



Science for the Carpathians

CONFERENCE ABSTRACTS

FORUM CARPATICUM 2016

**Future of the Carpathians:
Smart, Sustainable, Inclusive**

September 28 – 30, 2016

Bucharest, Romania



www.forumcarpaticum.org

Bucharest, 2016



Continuing previous meetings: Forum Carpathicum 2010 (Krakow, Poland), Forum Carpathicum 2012 (Stará Lesná, Slovakia), Forum Carpathicum 2014 (Lviv, Ukraine), Forum Carpathicum 2016 (Bucharest, Romania) addresses the need to make a bridge of smart sustainable development in the Carpathians with scientists, stakeholders, institutions, NGOs, communities.

The Carpathian Region – the Green Backbone of Europe – faces many opportunities as well as challenges to the future development of the area. The stakeholders, decision makers and research communities can use them wisely for the enhanced protection and sustainable development of the Carpathians. These overall goals meet well with the EU 2020 Cohesion Policy, which proposes “Smart”, “Sustainable” and “Inclusive” to be the keywords when addressing the main priorities for the near future.

Forum Carpathicum 2016 „Future of the Carpathians: Smart, Sustainable, Inclusive“ proposes to concentrate on these priorities and to debate how they can be implemented in the Carpathian Region, during the following main thematic sessions:

Smart Carpathians session aims to present and discuss the leading edge achievements in: recent and future information and communication technologies; emerging paradigms and methodological developments; front-rank research infrastructures, capacities and innovations; open knowledge, information and data systems applications, in particular those of Carpathian interest.

Sustainable Carpathians is expected to cover the topics that consider: climate change adaptation, risk prevention and management of the Carpathian ecosystems; measures aimed at the environmental protection, efficient use of natural and cultural resources of the region; transition towards low-carbon economy; sustainable transportation networks in the Carpathian Ecoregion; phenology and citizen science to the Carpathians.

Inclusive Carpathians are seeking for contributions dealing with: promotion of employment (green jobs) and support of labour mobility across the Carpathians to attain the targeted EU employment quotes; innovative approaches and solutions for empowering people and for creating sustainable job opportunities for women, young, elder and disabled people; challenges of overcoming poverty in the Carpathians, issues of social and territorial cohesion and social exclusion; sustainability and enhancement of good quality education and equal access to lifelong learning - to prevent brain drain and to attract brain gain; enhancement of institutional capacities and public administration for becoming more service - and goal orientated, implementation of the EU structural and investment funds and avoidance of overlapping responsibilities and splitting of competencies in disciplines with manifold and conflicting interests.

The Conference Abstracts of the 4th Forum Carpathicum 2016 Future of the Carpathians: Smart, Sustainable, Inclusive

Editors: Mihaela Verga, Gabriela Manea

English Proofing: Ana Irina Lequeux Dincă

The abstracts included in this volume were selected and subject to reviewed by the Forum Carpathicum Scientific Committee. Final version of the abstracts reflect the work of their authors and published here in as submitted to the committee of the 4th Forum Carpathicum.

Published online at: www.forumcarpathicum.org by Faculty of Geography, University of Bucharest, Bucharest, Romania, N. Bălcescu, 1, 010041, Bucharest, Romania

Front page: Elżbieta Laszczak, Dominik Kaim, Katarzyna Ostapowicz, Elena Matei

Photos: Elena Matei, Andrei Mihai Bogdan

FORUM CARPATICUM 2016

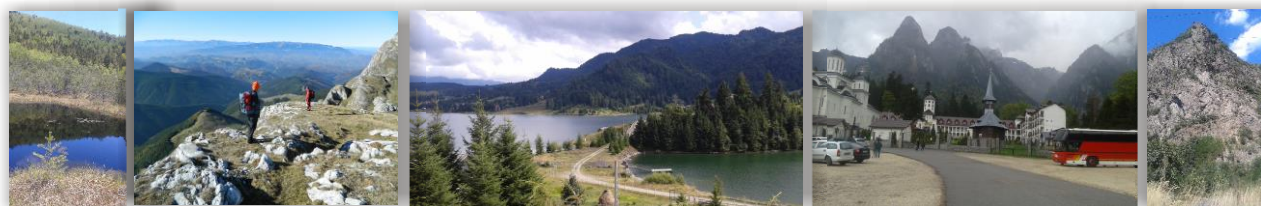
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Bucharest, Romania

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PROGRAMME OVERVIEW

Tuesday, September 27
Registration 16:00-20:30
Ramada Majestic Hotel, Calea Victoriei 38-40, Sector 1, Bucharest Code: 010082

Wednesday, September 28

Registration 7:30-9:00 Parliament Palace		
Opening ceremony 9:00-9:40 Parliament Palace Hall: C.A. Rosetti		
Coffee break 9:40-10:00 Restaurant Room		
Plenary session 1 10:00-12:00 Hall: C.A. Rosetti		
Sponsors presentation 12:00-12:30 Hall: C.A. Rosetti (entrance)		
Thematic session 1 12:30-13:30 <i>Smart Carpathians I</i> Hall: 1 FPC	Thematic session 2 12:30-13:30 <i>Sustainable Carpathians I</i> Hall: C.A. Rosetti	Thematic session 3 12:30-13:30 <i>Sustainable Carpathians II</i> Hall: 3 EC
Lunch 13:30-15:00 Restaurant Room		
Thematic session 4 15:00-16:30 <i>Sustainable Carpathians III</i> Hall: C.A. Rosetti	Thematic session 5 15:00-16:30 <i>Smart Carpathians II</i> Hall: 1 FPC	Thematic session 6 15:00-16:30 <i>Inclusive Carpathians</i> Hall: 3EC
Posters and coffee break: 16:30-17:00 C.A. Rosetti (entrance) and Restaurant Room		
Workshop 1 17:00-18:30 <i>Education for Sustainable Development in the Carpathians</i> Hall: 3 EC	Thematic session 7 17:00-18:30 <i>Sustainable Carpathians IV</i> Hall: C.A. Rosetti	Workshop 2 17:00-18:30 <i>The Potentials of a Carpathian Convention Protocol on Sustainable Agriculture and Rural Development (SARD) for Fostering Innovative Agricultural Initiatives to Promote the Vitality of Rural and Peripheral Areas in the Carpathians</i> Hall: 1 FPC
CITY Tour 18:30-20:00	SCIENCE FOR THE CARPATHIANS SSC 18:30-19:30 Hall: C.A. Rosetti	

Thursday, September 29

Plenary session 2 9:00-11:00 Hall: C.A. Rosetti		
Photos 11:00 C.A. Rosetti		
Posters and coffee break 11:00-11:30 C.A. Rosetti (entrance) and Restaurant Room		
Thematic session 8 11:30-12:45 <i>Carpathians: Smart and Sustainable I</i> Hall: 1 FPC	Thematic sessions 9 11:30-12:45 <i>Sustainable Carpathians V</i> Hall: C.A. Rosetti	Thematic session 10 11:30-12:45 <i>Carpathians: Smart and Sustainable II</i> Hall: 3EC
Thematic session 11 12:45-14:00 <i>Sustainable Carpathians VI</i> Hall: 1FPC	Thematic session 12 12:45-14:00 <i>Carpathians: Smart and Sustainable III</i> Hall: C.A. Rosetti	Thematic session 13 12:45-14:00 <i>Carpathians: Smart and Sustainable IV</i> Hall: 3 EC
Lunch 14:00-15:00		
Plenary session 3 15:00-17:00		

Hall: C.A. Rosetti		
Coffee break 17:00-17:30 Restaurant Room		
Workshop 3 17:30-18:45 <i>Smart Marketing for Sustainable Carpathian Tourism Destination(s)</i> Hall: 1FPC	Thematic session 14 17:30-18:45 <i>Sustainable Carpathians VII</i> Hall: C.A.Rosetti	Workshop 4 17:30-18:45 <i>Enhancing Economic, Social and Territorial Cohesion in the Carpathians</i> Hall: 3EC
Official dinner 19:30 Bizantine Hall, National Military Circle Palace		

Friday, September 30

Plenary session 4 and plan for future 9:00-10:30 Hall: C. A. Rosetti
Coffee break 10:30-11:00 Restaurant Room
Awards and closing ceremony 11:00-12:30 Hall: C. A. Rosetti

Post-Conference Tours

Tour 1 Open Air Village Museum 14:00-16:00	Tour 2 Mud Volcanoes 13:00-21:00	Tour 3 Fagaras Mountains Start 14:00
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Saturday, October 1

Tour 4 Brasov-Bran Old Castles 8:00-21:00	Tour 5 Bucegi Natural Park 8:00-21:00	Tour 3 (Continuation) Fagaras Mountains End 21:00
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PLENARY SESSIONS



Climate change and air pollution effects on the Carpathian Mountains with an emphasis on forests and their services

Andrzej BYTNEROWICZ

USDA Forest Service, Pacific Southwest Research Station, USA

The Carpathian Mountains have been strongly affected by climate change. Average annual temperature in the Carpathians has increased by 0.6 to 1.6°C between 1961 and 2010, with the highest increase in summer. Highest temperature increase occurred in W and E Carpathians and at low elevations. It is projected that by 2100 average annual temperature in the Carpathians could increase by 3°C to 4.5°C. Annual precipitation has increased in most of the Carpathians, especially in their NE part, while their W and SE areas have experienced precipitation decrease. Projected changes of temperature and precipitation in the Carpathians are characterized by highly uncertain spatial and seasonal variability. However, in general, more precipitation in winter (with more rain and less snow) and irregular summer precipitation (with higher risks of droughts and floods) are projected. Since 1980s there have been steady decreases of sulfur oxides concentrations, sulfur dioxide direct phytotoxicity, and sulfur deposition in the Carpathians. During that period nitrogen oxides concentrations have decreased more than those of ammonia, and a pronounced reduction of total nitrogen deposition has taken place. Background ozone concentrations have remained high in the Slovak and Romanian Carpathians resulting in exceedances of critical levels of this pollutant. Trends of increasing ozone background concentrations to its potentially phytotoxic levels will most likely continue in the 21st century due to increasing temperatures resulting in higher rates of atmospheric photochemical reactions and ozone generation. Additional ecological and human health impacts in the Carpathian region have been caused by elevated levels of suspended particulate matter and heavy metals. Forest functioning and health are affected by multiple interactive stressors including air pollution, climate change, outbreaks of pests and diseases, and improper management practices. All these factors affect Carpathian forests and their key ecosystem services such as timber production, carbon sequestration, provision of non-woody products, water protection, soil protection, climate change regulation, biodiversity conservation, habitat existence, education, as well as cultural, aesthetic and recreational values. Specific impacts of individual climatic and air pollution factors as well as their interactive impacts on forests and their ecosystem services will be discussed and illustrated with examples from various parts of the Carpathians. Research, management and policy needs as well as recommendations for better adaptation of the Carpathian forests to impacts of climate change and air pollution will be discussed.

