the authors as a relation between the employees number in industrial and tertiary sectors, and by the branch structure of the private economic entities – a significance of industry as the development factor does not matter much for Carpathian cities. In the basic centers (Bielsko-Biała, Gorlice, Krosno, Nowy Targ) some industrial plants were closed, others, due to privatization (also by foreign owners) have reduced the employment. But some small centres of traditional craft, specialized in a given production, are in better situation, like Sułkowice (metal industry) and Kalwaria Zebrzydowska (furniture production). The most effective branches of tertiary sector are: retail and wholesale trade, transport, and tourism. For 7 cities the new function is university education. Liberalization in cross border traffic and new contacts with neighboring States are important for cities lying close to borders with the Czech Republic (Cieszyn), Slovakia (Krosno, Nowy Targ) and Ukraina (Ustrzyki Dolne).
The transition of Poland from the managed economy to the market one after 1990 changed also physiognomy of the discussed cities, mostly of their central parts. The tertiary function of those areas has grown, while the residential one was reduced, among old buildings new structures have appeared. Conditions of traffic were improved, roads leading to them also; an underdevelopment of the transport infrastructure (especially that of railway) is a considerable barrier to economic growth of the whole region and its cities.
The above listed changes are observed mainly in the western part of the Polish Carpathians, while eastward of the Nowy Sącz – Tarnów line the progress is weaker, the cities are less numerous and their economic and social evolution less intensive. But in the whole discussed area, due to favorable natural conditions and the considerable demographical potential, opportunities of the further development of the urban network are considerable.

POSTER PRESENTATIONS

GLOBAL CHALLENGES AND STRATEGIC RESPONSES IN URBAN DEVELOPMENT: THE CASE OF THE HUNGARIAN REGIONAL CENTRES

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Keywords: competitiveness, regional centres, urban development strategies, growth poles in Hungary

European spatial development is again focusing on cities since spatial processes are constantly becoming more concentrated on this territorial unit. The character of cities and the nature of their function determine the development of their broader areas, and they both generate and display competitiveness. The structure of the hierarchical relations breaks down. On the one hand there is a growing concentration around the great urban areas, while on the other hand the division of labour between cities changes. According to the influence of the globalisation, international spaces break down and are followed by the formation of cross-continental functions, therefore the competition is intensifying at all levels of the system, especially at the ones concentrating wider range of functions; networks become more important in spatial

development than individual multifunctional centres. In the network connections the former hierarchical structures disappear, the fragmentation of functions is not determinant any more instead the abilities increasing competitiveness are coming to the front. This change can be well followed through in the focus of the Hungarian scientific literature in according to spatial development of recent years.
The main goal of urban development is to improve the living standards of the residents, which makes the policy-makers to choose between competitiveness and cohesion carefully. According to the new, so called 'soft' factors of success these dimensions became tightly related as ever. The significance of the knowledge-based and service sector, the range of business services (information economy, production services, R+D sector) became drivers of development. The new growth factors and resources redrew the competitiveness map of cities, which means that in cities that were lagging behind according to the traditional factors (e.g. location and infrastructure) with a 'good' strategic plan policy-makers can help to restructure the economy and create a business friendly environment and a good to live in city
The emerging entrepreneurial urban policy is one where the primary concern is with long-term efficiency, where the creation and enhancement of localised positive externalities becomes a centre goal of urban policy. Cities compete increasingly across national borders and comparative advantage is no longer based upon resources or cheap or productive labour, but on innovative capacity. The cities will become the major actors in the new global economy. This in turn implies that the main concerns of urban economic policy have become transformed and include:
enhancement of innovation and creativity,
improvement of the quality of human capital,
promotion of entrepreneurial vitality,
promotion of networks (networks involve positive externalities),
enhancement of amenity value and housing in the cities to attract a high-income and creative labour force,
creation of synergies,
risk bearing.
The function of strategic planning is not only to prepare for the future but is a proactive and systematic method of forming and changing it. Its final result is an integrated approach, which summarize the most important issues according to the cities development, and the method of planning becomes based more and more on participation.
In Hungary the key factors of success is examined from the economic point of view of competitiveness. The focus is increasingly on the greater cities because – besides the fact that Budapest has a prominent and undeniable role in the spatial structure of Hungary – they determine the development of their regions. The role of government is undoubtedly shifting from direct provision to an enabling one. The individual city's government and private sector entities can do a great deal to enhance the city's competitiveness and to enable it in order to achieve the most desirable economic future possibilities. The main scope of action by urban policy-makers is in enhancing the business environment, fostering innovation, and learning and assuring social cohesion.
Our cities are facing global challenges, while they are in competition both in nationally and internationally to attract investments and residents. They can match these challenges only with consequent strategic programs, which have to offer solution for the global economic challenges and social conflicts of the 21st century. The main goal of my presentation is to introduce the global challenges the Hungarian 'pole-towns' are facing and the strategies along which they hold on to the competition and become real regional centres.

PARTICULARITIES REGARDING THE POPULATION OF THE CARPATHIAN MOUNTAINS

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Keywords: mountain areas, the geodemographic particularities, Carpathian mountain space

It is a known fact that the mountain areas are generally not so populated due to the more difficult living conditions and to the reduced level of access reach. The current study aims at analyzing the process of population given the circumstances offered by the Carpathian mountain space.
The level of population of this mountain area has undergone an evaluation procedure, based on the evolution of the number of inhabitants, by taking into account not only the role and the importance of natural factors, but also the socio-historical, economic and demographic ones, which have determined, in time, the dynamics of this process.
The correlation analysis confirms, on one hand, the existence of a significantly statistical association between the density of population and the degree of fragmentation of the relief, and on the other hand, between the rhythm of demographic growth and economic one.
Generally, the demographic statistical indicators correlate with the cartographic indicators, without the reciprocal explained alternative to be very high. The geodemographic particularities refelect both in the numerical evolution of the population, as well as in respect to its spread, resulting in areas and nucleas of concentration and dispersion of the inhabitants.

Thematic session: Water Resources and Management, Fluvial Processes and Interactions with Biotic Processes

Chairs:
Joanna Pociask-Karteczka (Jagiellonian University, Poland),
Artur Radecki-Pawlik (University of Agriculture in Kraków, Poland),
Bartłomiej Wyżga (Polish Academy of Sciences, Poland)

The session focuses on hydrological responses to recent and future climate, land-use and channel changes, channel adjustments to catchment environmental changes and human in-channel modifications, and implications of hydromorphological processes for aquatic and riparian ecosystems. The objective is to provide the scientific background for a river and basin management policy, which will increase the availability and quality of water resources and enable sustainable use of Carpathian waters with the simultaneous improvement of integrity of aquatic and water-related ecosystems. The presentations in the field of catchment-wide and cross-boundary water management, interactions between surface and ground waters as well as between hydrological, geomorphic and biotic processes, and the role of hydrological research in representative and experimental basins are especially

ORAL PRESENTATIONS

EVIRONMENTAL ROLE OF LARGE WOOD IN CENTRAL EUROPEAN MOUNTAIN STREAMS AND RIVERS WITH VARYING DEGREE OF HUMAN IMPACT

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Keywords: mountain watercourses, large wood, human impact, river ecosystem, Central Europe

Since the Neolithic, the growing impacts on catchments and stream channels significantly altered the functioning of watercourses in the mountainous parts of Europe. One of the most changed was the supply of fallen trees to the channels and their interaction with physical and biotic processes in the watercourses. Removal of trees from channels and limited wood recruitment from deforested riparian areas resulted in nearly total disappearance of large wood from mountain rivers in Europe, thus changing the nature of fluvial processes and the earlier perception of wood as natural element of streams and rivers within the temperate zone.

Studies on the environmental role of woody debris in watercourses commenced a few decades ago in the western part of North America, where significant impacts to the fluvial environment occurred relatively late and where large wood is still present in the watercourses. In Europe, such studies have been initiated in the 1990s following the afforestation of the montane catchments and valley bottoms and increasing supply of wood to watercourses.

The paper presents results of research on the impact of woody debris on fluvial processes and on the functioning of river and riparian ecosystems, which were conducted in seven watercourses of various size in mountain areas of Central Europe. One part of the study was performed in five streams with varying catchment and riparian zone management: Oder (Harz), Finzbach (Bavarian Alps), Seebach (Bavarian Forest), Kamienica (Beskidy Mountains) and Waksmundzki (Tatra Mountains). Another part encompassed two rivers in the Tatra foreland: Czarny Dunajec and Białka. The study aimed (i) to determine natural and anthropogenic controls on the amount and pattern of large wood occurrence in mountain watercourses, and (ii) to assess the environmental role of woody debris in Central European mountain watercourses.