Romanian Carpathians Futures – Human Impacts and Environmental Hazards

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The Carpathians in Romania extend over 54% of the entire length of this mountain range, covering 27.8% of the country's surface area (66.300 sq.km) and being characterized through a large diversity of human-environment relations.

The presentation will cover the following aspects: mountain space in the context of the climate change impacts and variability; types of human pressure on the environment; inter-disciplinary researches with a focus on the active involvement of stakeholders into the research process; perspectives on trans-national cooperation with key players in the Carpathians and Alpine regions. The outcomes of such aspects are derived from previous FP6 and FP7 projects and are integrated in

relation with the results of the synthesis work of the United Nation for Environment Program (UNEP) “ Carpathians Environment Outlook 2007” on state of the environment and development of the Carpathian Mountains, which was elaborated 10 years back from the present. The current analyses highlight an increase of natural and anthropic hazards in connection with climate change / variability and with the increased extend of some new areas with different degrees of vulnerability, respectively.

Resistance to Change of Carpathian Villagei in the Adaptation Process at the New Challenges

Ioan IANOS
University of Bucharest

The aim of our study is to show the villages’ advantages to resist the dismantling identity tendencies as long as they have the capacity to face globalization, urbanization and climate change. The main data that have been used are provided by land use changes, interviews with different local authorities’ representatives, population and planning specialists’ surveys and by statistical data related to demography, economy and rural infrastructure. The villages’ vulnerability in a mountain area, when a country is still in transition, is amplified by a paradox: the lack of some resources for local projects and the attractiveness of other resources for investors. This situation determines the acceptance without much reserve of the extension for the built-up area as well as of the general urban plans’ modifications through the appearance of new functions and the change of the initial destination of certain structures in the villages. Villages with a high recreational potential, given by forest and lake areas, didn’t manage to limit the tourists and entrepreneurs’ aggression as they rather did the contrary. These villages suffered the most severe changes, tending to lose their identity. Moreover, the idyllic image of a modern village in the vicinity of a developed axis has been altered and has been replaced, through the destruction of the old rural life, by a rural society fragmented by the newcomers that do not get involved in the village life. To avoid identity destruction, the villages try to associate themselves into *local action groups* or other associative frameworks which have their own development plans. Crisis conditions oblige not to miss any opportunity linked to future development and selection for new investors’ acceptance might be a solution to avoid the fundamental transformation process. The enforcement of certain rules concerning the respect towards rural space has been increasingly accepted by local authorities. However, if the force and the fascination of the increasing accessibility are taken into account, the village resistance to the new challenges is extremely limited.

Carpathian Old-growth Forests in a Global Context: Shared Form and Function or Regional Distinctiveness?

William S. KEETON^{1*}, Garrett MEIGS¹, Sabina BURRASCANO², Yuirj BIHUN¹, Carlo BLASI², Jiquan CHEN³, Mykola CHERNYAVSKYY⁴, Dmytro KARABCHUK⁴, Brigitte COMMARMOT⁵, Jerry F. FRANKLIN⁶, Georg GRATZER⁷, Thomas SPIES⁸, Mark E. SWANSON⁹, Grant WARDELL-JOHNSON¹⁰, Christopher DEAN¹¹, Miroslav SVOBODA¹², Volodymyr TROTSIUK¹², Magdalena MAIN-KNORN¹³, Christine GOODALE¹⁴, Gregory MCGEE¹⁵, Jonathon THOMPSON¹⁶, Andrew WHITMAN¹⁷

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Recent decades have seen tremendous advances in both scientific understanding and conservation of old-growth forests in the Carpathian Mountain region. Recognition of the diverse values provided by old-growth forests is manifest both in the forest protocol of the Carpathian Convention and the recently expanded pan-European network of World Heritage sites protecting primary beech forests. These trends mirror the growing awareness of the unique ecological values provided by old-growth ecosystems in many temperate regions globally.

We have reported previously on a collaborative project involving over 20 scientists that is exploring commonality and divergence in late-successional structure and function among temperate forest systems around the world (Keeton et al. 2010). The results of a meta-analysis using literature-derived summary statistics were published by Burrascano et al. (2013). More recently our team has: 1) expanded the global dataset of stand level biometrics to 501 sites distributed across eight sub-continent scale ecoregions within the temperate forest biome; and 2) completed a more robust multi-variate analysis using ordination techniques. Here we report the results of the updated analysis, affording an opportunity to ask: how do form and function in Carpathian old-growth forests compare to other regions? Are old-growth characteristics universal or are there regional differences reflecting factors such as variation in growth, stand dynamics, and disturbance history?

We tested the hypothesis that important ecological functions are provided universally by old-growth temperate forests, such as high carbon storage and co-varying habitat complexity as indicated by stand structure metrics. We pooled site-specific (n =501) forest inventory datasets representative of eight ecoregions: 1) U.S. Pacific Northwest, 2) U.S. Northeast, 3) U.S. Mid-Atlantic, 4) Southern Europe, 5) Central Europe, including the Carpathian Mountains, 6) Chile, 7) Northeastern China, and 8) Temperate Australia. We used Non Metric Multi-Dimensional Scaling (NMDS) run in PC-ORD to analyze similarity/dissimilarity in stand structure among and within the ecoregions, broadly defined forest types (temperate deciduous, coniferous, and mixed conifer-deciduous) and by late-successional age class (mature vs. old-growth; class based on regional criteria). Dimensionality of the data was assessed using the Monte Carlo permutation procedure with 50 runs of randomized data. Additional post-hoc tests employed bi-plots and Kendall's Tau to assess ranked correlations of structural variables with ordination axes.

NMDS results reveal a wide range of structural variability within and among old-growth temperate forest systems. Results show a degree of structural dissimilarity between mature and old-growth ages classes, but also a very high degree of overlap among both ages classes and sub-regions. Ordination results did show distinct inter-regional variation in old-growth forest structure, with the Carpathians and Alps most similar to the U.S. Northeast and least similar to the U.S. Pacific Northwest and the southern hemisphere. When old-growth is assessed by forest type, a clear gradient of structural complexity emerges. Evergreen broadleaf and needleleaf forests occupy one end of this spectrum, mixed conifer-deciduous systems are intermediate, and deciduous broadleaved forests exhibit lower relative values for structural indicators. Live aboveground biomass, downed coarse woody debris, and tree density are the top ranked indicators explaining directionality in the spread of data both for inter and intra-regional variability. In relation to other regions, Carpathian forests exhibit greater contrast in mean basal area, downed coarse woody debris, and aboveground biomass (live and dead) when comparing old-growth vs. mature age classes, but have less contrast for canopy height. Structural indicators in Carpathian forests have similar variability around means compared to that exhibited globally.

As is true both universally and for the Carpathians specifically – management for and conservation of high biomass, late-successional forests provide both carbon storage benefits and structurally complex habitats. Yet the results also show tremendous variability in form (i.e. structure) and function (i.e. carbon storage) within and among systems. In some cases, structural characteristics typically associated with old-growth forests may be equally if not more pronounced in mature forests, depending on site characteristics and disturbance history. This suggests a need to broaden our conception of late-successional ecosystems and dynamics, and to move away from overly narrow or rigid criteria not accommodating of this range of variability. For example, forest carbon projects will need to account for variability in stand development processes. Even so, our results support the fundamental conclusion that conservation of late-successional/old-growth forests globally and in the Carpathians remains an imperative for biological diversity, riparian functionality, climate mitigation, and the many other ecosystem services these systems provide.

References:

- Keeton, W.S., Burrascano, S., Pucko, C., Blasi C., Bihun Y., Chen J.M., Chernyavskyy, B., Commarmot, J.F., Franklin, G., Gratzner, J.S., Nunery, Y., Shparyk, T., Spies, A. and Swanson, M.E., 2010. A global analysis of temperate old-growth forests: commonality in carbon storage and co-varying ecosystem functions. *International Forestry Review* 12(5):3.
- Burrascano, S., Keeton, W.S., Sabatini, F.M. and Blasi, C. 2013. Commonality and variability in the structural attributes of moist temperate old-growth forests: A global review. *Forest Ecology and Management* 291:458–479.

Common conceptual and operational frameworks for research and sustainable governance of Nested Socio-Ecological Systems across Carpathian region

Angheluță VĂDINEANU
University of Bucharest

The presentation is based on the assumption that most, if not all participants at the Conference on the Carpathians' Future, are concerned about the recent conceptual and operational frameworks aiming to understand the sustainable governance of the complex and non-linear dynamic process between Humans and Nature or "natural and social environment" across space scales within the Global Earth System.

In this regard, attention is focused on: i) major theoretical, conceptual and methodological achievements in two global integrative scientific disciplines - "Systems Ecology" and "Sustainability Science"; ii) description of two conceptual and operational frameworks and platforms for interdisciplinary and transdisciplinary knowledge production and holistic and adaptive management of nested socio-ecological systems and; iii) challenges and opportunities for sustainable development in the Carpathian region.

Old and new challenges from ozone to forests

Elena PAOLETTI

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The impacts of air pollution and climate change are still a serious concern for forest ecosystems in Europe and worldwide. One of the major issue is tropospheric ozone (O₃), as control measures on precursor emissions have limited the peaks but background levels are still stable or rising. Ozone is a very reactive gas, that generates free radicals and Reactive Oxygen Species upon reaction with water and biological materials, does not accumulate in biological matrices, and elicits aspecific responses in plants. Free radicals and ROS, in fact, originate also from the usual physiological activity of plants. These characteristics have made the study of ozone impacts on vegetation so complex, that our understanding of the real-world effects of ambient ozone pollution on forest ecosystems is still insufficient. Controlled laboratory and field chambers have provided an immense database on tree responses to elevated ozone. However, artifacts may be arising, in particular due to differences in meteorological factors (especially temperature and wind speed) between chambers and natural conditions. After synthesizing the most recent developments in our knowledge of ozone impacts on forests, modern approaches for evaluating ozone impacts on forests will be presented, with focus on FACE systems and epidemiological approaches. Similarly to free-air CO₂ enrichment, experiments by Free-Air Controlled Exposure of O₃ (O₃ FACE) can be considered a better approach to provide a realistic estimate of tree responses under real-world conditions. Similarly to studies on human health, epidemiological investigations may play an important role in the assessment of ozone impacts on forests under field conditions.

Future forest landscapes of the Ukrainian Carpathians

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Forests are the main providers of ecosystem services and the primary reservoirs of biodiversity in the Carpathians. The sustainable development of the Carpathians depends on our understanding of the coupled natural-human systems in this region, i.e., how different management practices shape forest ecosystem development under changing environmental conditions. To understand these interactions, we simulated forest landscape development under climate change and adaptive management system.

Our case study area embraces the Rakhiv administrative region (190 km²) located in the Tisa river headwaters of Ukraine. The mountainous landscape includes oak, beech and spruce dominated forests. The landscape is characterized by patches of old-growth natural forests and extensive spruce plantations.

We are using a model of forest landscape change, LANDIS-II, to simulate the spatio-temporal trajectories of forest succession, including seed dispersal, forest growth, natural and human disturbances, as well as climate change (Scheller et al., 2007). Our study will comprise two main components: 1) modeling of the forest landscape dynamics under baseline climate and under

climate change; 2) simulation of the human-forest interactions using a novel extension for LANDIS-II, which is built on the idea of social-ecological adaptive systems.

Here, we present the progress within the first objective. We selected the six most common tree species of the region (Norway spruce, European beech, silver fir, sessile and pedunculate oaks, sycamore maple, and common hornbeam) and assigned their life history attributes: shade tolerance, longevity, seed dispersal capacity, and wind tolerance. The landscape was structured using two geodata sets to define ecotopes (i.e., site conditions), and initial forest communities (i.e., age classes and cohorts of species). The ecotopes were delineated via Shuttle Radar Topography Mission data according to bioclimatic altitudinal spans, topographic position, slope, and aspect. They were characterized by the probabilities of establishment and growth potential of each species, which were calculated considering heat supply, soil moisture and trophic statuses, as well as susceptibility to frost damage and wind disturbance. The initial forest communities and growth parameters were derived from inventory maps and the national forestry operational database. We investigate wind disturbance effects on forest communities under varying intensity to account for potential changes in wind regimes under climate change.

We expect distinctive climate-driven changes within our case study region, but also significant time-lags in the response of forest communities to a changing climate. Furthermore, we expect an acceleration of forest adaptation by intensified wind disturbance.

References:

- Scheller, R.M., Domingo, J.B., Sturtevant, B.R., Williams, J.S., Rudy, A., Gustafson, E.J., Mladenoff, D.J., 2007. Design, development, and application of LANDIS-II, a spatial landscape simulation model with flexible temporal and spatial resolution. *Ecological Modelling* 201, 409–419.

Land use legacies and their implications for bird conservation in the Carpathian Mountains

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European landscapes are changing rapidly due to agricultural intensification, reforestation and land abandonment. The resulting habitat loss, landscape fragmentation, and potential for habitat recovery make these changes a primary concern for biodiversity conservation. Bird populations in Europe are declining and conservation action is needed to protect these species and their habitat. However, there are land use tradeoffs when deciding to protect species of a particular habitat. This is why prioritizing conservation by accounting for long-term habitat changes and species importance in different geographic regions is crucial to achieving best conservation outcomes.

Empirical evidence suggests that bird populations in Eastern Europe are declining at slower rates than in Western Europe. This means that Eastern Europe may be a future hotspot for bird diversity conservation in Europe. Yet, it remains unclear which habitats in the Carpathians are important for species conservation at broad scales, given the contribution of the Carpathians to the European bird populations.

Our overarching goal was to provide conservation recommendations for the Carpathian Mountains, based on historic and recent habitat evolution for species of highest conservation responsibility at European level. To achieve this goal we analyzed a long term land use and land cover dataset since 1860s for the Carpathians^{1,2} and species range maps for 252 bird species whose European ranges at least partially cover the Carpathian ecoregion³.

First, we investigated which are the major habitat changes in the Carpathians over the past 150 years, and which birds are using these landscapes. Second, we evaluated for which of the bird species present in the Carpathians, does this region carry highest conservation responsibility at the European level and how their habitat evolved since 1860s. Finally we provide conservation suggestions given the observed habitat changes, species life history and threats.

We found that forest and grassland habitat increased substantially since 1860 within the ranges of all Carpathian species, and that agricultural habitat declined. Overall, the Carpathians carry a high conservation responsibility for species that use forests and grasslands as their major habitat and only low conservation responsibility for birds that rely on agricultural fields. Furthermore, the habitat requirements of species of high conservation responsibility indicated that several species would benefit from a mosaic of forest and grassland landscapes. The main threats at European level for the species of high conservation responsibility were agricultural intensification and natural system modification. Because we found that agricultural land declined substantially in our study region since the 1960s, we indicated that that high potential for conservation of these species exists in the Carpathians. We identified a list of 29 species for which the Carpathian ecoregion could become a conservation hotspot and suggest that land management is concentrated on providing suitable habitat for these species, such as supporting forest recovery, low-intensity grassland management and promoting forest structure and diversity.

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Recent grassland changes in the marginal region of NE Slovakia

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The Poloniny National Park (NP) represents a marginal region located in NE corner of Slovakia. The region is typical by forestry-agricultural landscape, almost without industry, but with high nature conservation value. With well-preserved nature and a geographical location at the border of the West- and East Carpathian biogeographical regions, the Poloniny NP ranks among the most valuable areas for biodiversity in Slovakia. Its importance was recognised also by inclusion to the trilateral (Slovakia – Poland – Ukraine) MaB Biosphere Reserve Eastern Carpathians.

Significant changes in the land use during last decades represent a result of substantial politic and socio-economic changes. They include two regimes changes (start of communist regime in 1948 and transition back to democracy in 1989), agriculture intensification in 1970-ties; removal of settlements of seven municipalities in the 1980s and finally joining EU in 2004 and start of the Common Agricultural Policy (CAP) application. The region suffers from strong depopulation – from almost 10,000 inhabitants in 1960s and 1970s to the current number of around 2,500 inhabitants (Bezák et Halada 2010). Remoteness and unfavourable natural, economic and living conditions represented the main factors of the overall decline of local agriculture. This is reflected in considerable increase of the forest cover land (from 65.1% in 1949 to 84.2% in 2013) and corresponding decrease of agricultural land.

The start of the CAP in 2004 hindered further decrease of agricultural land and many grasslands not managed for long time started to be managed again. Despite current CAP supports rather large-scale, intensive farming and we recognised homogenisation of non-forest land, the grasslands of the region maintain their biological quality and diversity. We can document this process by data from re-sampling of 104 grassland sites in the upper Cirocha river watershed. While in 1999 only 9% of grasslands were managed and 91% abandoned (29% without and 62% with scrub encroachment), in 2013-2015 we found 54% percent of grasslands managed (39% each year and 15% occasionally) and 46 % abandoned (32% without and 14% with scrub encroachment). The vascular plant species richness was maintained – while in 1999 we recorded in average 51.28% species per relevé, in 2013-2015 it was 53.69 species per relevé.

The positive situation in grasslands management and their biodiversity is related to grasslands in lower altitudes of valleys and basins. The existence of highly valuable meadows in mountain ranges (“poloniny”) is threatened due to their remoteness and abandonment. Uhrin (2007) reported that only six out of 50 „poloniny“ meadows occurring in the region are well-maintained, while restoration of 37 „poloniny“ meadows is not possible anymore due to high level of their degradation.

Our results allow to outline the possible future development of the region. We expect continuation of the depopulation of area, possibly with lower rates. The forestry that will probably play the main role in the economy of the region will be probably complemented by maintenance of agriculture, with broad application of agri-environmental measures. The slight increase of tourism and its stronger synergy with agriculture is expected as well.