In streams narrower than the height of trees growing on their banks, quantities of large wood stored on unit channel length exhibit no relation with channel width. Management of riparian woodland and stream channels, including channel cleaning practices, reduces the amounts and size of wood recruited to and stored in channels and lessens its environmental role. The catchments and channels of the five studied streams represented a clear trend of the increasing time of relaxation from human disturbance, with four of them having been taken under protection in national parks for different time (Waksmundzki since 1954, Kamienica and Seebach since 1980 and Oder since 1994) and the catchment of Finzbach Stream being still extensively managed. Currently in Waksmundzki and Kamienica Streams, the delivery of fallen trees and their interactions with fluvial processes are not modified by man, whereas in the case of Oder, larger trees are still harvested in the riparian zone and wood is periodically removed from the channel.

The mentioned differences in the degree of human impact and the relaxation time from disturbance were clearly reflected in the amounts of stored wood. In Waksmundzki and Kamienica Streams, the average number of wood pieces stored on 1 km of channel length exceeded that recorded in Oder by an order of magnitude, whereas the average mass of large wood stored on unit channel length was a few times greater.

With considerable size of wood pieces in relation to channel size, large wood may significantly influence physical processes

operating in mountain streams. Fallen trees and their larger fragments dam the channels and trap bed material on the upstream side of the dams. This leads to the formation of a stepped longitudinal channel profile and helps maintain alluvial channel beds in the high-energy mountain environment. The occurrence of wood dams enables efficient dissipation of flow energy due to the high turbulence of water in plunge pools that form below the dams. Large wood has also a considerable impact on the ecosystems of mountain streams. Increased variability of water depth and flow velocity in the channels with large wood creates varied habitat conditions beneficial for a greater variety of organisms and for their different life stages. Pools associated with wood dams provide flow refugia for fish during low water stages. Finally, in the oligotrophic environment of mountain streams, wood is used as food by many groups of aquatic microorganisms and helps trap fine organic matter in channels.

The above outlined environmental effects of large wood apparently depend on its abundance in channels. This can be illustrated by an average number of channel forms associated with large wood per 1 km of stream length. In Waksmundzki Stream with the longest time of relaxation from human disturbance, it was greater by two orders of magnitude than in Oder which is still subject to riparian woodland management and channel cleaning.

The study performed in the Czarny Dunajec indicated that in a mountain river wider than the height of trees growing on its banks, large wood is preferentially retained in wider channel sections. In the widest sections of this river, the quantities of wood stored on unit channel length exceeded those recorded in the narrow sections by two orders of magnitude. The increase in wood quantities with increasing river width was substantially greater from that, which could be simply explained by the enlargement of the channel area. While the differentiation of a mountain river into narrow and wide sections may be conditioned by geological controls, in contemporary Polish Carpathian rivers it mainly reflects the alternation of channelized and unmanaged channel sections. In channelized sections, bank reinforcement prevents the erosion of riparian forest, whereas the concentration of flood flows in the narrow and deep channel facilitates transport of wood pieces delivered from upstream. In wide, unmanaged sections, free migration of the active channel(s) across the riparian woodland enables efficient recruitment of woody debris, whereas low unit stream power and the abundance of retention features, such as bars and vegetated islands, facilitate deposition of transported wood.

The study in the Czarny Dunajec revealed also marked differences in the environmental role of large wood between the narrow, channelized river sections and the wide, multi-thread, unmanaged sections. In the former, scarce wood pieces were deposited outside the low-flow channel and exerted little influence on the river functioning. In the wide sections, large wood was retained in a variety of depositional sites, considerably contributing to the diversity of physical and biotic processes in the river. Its impacts comprised providing habitat structures for aquatic biota in low-flow channels, increasing channel sinuosity, dividing thalweg to initiate the formation of mid-channel bars, damming narrow, side channels and inducing the development of pioneer islands from sprouting pieces of willow driftwood.

Common harvest of larger trees in the riparian woodland and the removal of larger fallen trees from channels result in relatively small size of wood pieces occurring in European mountain rivers. The resultant high mobility of wood debris has implications for the island development in these rivers. Investigations in the Czarny Dunajec and Białka Rivers indicated that vegetative regeneration of living willow driftwood plays a crucial role in island development and that deposition of wood jams on the island head during successive flood events results in predominating growth of the islands in the upstream direction. This style of island development differs from that described from rivers in North America, in which large, immobile trees fallen to the channels stimulate progressive deposition of bed material and encroachment of vegetation in the downstream direc

STUDYING RELATIONS BETWEEN SPRING WATER CHEMISTRY AND VEGETATION COVER FOR IMPROVED MANAGEMENT OF SPRING NEIGHBOURHOOD IN SILESIAN BESKID MOUNTAINS

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Keywords: spring waters, spruce, water chemistry, Silesian Beskid Mts.

Chemical characteristics of mountain spring waters is very interesting due to its complexity. Contrary to springs situated in lowlands, mountain springs are often supplied only by precipitation. The way which water passed from the atmosphere to the spring decides about spring chemistry. Although the literature dealing with mountain springs becomes increasingly richer, the influence of plant cover seems to be underestimated or even not considered at all. The studies performed to date have focused only on precipitation and bedrock factors. Apparently, these two factors are the most important, however, we hardly have influence on them. Chemical composition of precipitation can change due to air contamination, which demands actions on at least state level. There is no possibility to change bedrock. On the other hand, we have a strong ability to form a chosen type of plant cover in the nearest spring neighborhood. Plant cover seems to be important means which can modify spring water chemistry. This paper presents an attempt to determine interactions between water circulation and biotic processes.

The study concerns springs located on the slopes of Skrzyczne and Barania Góra in the Silesian Beskid Mountains. These mountain massifs are underlain by the Istebna sandstones, with podzols being a predominant soil type developed on this

lithology. Some of forest sites in the area are under the negative influence of spruce monoculture introduced in the 19th century. Currently spruce stands, as in the entire Silesian Beskid Mountains, are subject to dieback. If an influence of forest stand on spring water chemistry is confirmed, it will be reasonable to use this knowledge during restocking the areas subject to forest dieback so as to improve water chemistry.

The investigated springs on the Skrzyczne Mountain are located in headwater areas of Żylica, Zimnik and Kalna Streams. All these streams are tributaries to the Soła River. In turn, the investigated springs on the Barania Góra Mountain are located in the catchments of Głębczański and Roztoczny Streams. These two streams flow into Biała Wisełka which further joins Czarna Wisełka to form the Vistula River.

Table 1. Quality classification of the water from springs on Skrzyczne and Barania Góra according to the Polish standard from 2008

	Skrzyczne				Barania Góra			
Class	1	2	3		1	2	3	
Snowmelt								
Number of samples	9	7	32		6	12	39	
Indicators of degraded water quality		NO_3^-	27 samples	NO_3^-		NO_3^-	18 samples	NO_3^-
			2 samples	NO_3^-, pH			13 samples	NO_3^-, pH
			2 samples	pH			8 samples	pH
			additionally:				additionally:	
			2 samples	NO_3^- in Class 2			3 samples	NO_3^- in Class 2
Dry period								
Number of samples	17	22	52		11	15	29	
Indicators of degraded water quality		NO_3^-	41 samples	NO_3^-		NO_3^-	9 samples	NO_3^-
			4 samples	NO_3^-, pH			2 samples	NO_3^-, pH
			7 samples	pH			18 samples	pH
			additionally:				additionally:	
			3	NO_3^- in Class 2			3 samples	NO_3^- in Class 2
Intensive rainfall								
Number of samples	17	29	45		10	13	15	
Indicators of degraded water quality		NO_3^-	36 samples	NO_3^-		NO_3^-	7 samples	NO_3^-
			3 samples	NO_3^-, pH			1 sample	NO_3^-, pH
			6 samples	pH			7 samples	pH
			additionally:				additionally:	
			1 samples	NO_3^- in Class 2			4 samples	NO_3^- in Class 2

Samples were collected three times: during snowmelt, dry period and intensive rainfall in 2009. Field works included water temperature measurement, spring type classification, determination of the spring position by GPS, plant cover description and photographic documentation. In a laboratory, the following properties were determined: conductivity, pH; Na^+, K^+, Ca^{2+}, Mg^{2+}, Cl^-, NO_3^-, SO_4^{2-} concentrations as well as Al, Fe, Mn, Zn ion concentrations. The data set was analyzed and classified according to the Polish standard for water quality (Dz. U. Nr 162 poz. 1008 - from 2008.).

Water quality depended strongly on the chemical composition of melting snow, bedrock and soil type, precipitation and vegetation. It was found that water from most sampling points in springs was unsuitable for drinking. During snowmelt 39 out of 48 samples collected on Skrzyczne and 51 out of 57 samples collected on Barania Góra were beyond Class 1 of water quality. In the dry period, 74 out of 91 samples taken on Skrzyczne and 44 out of 55 samples taken on Barania Góra fell beyond Class 1 of water quality After intensive rainfall 74 out of 91 samples collected on Skrzyczne and 28 out of 38 samples collected on Barania Góra were beyond the first class. The main reason for that was too low pH and high NO_3^- concentration (Tab. 1).