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Forest ecosystem services and the well-being of communities: a case of non-wood forest products in remote areas of the highlands in Scotland and the Ukrainian Carpathians

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This paper explores practical issues of the contribution of non-wood forest products and services (NWFPs & S) to sustainable development (SD) of remote mountain areas. Literature reviews on the topic formed the start of our research. Their findings show that NWFPs & S are generally considered to be particularly important for rural communities living in marginalised areas, such as mountains, where local well-being is usually lower than in more accessible regions. We test this hypothesis, and using participatory techniques in combination of mixed-methods, analyse existing similarities and differences between the contribution of NWFPs & S to rural communities' well-being in Scottish uplands and the Ukraine's Carpathians.

Results provide evidence that in the Ukrainian Carpathians, forest-dependent communities heavily rely on forest products and amenities. Local people primarily collect and use wild berries and mushrooms, but they also utilise birch sap, wild honey, herbs, etc. At times, they collect more NWFPs than they are capable to consume, and earn money by selling these. Remote mountain communities are also very much dependent upon the supporting ecosystem services. Forest also contributes to the sense of identity of many community members. Forest land is used for grassing and recreation, which is also typical for Scotland.

In Scotland, NWFPs which are sold unprocessed include wild mushrooms, moss and bulbs. Most commonly used wild woodland products include: wild food, honey and bee products, herbs, and wood products used for beverages, as firewood, in orchards, basket production and crafts. Among the cultivated NWFPs, berries and honey play a part in both the economy and the traditional image of Scotland. Sport hunting and fishing are popular. However, the resource base available for NWFPs in Scotland is relatively small (to compare with that in Ukraine) and forest management almost never takes NWFPs into account. Recent policy documents highlight the importance of enabling rural communities to choose their own priorities and solutions. Supporting local people to work on these appropriate solutions is deemed to enhance ecosystems resilience and sustainability of NWFP & S production, management and use.

However, there are many challenges in the field, observed both in the Scottish highlands and the Carpathian Mountains, including of how to attain a proper balance between NWFPs and wood production, as economically timber is still the most important resource provided by forests in both countries, while there is an increasing demand for NWFPs & S. Also, to protect the interests of forest dependent communities, their priorities and concerns in term of forest multiple ecosystem services need to be identified and included into the forest management planning. Recommendations for sustainable management of natural resources need to be developed by involving in the decision-making processes of all relevant stakeholder groups (e.g. through the creation of active groups). Commercialization and value-added processing of NWFPs, as a way to improve the contribution to household income, should be explored; while sustainable harvesting of NWFPs may find a niche role in sustainable development of remote localities through ecotourism. It is also important to increase environmental awareness in society and to strive for cohesion and social innovation in marginalised rural areas, which are largely represented in these countries by remote mountain regions.

This study was supported by the COST Action FP1203: European Non-Wood Forest Products in frame of the EU Framework Programme Horizon 2020.

Characterising thirty years of forest disturbance dynamics using Landsat time series

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Forest disturbances from wind, insects, drought, and wildfires have increased in Europe over the last century and are likely to continue to increase in the future. To successfully adapt forest management and policies to these future challenges will require improved monitoring of forest disturbances and their impacts on ecosystem structure and function. Earth observing satellites such as Landsat and Sentinel-2 can aid in this task by providing frequent and spatially consistent observations of the status and condition of forests. In the last decade, tremendous progress has been made in the development of automated pre-processing algorithms and change detection methods, enabling long-term analyses of forest disturbances using dense Landsat time series over large areas (Griffiths, Kuemmerle et al. 2012, Kennedy, Yang et al. 2012, Pflugmacher, Cohen et al. 2014, Senf, Pflugmacher et al. 2015). At the Forum Carpaticum, we will present our recent work on the mapping and characterisation of transient (e.g. defoliator, forest health) and abrupt (e.g. harvest, fire, bark beetle) forest changes at sites in Central and Eastern Europe using Landsat time series between 1985 and 2015. The aim of the presentation is to contribute to the knowledge of regional change processes in the Carpathian ecoregion and to show potentials and limitations for monitoring them with remote sensing.

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Forest Management and Chain of Custody Certification in Romania: Progress and Problems

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The purpose of the paper was to assess the evolution of forest management (FM) and chain of custody (CoC) certification in Romania and to explore the main challenges the forest management units and forest companies are facing during the certification process. The area of certified forests and the number of CoC certified companies has increased rapidly in recent years in Romania; by mid 2016, more than 2.5 million ha and 528 companies had been FSC certified in Romania, producing and exporting (especially to Western Europe) a wide variety of certified wood products. The main reasons for adopting FM certification were economic/competitive advantages, opportunities to get new customers, increased reputation, whilst the primary motivations for obtaining CoC certification relate to the market benefits of the companies and good reputation/international recognition. The certification cost is considered less relevant, while the lack of certified raw material on the local market and some of the FSC standard requirements were identified as more important impediments to certification. The main unconformities of the FM practice to the FSC standards were related to FSC principles 6 (environmental standards – 42%), 4 (community relations and workers' rights – 15%) and 8 (monitoring and assessments – 12%). Also the study revealed the need for some measures to stimulate the development of CoC certification, including some fiscal facilities for certified companies, a stronger awareness campaign on the benefits of certification and a more transparent harvesting licensing process.

Past and future forest cover change and its determinants between 1860's and 2065 in the Polish Carpathians

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Spatial and temporal forest cover change patterns are characterized by biophysical, historic and economic heterogeneity and reflects centuries of land management shifts. Since nineteenth century slow increase of forest cover is observed in many European countries (MacDonald 2000). However, there is broad consensus about past and future forest cover change only a little is known about the detail spatial and temporal patterns and its determinants of forest cover change on a long-term in regional scale among others in areas like the Polish Carpathians. Therefore in this study, we reconstructed the trajectories of forest cover change over the past 150 years in this region (about 20000 km²) based on historical and contemporary maps from 1860's to 2010's (three study periods 1860's-1930's, 1930's-1970's and 1970's-2010's). Then we evaluated the determinates (biophysical, demographic, accessibility and legacies variables) of forest cover change and finally discussed future possible scenarios of forest cover changes for the next 50 years (until 2065).

We used an ensemble modelling approach (GAM, CART, ANN, RF, GBM, GLM) to account for nonlinearities and interactions between the determinants in the past forest cover change assessment.

Then we modelled the magnitude and location of future land use change between 2015 and 2060 using the Dyna-CLUE allocation framework (Verburg and Overmars 2009). We defined three scenarios of future forest cover change trajectories in the study region: (1) biodiversity and landscape conservation oriented, (2) liberalisation with limited role of different policies like EU policies, and (3) extrapolation of current forest cover change.

The results showed a significant forest increase from about 27 % to 46 % between 1860's and 2010's. In general, a net forest increase in study period amounted about 46% and was the lowest in the last time period (1970's – 2010's) – about 17.5 %. Our statistical models performed well. The selected natural determinates were more important than anthropogenic. The exception was the second time period (between 1930's and 1970's) and the eastern part of the Polish Carpathians where population changes significantly shaped forest patterns. The highest forest dynamics was observed close to the forest boundary, in general both the forest gain and loss were more likely to occur on steep slopes and higher elevations. Since the past is already written based on this knowledge we projected the incoming forest patterns. The highest forest increase between 2010's and 2065 was found for the liberalisation scenario from 46% to about 66%. Trend extrapolation and the conservation oriented scenario lead to moderate forest cover increase from 46% to 56% and from 46% to about 51%, respectively. The newly forested areas in the study region appeared mainly in the western and central part of the region. Which is the consequence of the land use legacies, as the areas described by the similar environmental conditions in the eastern part of the Polish Carpathians were first abandoned and then reforested already after post-war depopulation in 1940's. In general, the local environmental conditions and land use legacies cause the differences in future forest cover change scenarios in the study region.

Research carried out within the FORECOM project (PSRP-008/2010), supported by a grant from Switzerland through the Swiss contribution to the enlarged European Union.

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Influence of wind disturbance on structural complexity and successional dynamics in temperate forest ecosystems: implications for sustainable forest management

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Forest ecosystems of the Carpathian Mountains, like other temperate regions, are shaped by multiple natural and anthropogenic disturbance factors. Wind storms (i.e., blowdown events) are one of the most important natural disturbances in temperate forests worldwide, and blowdown frequency or severity may increase with anthropogenic climate change and land use. Although wind storms represent a natural hazard in Carpathian landscapes, blowdown may or may not necessitate management interventions. Specifically, if blowdowns create undesirable forest conditions or economic losses, then salvage harvest may be justified. On the other hand, if blowdowns increase forest structural complexity or facilitate forest succession, then these natural disturbance events may support ecosystem management objectives, including late successional forest conditions and associated ecosystem services (e.g., carbon storage, water quality, wildlife habitat). To date, few studies have assessed the impacts of wind storms on forest structural complexity and successional dynamics – particularly following intermediate-intensity wind events – and compared findings among multiple temperate regions.

Here, we present a literature review of recent studies on blowdown effects on temperate forest structure, composition, and function, with a special emphasis on mature forests of the Carpathian Mountain region. Based on the literature, we develop two core hypotheses regarding wind storms: (H₁) by transferring overstory trees to the forest floor, blowdowns increase forest structural complexity and heterogeneity at stand and landscape scales and (H₂) by altering forest light environments, blowdowns instigate a shift in species composition and set back mature forest succession. To test these hypotheses, we present field observations of wind disturbance effects in temperate, mixed hardwood-conifer forest sites spanning a range of wind damage patch sizes in the northeastern United States. We compare forest structure and composition in blowdown patches to adjacent reference conditions and assess variability within and among sites.

As hypothesized, moderate-intensity wind storms transferred a substantial proportion of canopy trees to down coarse woody debris (CWD). On average, the initial post-wind ratio of CWD volume to standing tree volume was 6.45 times higher in blowdown patches than in reference conditions. Concurrently, the variability of canopy closure within blowdown patches (coefficient of variation among plots) was 16% higher, indicating not only an increase in canopy gaps but also diffuse edge conditions. Despite these structural changes, however, tree species composition was generally similar between blowdown and reference conditions across all sites, with generally late-successional, shade-tolerant species dominating all strata (overstory, saplings, seedlings).

Our findings suggest that intermediate-intensity wind events can enhance structural complexity without altering successional trajectories. Specifically, recent blowdowns increased down CWD and canopy gap heterogeneity (consistent with H₁), two key indicators of late successional forest structure that contemporary forest management activities aim to restore. Concurrently, the lack of shade-intolerant tree regeneration suggests that these forests will continue on their pre-wind trajectories and that blowdown may even accelerate late-successional development (in contrast to H₂). By presenting new field data and analytical methods within a broader framework based on temperate forest dynamics worldwide, this study contributes to a general understanding of wind disturbance effects. Our findings are directly applicable to current natural resources and environmental management issues in the Carpathian Mountains, particularly the question of how salvage harvest fits within a sustainable forest management paradigm.

Stand dynamics and disturbance history in mixed forest of Norway spruce and cembra pine from Eastern Carpathians

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Old-growth forest stand dynamics is the result of the interaction between internal competition and external natural disturbance regime. Scale and frequency of the disturbance strongly affect forest structure and functions. Forest dynamics involve a very large range of spatial and temporal disturbance scale. Better understanding of disturbance effects on forest structure and the type of the dynamics induced is becoming increasingly important in order to formulate a scientific base for designing nature-based forest management strategies. This study presents the main results concerning the actual stand structure (quantified according with the base diameter and age), the disturbance history and the relationship between them. The study area is represented by an old-growth mixed forest of *Pinus cembra* and *Picea abies* from Calimani National Park, eastern Carpathians (Romania). Three permanent plots (surface between 0.7 and 2.2 ha) were established in an altitudinal transect. For each tree were recorded the species, the main biometric parameters, spatial position and age. Disturbance dynamics was established by boundary line method.

In case of timberline plot the disturbance dynamics and stand regeneration history highlights an important advance of spruce limits in the last 50 years. The second plot targeted a forest out in late

optimal development phase where the actual spatial structure is the effect of multiple wind disturbances. The first wave of regeneration is observed on 1850 with a maximum on 1890, following a high intensity wind damage dated by dendroecological methods around 1840. The second regeneration wave, dominated by spruce, start after 1940 with maximum in 1960-1970 and the intensity is 2-3 times higher than precedent period. The last plot was established in a forest regenerated after catastrophic wind damage (dated in 1840). According with age the spatial structure is quite different. The regeneration history, analyzed using dendroecological methods, highlights the stand establishing starting with 1850 until 1910 with a maximum in 1880. This type of stand developments is specific to a regeneration of open-field and the following stand structure, on dimensional level, is conditioned by competition processes specific to forest ecosystem.

Based on millennium tree ring chronology of stone pine from Calimani Mts. was possible to reconstruct the disturbance dynamics in the last eight century from this region. A significant increase of frequency of disturbance is observed the last century and the largest one been that from 1840 when over 70% from the trees included in the datasets show a significant growth release.

Acknowledgement: This work was supported by a grant of the Romanian National Authority for Scientific Research (CNCS – UEFISCDI), Project Number PN-II-RU-TE-2011-3-0040.

Drought Impact on Vegetation in 2015 in the Czech Republic

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The average annual temperature for the Czech Republic was 9.4 °C with a deviation of 2.0 °C above the long-term average, making 2015 one of the warmest year on record since 1775 (Tolasz *et al.*, 2016). The meteorological, hydrological and agricultural drought deepened during the year. Ongoing drought had a negative effect on plant organisms and the progress of some phenological phases had been greatly affected. The Czech Hydrometeorological Institute manages a network of phenological stations and volunteer observers carried out phenological observations according to the instructions for observers (Anonymous, 2009; Coufal *et al.*, 2004). There are 45 wild plant species with 14 phenological stages in the CHMI phenological observation programme.

In the year 2015 deciduous trees reacted to the extreme conditions prematurely yellowing of leaves, usually 1–2 months in advance and some trees fell down leaves without turned yellow (it was observed mainly in beech, hazel, silver birch and elder). The highest negative deviations of leaves yellowing from long-term average were observed e.g. at Běleč nad Orlicí station (241 m asl, 50° 12' N, 15° 56' E) – *Fagus sylvatica* -46 days; *Quercus robur* -40 days; *Sambucus nigra* -46 days. From conifers was affected by drought only spruce, there was found the combined effect of meteorological factors and the effect of the bark beetle. Herbs (mainly family *Poaceae*) were burnt, therefore there was not the second haymaking except some parts of the Czech Republic e.g. North Bohemia area. Adverse conditions were also reflected on the formation and ripening of fruits (e.g. achenes of maples and ash, nuts of hazel, acorns of oaks, pomes of rowan, drupes of black elder etc.). The intervals between phenological phases (e.g. leaves yellowing 10 % - leaves yellowing 100 %; leaves fall 10 % - leaves fall 100 %; leaves yellowing 10 % - leaves fall 10 % etc.). were really different from other years.

Absolutely exceptional findings were obtained in the period from late August to October - the most of the drought-damaged vegetation reacted to the onset of "spring" phenological stages and actually initiated new growing season.

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Snow-related impact in the Carpathians under climate change conditions

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Winter sports are an important source of income in many mountain regions. Reduced snow cover affects winter tourism which leads to local socio-economic problems. On the other hand, the ski industry tends to adapt to reduced snow cover either by snowmaking facilities or by shifting to higher altitudes in mountains so as to reach snow-reliable areas, which creates further pressure on the alpine environment and water resources. Our study aims at assessing snow-related impact of climate change in the Carpathians.

In this context, we started from the results of five regional climate models which are available thanks to the EURO-CORDEX initiative (Jacob et al., 2014). We have used the 1972-2001 period as the reference interval for the present climate and analyzed projections for the 2021-2050 and 2071-2100 intervals. The analysis has been performed under the greenhouse gases (GHG) concentrations scenarios RCP 4.5 and RCP 8.5. Both scenarios indicate a decrease of the average snow depth over October to April season, the largest reduction taking place towards the end of the 21st century, under the highest concentrations scenario. Topography influences as well the local response to climate change signal. Under the RCP 8.5 scenario, considering high global GHG concentrations, regional model results suggest reductions in the snow depth up to 90% for certain regions (e.g. areas from the Western Carpathians in Slovakia and the Eastern Carpathians in Ukraine and Romania) towards the end of this century. Furthermore, strong increases in minimum temperatures will limit the effectiveness of snowmaking as an adaptation strategy for ski resorts, contributing also to water resources reduction.

A ski resort is snow-reliable and profitable for winter tourism if in 7 out of 10 winters snow depths reach at least 30 to 50 cm, for a minimum of 100 days, from 1st of December to 15th of April (Abegg, 2007). Based on this estimation we have further assessed the impact of climate change on the potential snow reliability for ski resorts in the Carpathians, under moderate and high concentrations scenarios. In general, one has to take into account the assessment based on climate projections and the intrinsic level of uncertainty which remains in quantifying both future climate change and associated economic impact when making decisions for sustainable adaptation to climate change (Bojariu et al., 2015). This approach also applies when selecting adaptation measures to cope with snow reduction.

The research leading to these results has received funding from EEA Financial Mechanism 2009 - 2014 under the project contract no 19SEE/2014.

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Setting a forest data platform to support sustainable forest management in Carpathian area

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Woodland and forest is the most represented ecosystem in the Carpathian Mountains, being the natural capital of the region and providing a wide range of ecosystem services that contribute heavily to the human well-being. The Carpathian forests are habitat provider for a wide range of animal and plant species, and more importantly they are Europe's largest area of virgin forests. These special characteristics raise the need to preserve the forest richness and ensure sustainable use of its resources, as formalized by the "protocol for sustainable forest management", signed by Carpathian convention Parties.

To support this protocol, the Carpathian Convention Secretariat, the Environmental European Agency (EEA) and the European Topic Centre on Urban, Land, and Soil systems (ETC/ULS), have identified three main spatial indicators to be applied at a regional level (i.e. covering the whole Carpathian region), in order to support monitoring and management of forests at a regional scale.

A first phase of the process focused on the identification, of available data and was followed by an in-depth assessment of their reliability to monitor spatial and temporal changes in forests. Based on this selection, specific methodologies for the production of regional indicators to support sustainable forest management in the Carpathian forest ecosystem were developed. Several datasets were explored, collected and harmonized covering the study area as defined in the Carpathian Environment Outlook (KEO). The spatial information collected supplied essential information on the land cover, forest type and density, tree species distribution and tree habitat suitability, virgin forest (various initiatives e.g. PIN-MATRA project) and on the protection measures in place in the region. The data extracted from different sources and developed at different scales did undergo consistency checks before its use on the assessments. To fill the gaps in data, Earth Observation data extracted from satellite images, including Landsat and Sentinel 2 (Copernicus products), were used to fill data gaps, mainly for Ukraine. The resulting datasets, validated through statistical methods, enabled an accurate differentiation of the forest cover from other land cover classes in the region, making possible the development of harmonised and accurate regional datasets covering the whole Carpathian forests. The application of these methods on time-series will provides a valid tool to monitoring the changes in forest coverage among time depending on the frequency and quality of images.