The high nitrate concentrations are connected with the acidification of snow cover. It is indicated by a lack of dependence of the concentrations on any of the investigated features, including altitude and plant cover. This phenomenon is similarly explained by other authors (Małek and Gawęda 2006, Humnicki 2007). Additionally, at the beginning of a vegetation period,

we can notice intensive leaching of nitrates from the catchment, which later decreases when these ions are assimilated by plants (Astel et al. 2008).
These authors determined higher concentrations of nitrates in surface water samples during the spring thawing and increasing concentrations of magnesium and calcium in autumn. Leached at the beginning and end of a vegetation period are not only those anions and cations but also Cl^-, Na^+, K^+ and NH_4^+, which is an evidence of the effect of Norway spruce monoculture. On the contrary, in the middle of a vegetation period, the leaching of NO_3^- Mg^{2+}, K^+, and NH_4^+ can be limited due to an increasing demand for the ions related to the photosynthesis activity of the forest ecosystems (Małek and Astel 2008, Astel et al. 2008, Małek and Krakowian 2009a, b).
The chemical composition of spring water depended also on the type of plant cover and on local properties of the drainage areas. A statistically significant difference was found between water from the springs located in spruce and beech mixed stands. Springs located in beech stands were characterised by higher concentrations of: Ca^{2+}, Mg^{2+}, K^+, Na^+, SO_4^{2-}, Cl^- and higher PEW, and those located on Barania Góra also by higher pH, especially during intensive rainfall.
During intensive rainfall in the vegetation season, beech and multispecies forest stands exhibited higher washing out of cations than spruce stands, which changed water pH and spring water chemistry and in consequence improved water quality. This phenomenon should be considered while afforesting spring neighborhoods where water is or will be used as a source of drinking water.

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CHANGES IN FISH FAUNA CAUSED BY THE RIVER FRAGMENTATION BY TRANSVERSAL HYDROTECHNICAL STRUCTURES: CASE STUDY OF THE SAN RIVER, EASTERN CARPATHIANS

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Keywords: San River, river fragmentation, ichthyofauna

The San is the largest Polish Carpathian river known from its unique character and great ecological value. Unfortunately, its course is fragmented by three transversal hydrotechnical appliances located at Zasław, Myczkowce and Solina. Electrofishing investigations were carried out at the San River along about 100 km of its course, from headwaters (Tarnawa Niżna) to Międzybrodzie village. The goal of the project was to determine fish species composition, quantity and biomass. There were 16 sampling sites located in different parts of the river. Nine sites were located upstream of the Solina–Myczkowce dam system (aprox. 60 km long reach), four sites between the Myczkowce dam and a weir at Zasław village (aprox. 28 km) and three between the weir at Zasław and Międzybrodzie village (aprox. 13 km). Obtained data show drastic differences in the number of species and composition of fish fauna caused by the three above mentioned transversal structures and by functioning of the Solina-Myczkowce power plant. The ichthyofauna of the San, from the river source down to the Solina dam lake, consists of 15 species typical of barbell zone, with absolute dominance of reophilic cyprinids (spotted barbell, chub, nase, and minnow). Their proportion in the fish abundance and biomass was 78,8% and 90,6%, respectively, while that of salmonids was only 3,0% and 5,6%, respectively. The proportions are totally different just below the Solina-Myczkowce dam reservoirs where only 6 fish species were found, with absolute dominance of salmonids (brown trout and grayling). Their share in the abundance and biomass of fish was 57,6% and 96,0%, respectively, versus 5,0% and 0,8% share of cyprinids. This situation is caused mainly by changes in the thermal regime of the river and the disappearance of gravel from the river bed downstream of the dam. The more tributaries and the longer the distance from the dam, the higher the number of species in the river was found. The composition of fish fauna returned slowly to the original one (recorded upstream of the dam). However, the number of fish species remains low (from 7 to 12) to the weir at Zasław (28 km downstream of the Solina dam lake). The highest number of species in the San (20) was found downstream of the weir at Zasław (1,5 m high) that prevents fish migration and is the limit of distribution area of several species such as barbell and nase. In this river reach, about 30 km downstream of the Solina-Myczkowce dam reservoirs, the composition

of the ichthyofauna returns back to the state observed in the river upstream of the reservoirs. At sites located downstream of the weir at Zasław, cyprinid reophilic fishes represent again more than 90% of the abundance and biomass of fish fauna. The results show the strong, negative effect of the dam lake, hydropower plant and the weirs on the state of ichthyofauna in the San River. At the moment there is no possibility to open the migratory corridor through the Solina-Myczkowce dam system that would lead to the upper San, Solinka and Wetlina Rivers. However, because the weir at Zasław ceased to function as a water intake facility, there is a great chance and the necessity to make this weir passable for fish. The simplest and most effective solution would be its demolition. This would open at least 30 km of the river course and hundreds of tributaries for fish migration, hence improving fish diversity and the ecological status of the San River.

SPATIAL AND TEMPORAL CHARACTERISTICS OF SOME KARSTIC LAKES AND THEIR ENVIRONMENT IN AGGTELEK AND SLOVAK KARST

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Keywords: lake, karst, water quality, eutrophication

Introduction

Three karst systems of the Aggtelek and Slovak karst were selected to present the nutrient transport from the catchment areas affecting the shallow karstic lakes.

Eutrophication of surface waters became evident in the mid-20th century. The nutrient input caused by human activities has led to a decline in water quality, which was indicated first by a loss of some functions of these water bodies, and ultimately by a complete elimination of their role in the ecosystem. These types of studies are important in karstic areas, because water has a crucial role in forming the karst system and the high permeability of rocks results in high infiltration rates, which influence quality of subsurface waters as well as flora and fauna of the caves. Karstic depressions accumulate pollution from anthropogenic land use and mediate it to deeper regions. Shallow lakes are especially endangered because the decline in water quality can be followed by their complete infilling. On the dry karst plateaus this means a substantial loss of resources for human use (e.g. fishery or tourism) and the decline of biodiversity because the habitat and reproduction of numerous species (many among them are protected) is bound to wetlands.

Lake Farárova jama is situated on the Silická Planina Plateau in the Slovak karst and it is in connection with the Silická L'adnica ice cave and the Gombasecké cave system through the Čierna spring. This spring also collects water from the Jašteričie wells. Lake Farárova jama originated in the 1970s, in place of a former garden. It is enclosed from the north with a road and a rural settlement, from the east and west with arable land, from the south with forest and from the NW side by village Silica. From the direction of the rural settlement there is a point source pollution inflow to the lake.

Lake Vörös is situated in the Aggtelek karst SW from village Jósvafő located in a doline, the surface of which was covered with red clay. In the case of Lake Vörös, the main problem was also the water supply, coming only from precipitation. The road constructed in its vicinity diverted a large amount of water inflow and the water level decreased. According to Huber (2006), many of the examined protected species (e.g. *Coenagrion scitulum* and *Coenagrion vernale*) became extinct during that time. In 2001 dredging was carried out in LakeVörös . The state of this lake has been stabilized, since the National Park authority built a water-diversion system from the road (with an oil-filter included). After that the water level started to increase and now it is usually around 1.5–2 m.

Lake Tengerszem was created artificially above the village Jósvafő in 1942 with the damming of the Jósva spring coming from the Baradla to provide power supply for the cave (Juhász – Salamon 2006). The lake has water supply from the Jósva spring and has an outflow; the water flows further to village Jósvafő.

We started to monitor water quality of several lakes monthly and their sediments yearly in March 2008. Temporal and spatial distribution of 3 years data on water quality is analysed . We search for similarities and dissimilarities in the state of the lakes with grouping methods. We also compare our data with the results of previous measurements and analyse the effect of drought and high precipitation events on the quality and quantity of water with a chosen drought index, the Standard Precipitation Index (SPI).