Finally, two spatial indicators on forest fragmentation and forest naturalness were calculated. Forest fragmentation map is obtained by applying a geometric model namely Guidos Toolbox (Vogt P., 2016) and offering a picture of the forest structure, differentiating Morphological Spatial Patterns (Soille P. et al., 2008) enhancing potential sensible zones to fragmentation, and identifying core forest zones. This indicator showed a high level of un-fragmented forest for Carpathian Mountains, being higher than 77% of core forest. The Naturalness indicator (ETC/SIA, 2014), shows a high naturalness index of the tree species composition for Carpathian biogeographical regions; being equal to the relation between the high percentage of natural species presence and the percentage of forest coverage. This indicator has been calculated per each bio-region of the area of study and allows to identify the forest zones where is highest the probability to detect a high level of natural forest.

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Palaeoecological assessment of human impact in the subalpine areas of the northern Romanian Carpathians: a prehistoric and historic perspective

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Designated as biologically outstanding ecosystems in the Global 200 Initiative for their species endemism and habitat diversity (Dinerstein et al., 2000), the Carpathian Mountains are one of the terrestrial ecoregions most critically endangered by the impacts of human activities and climate change (KEO, 2007). Such threats are likely to result in a dramatic loss of biodiversity and habitat change, particularly affecting the region's highly diverse, endemic species rich mountain pastures (Pauli et al., 2012).

We present a high resolution, multi-proxy palaeoenvironmental reconstruction (pollen, dung fungal spores, micro and macro-charcoal, mineral magnetic properties and geochemistry) of three sedimentary sequences located in the present subalpine belt across a range of elevations in the Rodna and Maramures Mountains (northern Romania) spanning the Late Holocene (i.e. the last 4000 years). We aim to: i) determine what aspects of prehistoric and historic human activity (e.g. burning, clearing, grazing) have shaped the subalpine landscapes of today, and ii) employ this information to optimise the management strategies of mountain pastures.

Our preliminary results suggest that throughout the last 4000 years today's subalpine belt has been subjected to anthropogenically-induced change characterised by both, increases in landscape openness after ca. 3000 cal yr BP, and particularly over the last two centuries, and periods of enhanced catchment erosion (3400 to 2600, 1000 - 700 cal yr BP and the last two centuries). Fire activity was identified as a key driver of vegetation change at high elevations, mainly due to its use as a tool to enlarge and maintain subalpine grassland areas used for grazing. Our results further suggest that low-intensity land-use practices on mountain pastures were actually beneficial for the biodiversity of mountain grasslands.

Based on this long-term palaeoecological perspective, we argue that an effective strategy to maintain landscape openness and likely diversity in the subalpine areas of the northern Carpathians would be to promote low to moderate intensity grazing and burning.

GF, IT and AF acknowledge the support from the Romanian National Authority for Scientific Research, CNCS-UEFISCDI PN-II-RU-TE-2014-4-2445.

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Historical land cover dataset of the Carpathian region: data, metadata, availability

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Eastern Europe has experienced several major socio-economic transformations during the last two centuries: the demise of the Habsburg Empire, two World Wars, the rise and fall of Socialism, and the eastward expansion of the European Union. The region represents a great "natural experiment" for social and land use scientists. The former territory of the Habsburg Empire has been thoroughly mapped since the 17th century, which provides a great resource for long-term land change analysis. We used an innovative sampling grid approach to digitize historical maps in the Carpathian region, for three points in time capturing major socio-political regimes. Here we discuss the long-term land-cover changes and their applicability for land change analysis.

Our study region includes the Carpathian Ecoregion, The Hungarian part of the Pannonian plains and the historical region of Moravia in the Czech Republic. We mapped land cover according to a 2x2 km sampling grid that matches the 2007 INSPIRE (Infrastructure for Spatial Information in the European Community) directive and LUCAS (Land Use and Cover Area frame Survey) grid. Our dataset comprises of 91,412 points covering 365,648 km² in 7 countries. We digitized three time layers: 1) For the Habsburg period, we used maps of the second military survey from years 1819-1873 at scale 1:28 800; 2) Interwar period was covered by different map sets from years 1915-1945 and scales range of 1:20 000-1:100 000; and 3) the Socialist period was mapped from national topographic maps for the years 1950-1983 at scales between 1:25 000-1:50 000. We collected metadata about year of mapping, map source and uncertainty. To harmonize data from different map sets, we designed a 4-level hierarchical legend.

The urban and built up area increased rapidly from 1,267 points (1,6%) in Habsburg time to 2,662 points (3,3%) in the interwar period. During the Socialist period total urban area slightly increased to 2,761 points (3,4%), but decreased in Romania and Ukraine. The agricultural area increased from the Habsburg period and was stabilized in the interwar period to 34,391 points (42,8%). Substantial decrease of agricultural land after the WWII was recorded in Poland, while agricultural area increased in Romania. Total area of grasslands and shrubs decreased during the first study period from 19,279 (24%) to 15,899 points (19,8%) and then slightly decreased, but there were substantial changes in grasslands area in all countries.

Forest transition occurred in the interwar period, when the lowest forest cover was recorded at 28,206 points (35,1%). Then the total forest area was stabilized, but higher increase was found in Poland and Hungary. The area of wetlands decreased rapidly from 1,029 points (1,3%) at Habsburg time, through 546 points (0,7%) during interwar period to 229 points (0,3%) in the socialist period. Water bodies and rivers were reduced from 753 (0,94%) to 689 points (0,86%). Bare land area was reduced over the time.

Our dataset represents the first detailed, cross-boundary data on long term land use in the Carpathians. Data were used for example for assessing the effect of land-use legacies on contemporary forest disturbance (Munteanu et al., 2015), for testing of different digitization approaches (Kaim et al., 2016) or for evaluation of land-cover changes at regional scale (Konkoly-Gyuró and Balázs, 2016). Data will be available for the public. This dataset is relevant both to scientists and practitioners working in the Carpathians dealing with the land use history, driving forces analyses, legacies effect and other landscape history issues.

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THEMATIC SESSIONS

A novel forest state assessment methodology to support conservation and forest management planning

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Traditionally forests were mainly used and managed for timber production. However, social expectations regarding forests have notably changed in the last few decades. In addition to the traditional production function, the other – often conflicting – functions that forests should fulfil include protective functions, biodiversity and ecosystem functions, social and cultural functions and economic functions (COM 2013).

One possible way to achieve these goals is to spatially separate the different function by designating nature reserves, protective forests (soil, landslide), recreational areas and forests serving primarily wood production. However, in Europe with long history of intensive land-use the magnitude of landscape transformation (habitat destruction, fragmentation and degradation) has exceeded the threshold of habitat loss where this approach is feasible.

This leads to the need of wise application of both segregative (strict reserves) and integrative approaches in forest biodiversity conservation. The latter means the integration of non-commercial goals in the management of forests providing multi-purpose services (Kraus and Krumm 2013). Integration of different management goals requires strategic planning using appropriate data that describe both the biological and commercial status and potential of a specific planning area at a sufficient spatial resolution enabling spatially explicit planning.

The motivation of our work presented here was the recognition of the lack of such data. Most databases contain thematically specific information that is designed to help practitioners to achieve certain management objective (e.g. production) regardless of other objectives. The combination of such databases is hindered by the differences in spatial and temporal resolution.

To achieve our goals, a new forest state assessment methodology has been developed and implemented. The main goal of the forest state assessment was to collect structural and compositional data that was missing and that could be used by forest management companies and conservation agencies (national parks) for strategic as well as daily planning of forestry and conservation activities. The assessment was also planned to support the analysis of forest naturalness and to enable us to find potential hot-spots of biodiversity. The method is point-based using a dense systematic sampling grid and provides more detailed information than vegetation maps or forest subcompartment descriptions, but requires less effort than forest inventories. Indicators include canopy composition and structure, dead wood, herbs, microhabitats, disturbances, shrubs and regeneration. The results can inform managers about the structural and compositional diversity of forests stands in the form of thematic maps and can provide the basis for analysis on habitat suitability for forest-dwelling organisms.

A smartphone application has been developed to enable electronic data collection. PostGIS and Python scripts were used in the data flow. The protocol has been designed for low mountain forests in Hungary, but it can be modified to fit other forest types.

This work was supported by a grant from Switzerland through the Swiss Contribution (“Multi-purpose assessment serving biodiversity conservation in the Carpathian region of Hungary”, registration number SH/4/13).

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Accordance between the Application of Silvicultural Operations in Protected Area with Standing Orders of Species Protection Management. Case Study: „Magura Odobesti“ – ROSPA 0075

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To the application of silvicultural operations is necessary to draw a strategy and a rule system developed for the *Special Protection Natural Area*.

For the silvicultural operations established in Forest Management Plan it is mandatory to delimit in space and time each work set and to identify the natural habitats in the *Special Protection Natural Area* where the target species have the places of reproduction, breeding and feeding.

Meanwhile, it is necessary to make a list of the main ethologic features for the target species.

For the conservation of the habitats indispensable for the survival of target species, each silvicultural operations takes place following certain rules and is modeled after dominant traits of protected species ecology.

In *Special Bird Protection Natural Area „Magura Odobesti“ – ROSPA 0075* from Curvature Carpathians, Vrancea county, Romania, where settled special conservation measures in accordance with silvicultural operations processed and depending on space and time of the execution.

First, consider the implementation of silvicultural operations the most important piece of this union, because they are the only way to conserv and to assure the continuity and biodiversity of the special forest habitats, anthropogenically influenced in the last 200 years.

In subsidiary, the implementation of silvicultural operations should be made in correlation with reproduction, breeding and feeding areas and habits of 12 protected birds.

The execution of cutting operations must maintain some special species of trees of different ages, favorable and designate to provide food and nesting areas for birds.