Results and discussion

Previous research showed the anthropogenic effect on the karstic lakes and on the caves which are in connection with them. The most affected are Lake Farárova jama and Lake Tengerszem. All of these reflect the human presence in a different way: for Lake Farárova jama the inflow from the rural settlement leads to water quality deterioration and Lake Tengerszem is mostly threatened by pollutants brought by the Jósva spring. However, Lake Tengerszem has a significant advantage: the continuous water supply helps to process the pollutants, so the lake better tolerates the influence of the nutrients and extreme meteorological events. Lake Vörös has a relatively natural environment but the amount and quality of the water are more affected by the lack of precipitation. Geological situation also plays an important role in defining the chemical features: it conditions water hardness and the ion content (e.g. the iron content in Lake Vörös) but it also influences human activity: e.g. larger amounts of K^+ in Lake Farárova jama where fertilizers are used. With regard to water trophy, Lake Farárova jama is in the worst condition (hyper-eutrophic state). Comparison of earlier and present data on

Lake Farárova jama shows that changes mainly occurred in the total phosphorus amount (decrease) but the a-chlorophyll amount seems to be higher, which is also shown by the dissolved oxygen profile from April. Alkalinity has also decreased since 1982 and so has the total hardness. The pH became generally more alkaline than it was in 1992 – this alkalization is probably caused by photosynthesis of the algae mass.
Till now we could observe that, according to the measured parameters, dredging has exerted a positive effect on the water quality of LakeVörös,
Results of cluster analysis indicate that better quality of Lake Farárova jama in the end of August and October is similar to the values of Lake Vörös from October. The values of Lake Farárova jama differ completely from the other lakes and the values of the other months are similar to those of Lake Vörös. The values of Lake Tengerszem are in a different group; it has the best quality. A separate group in the cluster analysis is composed by the sources of pollution for Lake Farárova jama, which are the animal farming establishment situated next to the lake and the village Silica where canalization is not solved yet and that falls according to the water quality assessment in whole year into the worst (4-5.) category. That means a real danger for Lake Farárova jama.
Using the SPI we could analyse the effect of precipitation values and its extremes on the changes of the quality and quantity of the lake waters. The data from the meteorological station of Jósvafő correlate more closely with the lakes situated nearer to it, mainly with the parameters of Lake Tengerszem and also Lake Vörös. It is visible that local climatic conditions basically influence the chemical and physical features of the lakes and they can also strengthen the anthropogenic effect that together can cause a major deterioration of the water quality. This deterioration is detrimental to wildlife of this habitat and also decreases the potential of the lakes for human use as an aesthetic attraction or for economical profit. It is important to monitor the effects of contamination on the lakes and try to protect them in an environment as natural as possible, so that they could fulfil their role in the karst-ecological system and not threaten it.

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HYDROLOGICAL RESEARCH AND MODELLING IN TWO MESOSCALE CATCHMENTS IN THE WESTERN CARPATHIANS

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Keywords: hydrological modelling, soil water content, SWIM, FRIER, forests

Modelling of hydrological processes in the catchments of various size is a widely used approach in hydrological research. Hydrological models provide the spatial distributed results as a useful basis for further ecological applications. However, the accuracy of simulated hydrological parameters strongly depends on the quality of input data, especially on distribution of soil types and related physical properties. Thus, precise specification of field parameters is highly essential for the development of properly calibrated hydrological models.
The aim of this study is to contribute to the knowledge of hydrological processes in two mesoscale basins in the Western Carpathians. Two distributed rainfall-runoff models were applied: SWIM – *Soil Water Integrated Model* (Krysanova *et al.* 1998) and FRIER – *Water Distribution (Flow, Routing, IUH) Model with Accent to Evapotranspiration and Radiation Methods* (Horvát 2008). Besides, in situ measurements of soil moisture and selected climate elements were conducted to build an experimental knowledge base allowing the validation of modelling outputs. In this paper, the models are briefly presented and inter-model comparison of simulated results is conducted.
Two experimental basins (Bebrava and Kysuca river basins) in the western part of the Carpathian Mountains were chosen as the model areas (Fig. 1). The selected basins are considered to be representative for the tree species composition of forests in Slovakia. The Kysuca river basin covers an area of 1016 km^2 with 52% of total forest coverage dominated by non-native pure Norway spruce stands with local admixture of beech and fir. The Bebrava basin is of a rather small area (420 km^2) with the total forest coverage of about 55%. The forest stands are dominated by European beech (40%) and Sessile oak. Besides the tree species composition, also the hydro-geological conditions of the model basins are different. The Kysuca catchment belongs to the external flysch zone of the Western Carpathians. The Bebrava basin is a typical example of karst area underlain by limestones and dolomites. Eight research plots with meteorological and soil moisture measurements have been established in the representative forest stands of each basin.
Daily-scale input data from 1981 to 2006 in the case of Bebrava basin and from 1995 to 1999 in the Kysuca basin were used for models calibration. The set of the maps, each representing an individual day of simulation period, has been obtained as a result of the simulation for each target hydrological variable. The results of the spatial hydrological models were statistically processed and compared to the daily data of volumetric soil water content (SWC%) observed within the field measurements. The comparison results related to the years 2007 (Kysuce) and 2008 (Bebrava) are presented. In the paper

the seasonal development of SWC% in the forest soils of different properties in relation to the daily precipitation amount is also discussed.

The comparison of simulated and observed discharges from the basin outlet indicates a satisfactory performance of both SWIM (Fig. 2) and FRIER (Fig. 3) models. On the other hand, the FRIER model markedly underestimates the measured data of soil water content at all experimental forest stands in Bebrava river basin. Against the relatively good fitting of both models, the presented results highlight the need of their further improvement. So the future research will focus mainly on further validation and re-calibration of FRIER model using the experimental data. On the basis of the model enhanced as stated, the research will continue by hydrological simulations under different land cover and climate change scenarios.

Finally, in spite of some uncertainties in modelling, the results presented in this study have shown that applied hydrological models can be considered as a practical tool for hydrological simulations at the mesoscale level. Moreover, resulting hydrological processes produced in various temporal and spatial resolution can be easily visualized using various types of GIS software. Nevertheless before interpretation of results, the models should be supported and validated by experimental data obtained directly on-site (e.g. soil moisture, leaf area index, meteorological parameters, hydro-physical properties of soils etc.).

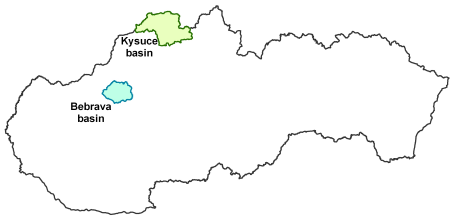

Figure 1. Location of the study mesoscale basins in Slovakia

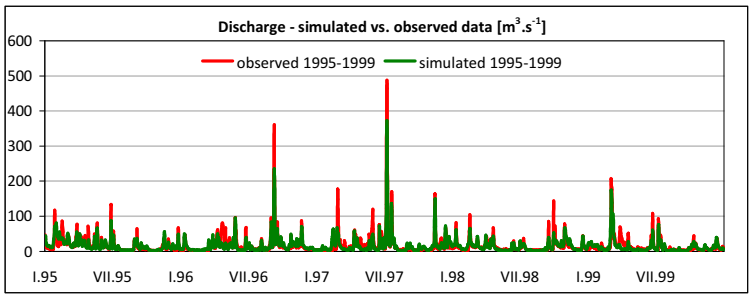

Figure 2. Comparison of simulated and observed discharge in the Kysuca basin outlet during 1995–1999

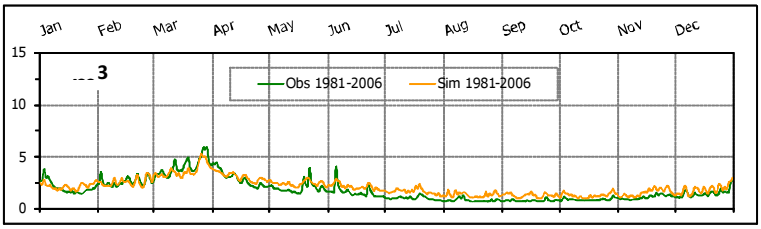

Figure 3. Comparison of simulated and observed discharge in the Bebrava basin outlet during 1981–2006

Acknowledgement

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HYDROGRAPHIC MAPS AS SOURCES OF INFORMATION ABOUT THE POLISH CARPATHIANS

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Keywords: Hydrographic maps, water resources, Polish Carpathians, Tatra Mts.

A hydrographic map offers a comprehensive picture of basic hydrological features, water circulation patterns and water management issues in a given area. Maps of the Polish part of the Carpathians are especially valuable due to the enormous

role that the region plays as a source of water for the entire Vistula River Basin. Hydrographic maps of the Polish Carpathians have been made since the mid-20th century, although the range of features presented has gradually changed. The paper looks at a number of consecutive editions of hydrographic maps of the Carpathians (scale: 1:50 000) and evaluates the degree of usefulness of the hydrological information they contain.

The idea for a detailed *Hydrographic Map of Poland (scale 1:50 000)* emerged in 1950 (Klimaszewski, 1956; Wit-Jóźwik, 1972). Four years later, the *Instructions for Creating Detailed Hydrographic Maps* were published, with amended versions being published in the years that followed. Two sheets were produced – a *Hydrographic Map of the Western Tatra Mts.* (Wit, Ziemońska, 1960) and a *Hydrographic Map of the High Tatra Mts.* (Wit-Jóźwik, 1974) – along with extensive commentaries. The maps were the most detailed representations of water phenomena across the northern slopes of the Tatra Mts. to date. Two subsequent editions were published in 1985 and 2006; the former was a hydrographic map published in the *Atlas of Tatra National Park*, while the latter was a generalized version of the first map. The updated features on the 2006 map included water management facilities, water quality information, and other modifications based on newer *GIS-3 Technical Guidelines* (Główny Geodeta Kraju, 2005).