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Simulation of changes in biodiversity during the conversion of secondary even-aged Norway spruce (*Picea abies* [L.] Karst.) into mixed uneven-aged stands in forest decision-making: the Ukrainian Carpathians case study

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Multifaceted phenomenon of climate change induces significant losses of ecological resilience and economic productivity of secondary even-aged Norway spruce stands in the Ukrainian Carpathians, developed for economic reason (Krynytskyy and Chernyavskyy, 2014; Keeton and Crow, 2009; Stoyko, 1998). Conversion of even-aged secondary stands into mixed, uneven-aged ones is thought

as an effective way to tackle these problems (Soloviy et al., 2011).

According to experts' estimates during and after the conversion process from secondary even-aged into mixed, uneven-aged stands, besides financial revenue (Hanewinkel, 2001), we receive many other benefits: increased productivity and biomass (Piotto, 2008; Pretzsch et al., 2010 and 2014); reduced financial risk through timber products diversification (Hildebrandt and Knoke, 2009); increased recreational value of forests (Norman et al., 2010; Grilli et al., 2014); reduced risk of windfalls (Schutz et al., 2006) and fires (Gonzalez et al., 2006); better resistance to drought (Merlin et al., 2015); reduced risks of pathogens' impact (Parpan, 2014); improved soil conditions (Brandtberg et al., 2000; Prescott, 2002), especially improved habitats for biodiversity (Lindenmayer and Hobbs, 2004; Carnus et al., 2006; Brouckhoff et al., 2008).

We modeled different conversion strategies with application of various alternatives of selective thinning and target diameter harvest by the growth simulator SIBYLA (Fabrika, 2005) for comparison of biodiversity richness during the conversion process. According to the Jaehne and Dohrenbusch index of diversity (1997), after simulation of conversion strategies we obtained uneven-aged stand structure (index values in the range from 6.0 to 7.9). Also analysis of the simulation revealed negative correlation between stands volume and the Jaehne and Dohrenbusch index of diversity. Achievement of the best horizontal and vertical diversity depends on time and intensity of the conversion regime. This was confirmed by the value of tree species heterogeneity, such as index lambda (Simpson, 1949) and Entropy H' (Shannon, 1948). All conversion strategies started with the same initial status of tree species richness, which was described by the indexes R1 (Margalef, 1958) and R2 (Menhinick, 1964) and characterized by a rather low value of the index (by 0.151 and 0.074). These indexes showed a small change during the conversion period. Only in the end of the period the obvious advantage got a strategy with a less intensity regime of thinning (by 0.437 and 0.127).

Generated quantitative estimates of biodiversity changes should be integrated into forest decision-making aimed at sustainability. They can be easily applied in analytic hierarchy process for multi criteria examination of strategies. Taking into account these changes in cost-benefit analysis of the conversion process seems to be more sophisticated but obtained results will provide forest decision-makers and society with important information on the attractiveness and necessity of the conversion process from economic point of view.

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Multidirectional analysis of a dendrochronological network from NE Romania in order to build a 600 years chronology used to reconstruct past climate

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Climate changes highlighted by recent studies, outline the necessity of better knowing the local climate to as long as possible periods of time. Tree rings width analysis offers credible and high resolution regarding climate oscillations. The study area is located in NW of Romania, respectively, in Maramures Depression, Somes Plain and Somesan Plateau. The biological material used is

represented by tree-ring cores of oak trees. Samples were collected from living trees and wood from historical buildings.

The information from tree-ring width regards the vegetation seasons – previous to annual tree-ring formation (earlywood) and the current one (latewood). In order to elaborate the long dendrochronological series of more than 600 years, we utilized archaeological wood which originates from Maramures Depression area.

By cross-dating, some samples which offered minimum correlative values with master series ($< 4t$ BP), were eliminated. The living oak trees series are uniform distributed in the area from where the archaeological wood originates and a primary analysis indicates different correlations with the climate. Although, the chronological series covers more than half millennium, the key question is: which of the archaeological wood samples have to be used to create the dendrochronological series with the main goal to maximize the climatic signal.

Another unknown issue is related to the new obtained series and if this can include both, oak and sessile oak samples. Starting from this point, we have analyzed the species influences, geographical settings and the features of tree rings growth climatic response. The obtained results highlight a response of trees to climate, different, depending on geographical location and the main landforms listed above. The multivariate spatial analysis emphasizes the role of geographical setting and studied species.

The research leading to these results has received partial funding from EEA Financial Mechanism 2009 - 2014 under the project contract no 18SEE. Part of this work was supported by a grant of the Romanian National Authority for Scientific Research and Innovation, CNCS-UEFISCDI, project number PN-II-RU-TE-2014-4-0855 "Reconstruction of Late Holocene History of Romanian rivers based on geomorphological and dendrochronological interpretation of subfossil trunks". The research was also, partially supported by funds from the Exploratory Research Projects PN-II-ID-PCE-2011-3, "Reconstruction of Romanian river-channel changes in the last 11.700 years: The role of climatic conditions and human impact."

POSTER PRESENTATIONS

Deadwood in managed and unmanaged oak dominated forest stands in the Hungarian Carpathians

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Standing and lying dead wood (DW) is an important component of forest ecosystems, as it provides habitat for several living organisms creating biodiversity hotspots in forest stands. The aim of the study was to describe the DW amount in managed and unmanaged sessile oak-Turkey oak forest stands. The study sites are located in the Hungarian Carpathians, a middle range mountain in the North-Eastern part of the country. Altogether 338 sampling plots were selected in 100 stands, belonging to three age classes and two management groups forming 5 stand types: 1 – young stands (40-79 years old) recently managed, 2 – young stands (40-79 years old) managed in the past, 3 – mature stands (80-119 years old) recently managed, 4 – mature stands (80-119 years old) managed in the past, 5 – overmature (120-165 years old) stands. In each sampling unit a 250 m² sized circular plot was defined for the measurement of living trees and standing DW. The volume of logs was estimated by line-intercept sampling method (3 × 16 m transects/plot). Stand type 1 and 2 (young stands) showed similar DW characteristics independently if the last management action took place within the last 10 years or before. The total amount of DW was around 11 m³/ha, where the ratio of living tree and DW was higher than 30%. Stand type 3 differed from these cases by even lower DW amount (approx. 8.5 m³/ha) and by the markedly low (15.1%) ratio of standing DW volume. Stand type 4 and 5 contained much higher amount of DW (35-45 m³/ha) than the three previous ones. Our

results show that deadwood is the first among the natural structural forest features that, in case of the cessation of forest management, reach volumes similar to those of old-growth forests.

SUSTAINABLE CARPATHIANS I

ORAL PRESENTATIONS

Recent forest covers changes (2003-2016) in Southern Carpathians. A case study from Iezer Mountains, Romania.

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Southern Carpathians are the highest region of the Romanian Carpathians and a mountain region featured by high degrees of forestation between 300 and 1800 m of altitude. Different authors explained the forest landscape change in the broader context of the Carpathian Mountains (Griffiths et al. 2014, Munteanu et al. 2014), some of them focusing on smaller mountain regions of Romanian Carpathians (Mihai et al. 2007; Săvulescu and Mihai 2011).

The paper proposes a continuity of the change detection analysis of forest cover in Iezer Mountains (Mihai et al. 2007), in the context of the recent deforestation processes (Griffiths et al., 2012), combined with the effects of natural hazards like windthrows and forest fires. The objective is to map the forest disturbances on types and magnitudes, in a mountain area with altitudes between 500 and 2462 m, featured by all the representative Carpathian ecosystems, from beech zone up to the spruce fir zone and the subalpine-alpine pastures.

The method is based on change detection analysis of satellite imagery with Landsat data (ETM+, TM and recent OLI imagery) and Sentinel-2 imagery. The analysis started with a complete calibration of multispectral data from 2003 (before the massive forest restitution to private owners), 2005 (an year with intensive windthrows on large areas), 2008 (the start of an intensive deforestation along the main valleys like the Upper Dâmbovița Valley), 2013 (intensification of deforestation on Souther slopes and forest fires on the northern slopes) and up to 2015-2016 (the present day-situation). For data classification a combination between classic supervised classification at pixel level (maximum likelihood and Support Vector Machine) and object-oriented classification was used. Training areas are based on defining the spectral signatures for all the classified data. Some masking was necessary in order to discriminate classes with nearly similar spectral features.

The forest change map is developed after combining the classification in a unitary formula, using image differences, Principal Components Analysis and the change vector analyses for some details. The main result is a map showing the type and the magnitude of forest cover change which is analysed from the statistical point of view.

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Future land use change and flood hazard in the Polish Carpathians

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Flooding has been a major natural hazard in recent decades in southern Poland. For example, floods in urban and rural areas of the Polish Carpathians caused casualties and losses estimated at 1.5 bln EUR. Assessing flood risk with hydrological modelling requires elevation and river network data, soil data, precipitation values and land use maps. Such modelling forms the basis of flood protection activities planned for decades ahead. Therefore, in order to better forecast future flood hazard, it is important to incorporate future land use and climate projections in hydrological modeling.

In this paper we combine future climate projections and future land use scenarios in order to define likely future flood risk for the Polish Carpathians, for the period 2010-2060. For climate scenarios, projections of average summer precipitation and average summer temperature based on IPCC Representative Concentration Pathways 4.5 and 8.5 were modelled. We modelled the future distribution of five land use classes (forest, arable land, grassland, shrubland, settlements) using a scenario approach and the Dyna-CLUE land use allocation framework (Verburg, Overmars, 2009). Three scenarios were defined along axes of regionalisation to globalisation and market-driven to high policy intervention: 1) globalisation scenario with a limited policy intervention, 2) self-sufficiency scenario with regionally centred development, and 3) trend extrapolation scenario. Within the land use change models suitability for a given land use type was defined in relation to several variables: temperature and precipitation (including future projections based on IPCC RCPs), slope, topographic position, population density (including future population projections), average farm size and forest ownership.