Hydrographic issues were also presented in cartographic form in the 1970s with the publication of the *Hydrographic Map of Poland* (scale 1:500 000) – "Cieszyn" (1977) and "Przemyśl" (1975) sheets.

The first maps (scale 1:50 000) of Carpathian areas outside the Tatra Mts. were published between 1985 and 1994 and included primarily the Śląskie Province. The maps were based on a topographic map using the PUWG 1965 geodesic system. In 1994, the geodesic system was changed to PUWG 1942 (6 sheets) and later to PUWG 1992. In 2006, the newest maps encompassed the Western Carpathians in the provinces of Śląskie and Małopolskie (Fig. 1). The only maps of certain parts of the Podkarpackie Province are from the 1980s. Today, all PUWG 1992 maps and selected older maps are available online in raster format (http://www.geoportal.pl).

The features found in the latest edition of the *Hydrographic Map of Poland* (scale 1:50 000) include topographic drainage divides, surface waters, springs, depth to the first groundwater horizon, ground permeability, water management facilities, floodwater range, extent of cones of depression, groundwater pollution zones, relief deformation zones, surface water quality, precipitation gauging stations, as well as surface water and groundwater hydrometric stations. Comments cover the natural environment, geologic structure, lithology, course of topographic drainage divides, precipitation conditions, surface waters, hydrological characteristics based on long-term data, groundwater, characteristics of the mapping period, surface water quality, and changes in water relations.

Figure 1. Current (2010) hydrographic map coverage of the Polish Carpathians and the geodesic systems (PUWG) used

One of the most important updates made to the first issue of *Hydrographic Map of Poland* was an addition of first groundwater horizon depths shown with isobaths, lithological data, and permeability of surface formations (coloured fields in the background). Furthermore, the hydrographic classification system became more detailed. The newer maps contain more general information on springs as well as seasonal and episodic streams. Differences in maps produced in different years are shown in the fragments covering the Morskie Oko area in the High Tatra Mts. (Fig. 2).

The Carpathians, and especially the Outer Carpathians, are characterized by a dense river network as well as a large number of springs. It is quite apparent from the maps presented herein that the scope of hydrological mapping (level of detail) is not the same everywhere. This is especially true with respect to point phenomena such as small springs. It is also important to consider the meteorological conditions which occurred during the mapping.

Geological characteristics such as the tectonics of the flysch portion of the mountain range disrupt the continuity of the first groundwater horizon. Hence, it is very important to carefully interpret the isobaths shown on the map. While the isobaths running across river valleys are quite reliable, those running across mountain ridges are not, and should be treated as approximate.

Despite a certain number of imperfections, resulting from a variety of problems, 1:50 000 hydrographic maps are an important source of information on the water environment. Maps of this type can be used in water resources management on a regional as well as local scale. Such maps are useful in spatial planning, flood management, and the broad field of environmental protection. The maps can help in the assessment of water resources and identification of

water surpluses and deficits. The maps offer a comprehensive perspective on water circulation conditions with a special focus on the natural environment and the changes it is undergoing. Finally, they also provide important information such as mean and extreme precipitation data, water levels and river discharge rates at selected hydrometric stations.

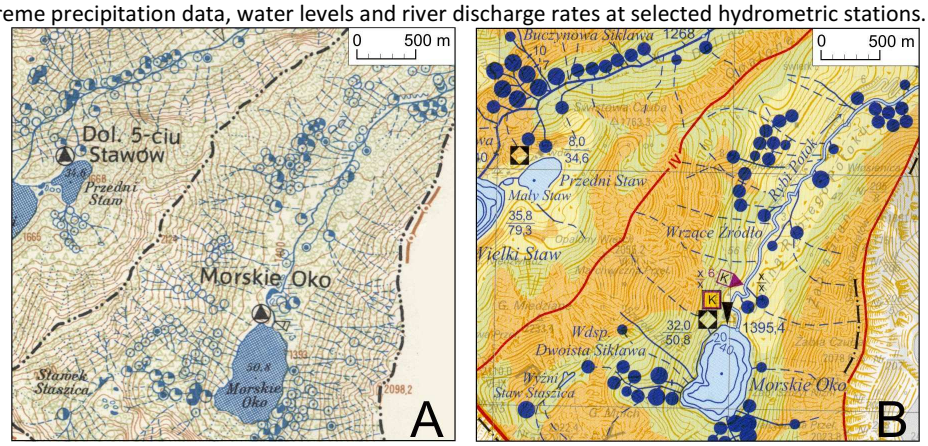

Figure 2. Lake Morskie Oko area (High Tatra Mts.) on hydrographic maps (scale 1:50 000) published in 1974 (A) and 2006 (B)

Detailed records of hydrological phenomena allow long-term analysis of changes in the water environment. Spring discharge rates, changes in spring locations, and the size of wetlands (indicators of water retention capacity) are some of the most important pieces of information that can be obtained from such records. With the growing intensity of tourist traffic in mountain national parks, hydrographic maps are an invaluable tool that becomes even more beneficial with time. Maps of this type also provide important information on existing and potential sources of pollution – information that can be very useful in spatial planning. Such maps can be used to help forecast changes in the water environment and identify environmental protection solutions. Hence, it is necessary to complete a hydrographic map for the eastern part of the Polish Carpathians as well as to supplement the existing maps with additional features representative of the Carpathian water environment.

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ORGANIZATION OF RIPARIAN GROUND BEETLE COMMUNITIES ON REGULATED CHANNEL BANKS OF PORĘBIANKA STREAM

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Keywords: riverine communities, Carabidae, disturbance, nestedness

Frequent disturbance resulting from flooding is a main structuring force for riparian communities. Habitat formation and destruction due to the seasonal dynamic of flood flows provides suitable conditions for many organisms in natural riverine ecosystems in temperate regions. River floodplains are among the most endangered landscapes in Europe. They are affected by changed water regimes and increased land use pressure in the floodplain areas. Modifications of river channels for flood and erosion control, called 'channelization', reduce the frequency and extent of floodplain inundation as well as channel dynamic which are necessary for the maintenance of ecological integrity of the river. A loss of seasonal flood peaks may lead to the succession of plant and animal communities which usually appeared higher above a low-flow channel in less frequently disturbed habitats.

The aim of the investigations was to identify factors responsible for sustaining riverine communities in stream sections with various bank regulation systems. We also tried to determine which life traits of terrestrial invertebrate species (in our case ground beetles of the family Carabidae) can be related to the main environmental factors disturbing riverine ecosystems. The relationships between carabid beetles and the hydrotechnical schemes were studied on Porębianka Stream in the Polish Western Carpathians. Three types of a regulated channel: channel with rapid hydraulic structures (without alluvial deposits below them), channel with drop hydraulic structures and concrete revetment walls along the banks,

channel with banks lined with rip-rap, and reference unmanaged channel with high, eroded banks were chosen for the analyses. In each channel type, four replicates of 10 pitfall traps were established in three rows varying in distance to the water level. Over 6000 ground beetle specimens belonging to 102 species were collected during the study.
Riverine ground beetle assemblages were significantly nested according to the nestedness calculator based on null model. For each of the three study benches and the whole dataset, the temperatures of the maximally packed matrices, indicating the degree of organization of species distribution between sites, were significantly lower than mean temperatures of randomly organised matrices of the same size. The most important correlate of nestedness for the whole of 60 assemblages was vegetation height ($r_s = 0.39$, $p < 0.001$) and site elevation above mean water level ($r_s = 0.27$, $p < 0.05$). A nestedness order of the assemblages recorded on low channel benches correlates negatively with vegetation density ($r_s = -0.45$, $p < 0.05$) and positively with the occurrence of rapid hydraulic structures ($r_s = 0.44$; $p < 0.05$). There was a positive relationship of a nested rank order of ground beetle communities from medium- to highly elevated channel benches in the maximally packed matrix with soil thickness ($r_{sm} = 0.54$, $p < 0.01$; $r_{sh} = 0.55$, $p < 0.01$) and negative with the lack of soil layer ($r_{sm} = -0.51$, $p < 0.05$; $r_{sh} = -0.4$, $p < 0.05$).
A detrended correspondence analysis (describing 20% of species variance for the first two axes) divided the recorded ground beetle communities into two main groups: communities inhabiting low channel benches and those living on medium- and highly elevated benches. However, among low bench communities, ground beetles of concrete bank revetments were placed close to high bench communities. Similar results were obtained using a TWINSPAN analysis. First division (eigenvalue 0.41) clearly separated low bench communities of all types of regulated channel with the exception of concrete revetment and reference sites.
The forward selection of a canonical correspondence analysis revealed five factors significantly describing ground beetle communities. The most important factor, correlating with the first canonical axis ($r_w = 0.82$), was a presence of alluvial deposits ($\lambda = 0.36$, $F = 3.76$, $p < 0.001$). The second factor, corresponding to the second ordination axis ($r_w = 0.63$), was a height of the site above mean water level ($\lambda = 0.29$, $F = 2.53$, $p < 0.001$). The two first axes described 60% of the total variance in the data about species-environment relations.
Among life traits characteristics of the ground beetle communities, only two were related to hydroecological factors: body size and dispersal power. The distribution of the abundance and species richness in body size classes was affected by a height of the site above mean water level ($\lambda = 0.1$, $F = 7.28$, $p < 0.001$) and vegetation height ($\lambda = 0.08$, $F = 2.99$, $p < 0.05$). The two factors corresponded to the first and the second axis of a redundancy analysis ($r_h = -0.67$, $r_p = 0.66$), respectively. Ground beetles with a small body size preferred lower, more frequently flooded stands with small plant species. Similar results were obtained for the abundance and species richness of macro- and brachypterous beetles. Macropterous beetles preferred lower stands with smaller plants, whereas brachypterous beetles lived on more stable, higher stands with trees.
We conclude that the ground beetle assemblages of the studied channel regulation schemes respond mainly to hydraulic parameters of the stream. Elimination of frequent bank inundation due to the formation of a regulated channel of high flow capacity is the main factor responsible for the impoverishment of riverine communities and the loss of β diversity of stream banks.

RESULTS OF MONITORING TORRENT-CONTROL HYDROTECHNICAL STRUCTURES IN THE CÂRCINOV RIVER WATERSHED

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Keywords: monitoring, hydrotechnical works, damages, torrent control

In the last decades many dramatic changes of the environment were recorded. These changes influence the engineering solutions, which take into consideration the relation between physical and biological processes, and those which affect the watercourses.
Water Framework Directive (adopted by the European Commission in 2000) formulates the objectives of increasing the availability and quality of water resources and of attaining the sustainable use of waters in EU countries by 2015. Diminishing of drought and flood effects is among the major problems considered, reflecting high frequency and significance of these events.
In Romania, the national flood risk management strategy was adopted at the end of 2005. It formulates the following objectives for the National Authority for Silviculture:
mapping the forest areas on torrential flood vulnerability criteria
investigating the functioning of torrent-control structures
elaborating a national program for managing torrential watersheds
sustainable management of forests.
According to the above mentioned objectives, research was performed in the Cârcinov River watershed in order to characterize the functioning of hydrotechnical structures. This paper presents results of the monitoring of hydrotechnical structures according to a procedure that was first formulated and applied in the upper Tărlung River watershed (Clinciu, 2003).

The study area is located in the southern part of the Meridional Carpathians and is characterized by a high-energy landscape. The area is underlain by cross-stratified rocks, marls and sandstones, covered with a 3 to 5 m thick layer of loess deposits.

Research methodology

Because the functioning of torrent-control hydrotechnical structures cannot be verified in laboratories (because of the encountered difficulties in reproducing the phenomena from torrent valleys in models), field observations provide the main possibility for monitoring this functioning.

To collect data referring to the functioning and effects of hydrotechnical structures situated in a managed torrential valley from the upper Cârcinov River basin, the structures and their component parts were identified according to a standard form (Clinciu 2003).

In the form, as component parts of a structure were considered the physical parts, which compose the construction and functional parts (e.g. apron, spillway, etc.) or those valley areas, which interact with the structure (e.g. the upstream or downstream area). The forms were filled in the field, following visual description of the structures and their component parts, more detailed observations and measurements. These observations were made in order to recognize the nature, frequency and proportion of various types of events which occurred during structure functioning.

The information recorded in the field was introduced to a Microsoft Access personalized database in order to facilitate the analysis of large amount of data. The structure of the database comprised:

entity (encountered deficiencies/damages on hydrotechnical structures)

attributes (the description and properties of damages/dysfunctionalities)

values (the quantitative estimation of the entities)

Results and discussion

During the research performed in the upper Cârcinov River watershed, 58 transversal hydrotechnical structures were identified. According to typological criteria, 41% of them are represented by traverses, 24% by sills and 35% by dams.

The created database was used to identify and analyse both the events, which affect safety of exploitation and durability of the structures, and those which affect structure functionality.

In order to increase the efficiency of handling the data on the damages affecting the safety and durability of structures, the following codes were used (Clinciu, 2003; Lupaşcu, 2009): cracks (F), breakages (R), carrying away (A), deformations (Df), damage through erosion (De), weathering (Dz), undermining of the structure body (Sc), undermining of the apron (Sr), suffusion (Sf) and infiltrations (I). The damages affecting structure functionality comprised: obstruction of the spillway (Bdv), clogging of the apron (Cr), uncontrolled installation of vegetation (Ihv), unattained atteration (Nat), atteration washing (Spat), deepening of the valley (Aa).

Considering the number of affected structures (NLA), the events with higher frequency were:

cracks (45), breakages (17), undermining of the structure body (16) and damage through erosion (15) in the first group of events

uncontrolled installation of vegetation (48), clogging of the apron (19) and deepening of the valley (16) in the second group of events.

considering the number of affected parts of structures (NPLA), the events rankings were:

cracks (105), breakages (30), damage through erosion (26)

uncontrolled installation of vegetation (140), clogging of the apron (19), deepening of the valley (16).

An analysis of the events frequency to component parts of structures indicated that the part with the highest events frequency was the apron, affected in 71 cases by 8 events, the second ranked was the spillway area, affected in 65 cases by 10 events, and the third was the left wing of a dam, affected in 52 cases by 9 events.

Correlation analysis of the relations between the number of structures and the recorded events, considered for both damage categories and for individual structures, revealed that there is a direct influence of the number of structures on the amount of recorded events. The research also indicated, on a statistical basis, the influence of various factors (e.g. the structure height, the position of a structure in the hydrotechnical system) on producing and manifestation of the damage events to hydrotechnical structures.

Knowledge on the functioning of hydrotechnical structures gives a possibility to better identify the interactions between channel adjustments to watershed environmental changes and human in-channel modifications. The above presented research shows a strong correlation between the structures constructed in torrent valleys and the mode of valley adjustment, which can be analyzed using statistical methods.

HYDROMORPHOLOGICAL CONDITIONS IN A MOUNTAIN RIVER SUBJECTED TO VARIABLE HUMAN IMPACT AND THEIR REFLECTION IN THE ABUNDANCE AND DIVERSITY OF FISH FAUNA

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Keywords: mountain river, human impact, hydromorphological river quality, fish habitats, fish community

During the 20th century human interventions in European mountain rivers resulted in considerable aggravation of their hydromorphological quality and a dramatic decrease in the biodiversity of aquatic and riparian ecosystems. Restoration of good ecological status of watercourses requires knowledge about the relations between the structure of river biocoenoses and hydromorphological characteristics of the habitats. This study focuses on the relations between the abundance and diversity of fish fauna and hydromorphological river quality in a number of cross-sections of the Czarny Dunajec, Polish Carpathians. This river has been subject to considerable though spatially varied modification by human activity and now presents a high variability of river morphology and channel management.

The study area encompasses a 17 km long reach with no major tributaries. In the upper part of the reach, the river incised deeply during the second half of the 20th century in response to in-stream gravel mining. The middle part was channelized with the use of concrete weirs resulting in replacement of the former multi-thread channel by a single, nearly straight one, and disruption of the river continuity for fish. The lower part of the river reach remains unmanaged, with island-braided to heavily island-braided channel pattern. The downstream end of the study reach is a narrow, regulated channel without drop structures. This variability of channel types conditions high variability in physical parameters of habitats along the reach which, in turn, is likely to be reflected in the differences between local river biocoenoses.

Twelve cross-sections representing a range of hydromorphological conditions of the Czarny Dunajec were examined. Water depth, mean flow velocity and mean grain size of surface bed material were determined at 1 m intervals within the low-flow channels. Next, means and coefficients of variation of the parametres were calculated.

Hydromorphological quality of the river was assessed by 4 experts in fluvial geomorphology, river engineering and hydrobiology who scored channel, river banks, riparian zone and floodplain features according to the European Standard EN-14614. Each assessed category was scored on the scale from 1 (near-natural) to 5 (extremely modified conditions).

Species composition of fish communities was estimated by single electrofishings conducted in 10-m wide stripes along the cross-sections. Number and approximate total lengths of fish specimens caught in particular low-flow channels were recorded.

The analysis of hydromorphological conditions in river cross-sections with different number of low-flow channels showed that the degree of complexity of flow network clearly affects the formation of fish habitats. Multi-thread cross-sections had significantly greater aggregated width of low-flow channels. Moreover, single-thread cross-sections showed remarkably lower variability in flow depth, velocity and bed grain size than multi-thread cross-sections. In the former, only gravelly bed occurred whereas in the latter, the dominating gravelly parts of the bed were accompanied by those covered with sand or mud.

The hydromorphological quality in the reach varied between 1.08 and 3.95. All cross-sections with 4 low-flow channels represented high status conditions, with two cross-sections showing heavily island-braided morphology denoting only slight change due to human activity. Single-thread cross-sections with regulated channel fell into Class 4, which reflected a radical modification of channel geometry in the cross-sections, the lack of erosional and depositional channel forms, disturbance of fish migrations by weirs, lateral channel stabilisation and the loss of hydraulic connectivity of the river with its floodplain. Unmanaged cross-sections with deeply incised channel fell into Class 2 of hydromorphological quality.

The cross-sections hosted 4 fish species (brown trout, Alpine bullhead, Eurasian minnow and stone loach) with a total of over 1400 individuals recorded. Multi-thread cross-sections hosted three or four species and numerous juvenile as well as subadult and adult fish individuals. In contrast, single-thread cross-sections had only 2 species, scarce adult specimens and almost no juvenile ones. The average number of subadult and adult fishes was six times higher in the cross-sections with 4 low-flow channels than in the single-thread ones. Two-species fish assemblages with low numbers of specimens were typical of single-thread cross-sections situated both upstream and downstream of the unmanaged, multi-thread river stretch.

Regression analysis of the relations between the diversity and abundance of fish assemblages and physical habitat characteristics indicated the number of both species and specimens to increase linearly with increasing variation in water depth in a cross-section and exponentially with improving hydromorphological river quality. Especially large increase in the number of specimens occurred with relatively small improvement in the hydromorphological quality of the river that was associated with the change from its island-braided to heavily island-braided morphology. The number of fish specimens increased also with decreasing grain size of bed material and with increasing variation of grain size in a cross-section.

Comparison of the results with historical records of fish in the Czarny Dunajec showed that the extent of stone loach and

Eurasian minnow in the study reach considerably decreased in the last decades. At the same time, deep channel incision in the upper part of the study reach and channel regulation in its middle part resulted in almost complete elimination of multi-thread flow pattern and shallow areas in the channel, leading to the unification of habitat conditions and a considerable increase in flow velocity and mean grain size of bed material. These changes, together with the disturbance of fish migrations by weirs must have reduced the extent of stone loach and Eurasian minnow.
The study of the Czarny Dunajec River showed the dependence of the number of fish species and specimens on the variability in water depth, while their relation with an aggregated width of low-flow channels was not confirmed. Fish abundance and diversity reflect not habitat size but its diversity, especially the presence of habitats which are crucial for juveniles. Multi-thread channel sections exhibit greater variability in many habitat parameters, such as the co-existence of patches of coarse and fine bed substrate, slow and fast water current, zones of the inflow of hyporheic water and the infiltration of riverine water into the channel bed, or zones of different water shading by tree canopy, which together are reflected in better assessment of hydromorphological river quality.
This study shows that the high variability of hydromorphological quality of the Czarny Dunajec, caused by spatially varied human impacts, is clearly reflected in the diversity and abundance of fish fauna. More diverse and relatively abundant fish communities were recorded only in a short reach where natural river dynamics and a multi-thread channel pattern were preserved due to the lack of significant human intervention. Undisturbed channel dynamics and the high variability of habitat conditions in the unmanaged reach are essential for preservation of species diversity of fish communities in the Czarny Dunajec, and will be necessary for future restoration of this diversity in the modified river reaches. Future improvement of the ecological status of this and other mountain rivers will require a renewed increase in morphological complexity of their channels and improvement of hydromorphological conditions in the rivers.

POSTER PRESENTATIONS

FINDINGS FROM LONG TERM-FOREST HYDROLOGICAL RESEARCH IN SMALL MOUNTAIN WATERSHEDS

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Keywords: precipitation, runoff, watershed, forestry hydrology

Since 1954, a long-term forest-hydrological research in two small experimental watersheds of Červík (CE) and Malá Ráztoka (MR) Streams have been done. The goal of the experiment is to evaluate the influence of the forest stands and forest management on the water balance in spring areas. Both these experimental watersheds are situated in the Beskydy Mountains (northeast area of the Czech Republic). The watersheds were calibrated without forest cuttings between 1954 and 1965. This period was followed by a period of accelerated stand regeneration (1966–1985). The renewed forests in both experimental watersheds are 20–40 years old now. At the beginning of this research, it was expected that modifications of water outflow from the small, forested, hilly watersheds will be easily demonstrated by the differences in water balance between the calibration period and the period of accelerated cut of woods and their renewal. However, it appeared that any changes cannot be detected using the equation of water balance. Relationships in the subsystem are complicated and not easily provable. Analyses of data continuously recorded till now show that the relationship between runoff and precipitation depends more on precipitation events than on the methods of forest management. We have learned that with high amounts of precipitation, forest cannot prevent floods. It has a mitigating effect during low precipitation events, when it helps transform surface runoff to subsurface runoff. Abundant herbaceus and bushy vegetation, which develops after the forest cuttings, obstructs rapid surface runoff. It is necessary to evaluate sufficiently long-time series of data to obtain reliable results. The water regime in both watersheds is characterized by great natural variation of intermittent component changes, not fully described and understood by statistical methods. The long-term forest-hydrological experiment shows the need for deeper insight and explication of water balance relationship in the forest ecosystem.

RIVER BANK EROSION: CASE STUDY OF THE TROTUS RIVER, EASTERN CARPATHIANS

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Keywords: river bank erosion; alluvial sources; map comparison and surveying; 3D Leica laser scanner; Trotus River

River bank erosion is a natural geomorphological process specific of river channels. In many countries, including Romania, there was little interest in quantitative measurements of river bank erosion, compared with other processess, although it is a major process responsible for direct feeding the river channels with materials.
This poster presents preliminary results from a larger study focused on river banks as one of the sources of sediments in the Trotus River drainage basin (4,500 km^2). A first step was to identify river reaches subject to bank erosion, which were then classified in two groups depending on prevailing processess that trigger lateral erosion (i.e hydraulic processess and mass movement).
In the second stage, grain size of the river bank materials was analysed as it is known that the effectiveness of erosion depends also on the degree of cohesiveness and particle size of the deposits. With data on the amount of the Trotus River bank erosion and bank material characteristics available, methods and quantification techniques were chosen. Assessment of the bank erosion was made by geomorphological survey, cartographic analysis of different map editions (1896-1982), indirect computing methods (Neil, 1987) and, lately, by using Leica 3D laser scanning techniques for river bank monitoring.
During the geomorphological survey the length and width of active river banks as well as the type and thickness of the deposits were recorded. The aggregation of all areas with strong river bank erosion yielded an active area of 140,000 m^2, extended on 32 km of the river length (20% of the total river length). Most of the areas with river bank erosion are located in the lower river course, where the channel is wider and shows greater lateral instability.
To assess the importance of bank erosion as a sediment source for the river, cartographic measurements of the retreat and accretion of river banks were performed using different editions of a 1:25,000 scale map (from 1896, 1962 and 1982). They yielded bank erosion rates varying for different river sectors between 1 and 12.5 m/yr and bank accretion rates varying between 3 and 12.5 m/yr.
Bank erosion monitoring using Leica 3D laser scanner started in August 2009 and we expect that after planned surveys in spring and summer 2010, we will have data worth of analysis.

IDENTIFYING CHANNEL INCISION AND ITS HYDRAULIC IMPORTANCE: EXAMPLES FROM POLISH CARPATHIAN RIVERS

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Keywords: channel incision, channel conveyance, river size, river adjustment, flood-flow hydraulics

Deepening of a river channel may result either from channel incision, or from river metamorphosis changing a wide and shallow channel to the narrow and deep one. However, only the first type of change leads to increased flow capacity of the channel. Hence, a lowering of water stage associated with a given discharge rather than simply a lowering of the river bed should be used as an indication of channel incision.

The amount of channel incision, determined on the basis of the lowering of minimum annual water stage at gauging stations, is typically used to assess the relative importance of the phenomenon along a river or within a particular region. Rivers of the Polish Carpathians incised by 0.5-3.8 m over the 20th century, with the amount of incision being greater in their middle and lower courses than in the upper ones. In this study, variability in the hydraulic importance of channel incision with increasing river size is analysed by comparing changes in the frequency of valley floor inundation at a few gauging stations located along the 7th-order Dunajec River. The comparison shows that despite a lower nominal amount of channel incision in the upper river course, here incision has increased channel conveyance and reduced the frequency of inundating particular levels on the valley floor at a considerably greater degree than in the lower river course.

Hydraulic effects of channel incision depend also on the lateral stability/mobility of an incising river. During the 20th century considerable differences in the style of river adjustment occurred between the eastern and western part of the Polish Carpathians. Low-energy rivers from the eastern part remained laterally stable during channel incision. This has resulted in substantial lowering of stages for low flood discharges and markedly smaller one for high-magnitude floods, whereas velocity of the flows conveyed over the highly elevated floodplains has been considerably reduced. In high-energy rivers from the western part of the Polish Carpathians, alternation of channel incision and lateral channel migration over the 20th century has led to the formation of incised meander belts, with substantially lowered stages for all flood discharges and increased velocity of the flows conveyed over the newly-formed, low-lying floodplains.

GOOD PRACTICES IN FOREST LANDSCAPE MANAGEMENT: WHAT CAN WE LEARN FROM EACH OTHER?

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During last decade a range of international and national policies related to the sustainable management in the Carpathian ecoregion of natural forest and cultural woodland landscapes as integrated social-ecological systems have been formulated. This is associated with discussions among stakeholders from different societal sectors and governance levels about the challenges and problems concerning implementation on the ground of the policies related to sustainable development as a process and sustainability as concrete outcomes. However, existing knowledge and information about good practises in forest management aimed at maintaining and increasing economic, ecological and/or socio-cultural values of forest landscapes is local and regional, and usually not shared among sectors and countries. There is an urgent need to highlight and scale up existing good practices in forest management based on traditional forest knowledge and novel innovative approaches, and to develop strategies to encourage holistic approaches which encompass both social and ecological sub-systems of landscapes.
The aim of this workshop is to communicate and disseminate the results of good forest management practices which currently are applied on the ground. The workshop will be organized as round-table discussions among practitioners and scientists. The main outcome of the workshop a SWOT-analysis (i.e. Strengths, Weaknesses, Opportunities and Threats) of the opportunities and challenges to achieve sustainable forest landscapes in the Carpathian ecoregions. The workshop will help to build bridges among actors and stakeholders from different countries for mutual learning and promote development "win-win" cooperation among landscapes, regions and countries.
The managers of forest enterprises, protected areas, forest industrial companies, tourist enterprises, representatives of governmental organizations responsible for management of forest landscapes, representatives of NGOs, researchers and those who want to share their holistic knowledge, to discuss and learn from other are warmly welcome to the workshop.
UNEP-Interim Secretariat of the Carpathian Convention (Austria) participates in the workshop preparation.

MOUNTAIN SUSTAINABILITY. TRANSFORMING RESEARCH INTO PRACTICE. OPPORTUNITIES FOR THE CARPATHIANS

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Projects of the EU Framework Programmes and the Interreg B strand generally close with the publication of the Final Report. The partners return home to their institutes and look for new challenges, while the webpages of the projects become orphans. Mostly there are neither funds nor personnel to transform the results into instruments ready for the use of practitioners. This situation was the starting point for a new attempt to transform the results into practical instruments, in order to inform practitioners and to enhance sustainable regional development in the mountain areas of Europe. The project mountain.TRIP is funded in the 7th Framework Programme of the European Union.
The workshop invites:
Practitioners from administrations, associations, private enterprises, NGOs, etc., interested in discussing their thoughts regarding information needs and ideal channels.
Scientists who can look back at a successful transfer of research results into practice, and who are willing to share their experiences.
Any participants interested in a discussion on the transfer of research results on the Carpathians into practice.
The workshop will cover the following points:
Inform about mountain.TRIP: project outline and preliminary findings.
Discuss best practice examples of knowledge transfer: stakeholder involvement, points of success, lessons to be learnt.
Assess the information needs of practitioners in the Carpathians: thematic gaps or gaps in communication?
Collect projects relevant for the Carpathians which could serve as examples in the course of the mountain.TRIP project.
Outcomes: feed-back to mountain.TRIP regarding relevant projects and research deficits in the Carpathians, as well as regarding best practice examples.

The participants will become familiar with the mountain.TRIP approach and will profit from the discussion of best practice examples. Participants will also be able to suggest projects for inclusion in the mountain.TRIP product development.

AGRICULTURAL BIODIVERSITY IN THE CARPATHIANS [ABC]

CROSS-BORDER COOPERATION IN THE CARPATHIAN REGION FOR SUSTAINABLE CONSERVATION OF AGRICULTURAL BIODIVERSITY

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Topics
Introduction to in situ/on farm conservation of agricultural biodiversity (agrobiodiversity).
Introduction to the SAVE Foundation and its programmes. Introduction to the proposed programme for Carpathian region.
It is intended that this programme will record and evaluate basic data where it is still missing and extend the synonym register of fruit varieties in all languages of the Carpathians (with free access by internet) used for enhancing cross-border cooperation and facilitating comparability of varieties. Development of a monitoring system for all plant varieties and livestock breeds plus an actor network for the region.
Programme goal: Promotion of conservation strategies and collaboration and establishment of practical projects.
These introductions will be followed by a guided plenary discussion of the material presented.
The workshop will close with a summary of the discussion.
Goals
Promotion of cross-border cooperation for sustainable conservation of agrobiodiversity in the Carpathian region.
Feedback on and in-put to the proposed programme for conservation of agrobiodiversity in the Carpathian region.
Expected outcomes
Understanding of topics and goals, motivation to join a cross-border stakeholder network for conservation of agrobiodiversity in the Carpathian region.
Identification of partners for closer future cooperation.
Suggested Contributors:
General Introduction to topic and to SAVE: Hape Grünenfelder, SAVE Foundation
Introduction to proposed Carpathian Programme: Elli Broxham, SAVE Foundation
Case Study Walachian Sheep: Antje Feldmann, GEH

ECOSYSTEM SERVICES - CHALLENGE FOR INTERDISCIPLINARY RESEARCH OR ONLY NEW TERM FOR KNOWN STATEMENTS?

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With the publishing of new concept Ecosystem Services (ESS) in the frame of Millennium Ecosystem Assessment (ME) project in 2005, big expectation about new interdisciplinary research of natural and socio-economic scientists grew up. It resulted from some ME statements, e.g. "…The capacity of ecosystems to provide services derives directly from the operation of natural biogeochemical cycles that in some cases have been significantly modified". Unfortunately, this expectation has not filled yet, minimally in the Czech Republic. Most of socio-economic scientists stand upon their economic and sociological approaches to ESS valuation (e.g. contingent valuation method) and natural scientists use this situation and speak about ecosystem services in place of ecosystem processes and functions, they spoke about before.
According to our opinion, it is necessary to focus our research on describing and understanding both previous and current ecosystem functions, goods and services to society, in semi-natural, rural, sub-urban and urban environments, and linkages to and influences from the natural, economic and socio-cultural environment.
The aim of the proposed workshop is to put together insights of natural and socio-economic scientists from various countries on principles and approaches to ESS valuation and to propose next steps of movement in this direction in the frame of S4C activities.
European land systems call for a new integrated resource management toward greener sustainable landscape that will cover material needs of current generation while optimizing restoration activities toward the potential natural vegetation. It is necessity to introduce new unique Pan-European integrative methodology for symbiosis of traditional economic land-use with optimal landscape restoration management through integrated ecological and economic valuations.
The principal activities could be to develop the capability for understanding, assessing and enhancing human use of terrestrial ecosystems and their multiple services, considering key sectors of rural land use in case study areas, with a view to their interpretation across wider European regions. The research activities have to focus on describing

and understanding both previous and current ecosystem functions, values and services to society, in rural, urban or peri-urban environments, and linkages to and influences from the natural, economic and socio-cultural environment. The extent of these linkages and the depth of the influences will define the scope of the studies in each both spatially and conceptually. A thorough analysis of past changes in land use and management practices, especially as they relate to ecosystem use, functions and values, will provide a robust basis for model specification and assessment, and for the grounding of the development of scenarios.

Mountain ecosystems provide a large array of services (e.g. prevention of soil erosion, regulation of water flow, maintenance of genetic resources, production of biomass), which are highly sensitive to changes of climate and land use. The goal of this working group is to discuss the research need in order to evaluate the supply and demand for ecosystem services facing such global change. Science, the community, private business and policy makers must engage with each other in a robust manner to come up with an evidence-based research agenda which reflects (i) the sensitivity of the supply of ecosystem services to global change, (ii) the socio-economic demand for ecosystem services and (iii) the required design of policy instruments, market mechanisms, and land use practices to support the adaptation of individual regional ecological economic systems to global change.

PLANT RESPONSE TO OZONE IN THE CARPATHIAN MOUNTAIN REGION AND OTHER MOUNTAIN REGIONS

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Elevated levels of ozone (O_3) occur in several locations in the Carpathian Mountain Region in summer and in other mountain regions of the world. Some plants are O_3-sensitive and can be used as bioindicators of O_3. The long-term effects of O_3 on growth, reproduction, competitive ability and ecological function are largely unknown.

Goals

to share and increase knowledge about the nature of O_3 injury on plants

to share and increase knowledge about bioindicator plants for O_3

to discuss possible collaborative ways to determine the long-term effects of O_3 exposure on native plants in mountain regions.

Expected Outcomes

It is expected that a group of interested investigators from various parts of the Carpathian Mountain Region will have discussions about the use of bioindicators for O_3 and begin to plan collaboration for field investigations on the effects of O_3 on native vegetation, both in the Carpathians and elsewhere.

Potential Contributors

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