River basins chosen for hydrological modelling differed in projected urbanization rate and forest cover area. Future land use maps for three different scenarios were applied to hydrological models and the results were analysed in the context of flood hazard assessment.

The results of hydrological modelling showed that the retention capacity will increase and the overall flood hazard in modeled area will decrease due to forest cover increase. On the other hand, in urbanized catchments, the level of flood risk may increase in the coming years because of the impervious surface area increase.

Research carried out within the FORECOM project (Forest cover changes in mountainous regions – drivers, trajectories and implications, PSRP 008/2010), supported by a grant from Switzerland through the Swiss contribution to the enlarged European Union.

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Land cover and landscape diversity changes assessment as a contribution to sustainable use of traditional viticultural landscape in the Malé Karpaty Mts. (Western Slovakia)

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Traditional viticultural landscape situated on the foothills of Malé Karpaty Mts. (Western Slovakia) can be considered nowadays to be a landscape heritage and a significant landscape stability factor. On the other hand, the proximity of the capital city of Bratislava makes a heavily impact through

the development projects and thereby it causes the disappearance of this type of landscape. Land cover and landscape diversity changes analysis was applied in the study areas of Svätý Jur and Modra for two historical periods (Svätý Jur: 1896 – 1949, 1949 – 2011; Modra: 1894 – 1949, 1949 – 2015).

The analysis was complemented by local landscape history analysis. The study focused on the changes of traditional viticultural landscape into a modern one, which took place during the socialism era, accompanied by building of massive terraced vineyards in parts of the study areas. The source material for detailed land cover and landscape history analysis comprised historical and contemporary cadastral maps, state maps, monochrome aerial photos, aerial orthophotos, historical postcards and archive documents and other written sources. Land cover (LC) in the last study period was verified by field mapping. The remnants of still existing traditional viticultural landscape from the Middle Ages were confirmed in the field by occurrence of archaic stone ramparts and walls on field margins, also by original terracing and traditional way of use. Detailed LC legend was designed for both model areas in order to record the small patches of semi-natural habitats (slopes of modern vineyard terraces, stone ramparts on the traditional vineyard margins). Based on the changes in areas of the individual land cover classes we have identified the main trends of land cover changes. The model areas (sized 66 and 88 ha respectively) were divided into a grid (cell size 25x25 m) and landscape diversity (LD) values were evaluated for all cells for all years. The Shannon and Simpson landscape diversity index (SHDI and SIDI respectively) were chosen for the purpose of LD assessment.

Both LC and LD changes were more pronounced during the 1949 – 2011 (2015) period comparing to the 1896 (1894) – 1949 period in both areas. In LC pattern distinct decrease of vineyards was observed between 1949 and 2011 (2015). During the collectivisation process in the 1950s and 1960s traditional, prevailingly non-terraced vineyards were mostly transformed into modern terraced vineyards in both areas. Similarly, the increase of forest, grasslands and built up areas were also typical LC changes during the 1949 – 2011 (2015) period. The main driving force of the LD rise during the 1949 – 2011 (2015) period was the dissection of relatively homogenous smooth vineyard slopes into terraces which led to the increase of patches and the edge length and resulted in a higher LD. The use of fine-scale LC and LD changes analysis complemented by knowledges of local landscape history led to interesting findings that now LD is distinctly higher despite of intensification of agriculture connected with forcible land consolidation under socialism era.

The results of our study could improve landscape knowledge basis, and thereby contribute to the efficient use of outstanding bio-cultural resources of the region.

Acknowledgement: The article was written as part of the VEGA Project No. 2/0023/15 and VEGA Project No. 2/0158/14.

Forest cover change trajectories from historical maps: assessment of change detection uncertainties

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Maps are simplified models of reality, and any map series comparison (overlay) implies error propagation. Forest cover information from topographical maps is typically a binary vector - showing presence or absence of forest. For any map series, forest cover change dynamics at a specific location is expressed by forest cover change trajectory that is a sequence of 0 (non-forest) and 1 (forests). Many methods and theoretical models deal with uncertainty in land-use research (Plewe 2002, Leyk et al. 2005). Kaim et al. (2014) have discussed usefulness of the trajectory investigation for assessing the reliability of forest cover change analysis from historical maps. The

initial presumption is that, given a specific land use history, not all trajectories are equally likely. For example, four moments 0-0-1-1 trajectory may likely signify a change from non-forest to forests in between the second and third moments in time, whereas 0-0-1-0 trajectory may likely indicate a measurement error in the third moment.

In this study, we refined the methodological framework for reliability assessment of forest cover change from a map series based on the forest trajectory concept by adding forest geometry. We used extensive forest cover vector data from historical maps, collected in the Polish Carpathians (nearly 20,000 km²) over the past 160 years and current national topographic vector data (Baza Danych Obiektów Topograficznych 10k; BDOT10k). In general, the data showed a clear and gradual forest cover increase in the region in recent 150 years, from the minimal level in the first half of the 19th century till now. However, trajectory-based investigation provided more detailed forest cover changes description. While investigation of trajectory reliability, Morphological Spatial Pattern Analysis (MSPA) (Vogt et al. 2007) was applied, which described the geometry and connectivity of the image components by giving spatial patterns indicators of forest fragmentation from binary forest (1) / non-forest maps (0). 0-1 transitions and transitions between various MSPA classes (edge, core, patch, perforation, bridge, branch, islet) were investigated for different raster resolutions (Ostapowicz et al. 2008). Results showed, that the most likely transitions – core to core, edge to core and non forest to edge - were dominant (i.e. for 30m raster resolution: 0-0-1-1 trajectory – 79%, 0-1-1-1 – 80%), while unlikely transitions frequently reflected erroneous trajectories.

Research carried out within the FORECOM project (Forest cover changes in mountainous regions – drivers, trajectories and implications, PSRP 008/2010), supported by a grant from Switzerland through the Swiss contribution to the enlarged European Union.

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POSTER PRESENTATIONS

The use of GIS applications and remote sensing for the evaluation of the vulnerability of the eco-environment determined by the abandonment of grasslands and mountain pastures in Brasov county

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Brasov, the "central" district of the country, located along the middle course of the Olt river, is one of the oldest inhabited areas in Romania dating back to 60 000-40 000 B.C. and including old livestock traditions. Sheep breeding has always been a main activity for the inhabitants of this region as topography, climate, vegetation and soil have been favorable factors for its development. If in the past it generated most of the needed food and products to residents in the region, currently the modern era has brought important changes which make hard to preserve traditional working. The expanding settlements, the changes in the land use, the switch to mechanized agriculture, the emergence of agricultural associations and modernized activities made a series of agricultural land

areas, especially pastures and grasslands, to be replaced by other types of land or in most cases to be abandoned.

The census of agricultural land from 2002 revealed that over 20 000 hectares of farm land and over 10000 ha of grasslands and pastures in the county were abandoned. In the last twenty years no further investments have been made to create and improve grasslands and pastures in the county, and in time, climate change has accentuated even more the degradation process of these lands.

Taking into consideration data for Brasov county, our study proposes the usage of GIS techniques and remote sensing for the inventory and analysis of the dynamics of grass lands and pastures for a period of 50 years in order to assess the vulnerability of the eco-environment in relation to the changes and to transpose the results obtained in a vulnerability map for the region of study.

In this respect, the eco-environment vulnerability assessment is based on a model of spatial analysis and its principal components: land use, environmental groups of soils, topography, vegetation, climate, social economy variables. The model helps us to establish an ecological vulnerability index for the analyzed region. The obtained results are reclassified in four categories (potential, light, medium and heavy) allowing to highlight areas that are degraded, affected (with an increased index of vulnerability), with a certain risk to be damaged in the future (with a small- medium index of vulnerability) or free of risk (with a zero index of vulnerability).

GIS techniques offered the possibility to collect data on the map support, to store them in a data base and analyze them at a later date whereas remote sensing allowed us to capture updated satellite images even for less accessible areas.

The obtained results may be put at the disposal of the Brasov county's managing authorities in order to help them understand the changes occurred in the eco-environment during the last decades and to enable them to draw up a management plan for these lands with a view to sustainable development in the region.

SUSTAINABLE CARPATHIANS II

ORAL PRESENTATIONS

Conservative status of the habitats of European Community importance from the Alpine biogeographic region – Romania

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In this paper we present the conservative status of the habitats that occur in the Alpine biogeographic region of Romania based on available data that were resulted from the first monitoring of conservative status of the habitats and species of the Community interest from Romania. This has been achieved during the 2011-2015 period as an obligation arising from Article 11 of the Habitats Directive (HD) in order to report the summarized and analysed results to the Commission, according to Article 17 of the directive that requires Member States to report every six years the progress made with the implementation of the HD.

Of the nine continental biogeographical regions that are defined within Europe according to the European Commission of Habitats Directive (92/43/EEC) and the Habitats Committee (5/04/2005), five are found in Romania, as a consequence of geographical position: Alpine, Continental, Pannonian, Steppic, and the Black Sea (Pontic). Due to this biogeographical junction and the great heterogeneity of the landscape within its territory, Romania has a great diversity of wildlife and natural habitats.

The Alpine biogeographical region overlaps with all mountain ranges of Europe irrespective of their orogeny. Because the boundaries for the biogeographical regions were drawn using the Map of the Natural Vegetation of Europe, in term of land forms and geological terrains, there is no integral overlapping between the Carpathian range and the extent of the Alpine biogeographical region (ABR) on the Romanian territory. However, the ABR that occurs in 13 EU countries (31.1% of total terrestrial area of EU) extends over 20% of the Romanian territory, which represents 8.6% of EU territory and around 6% of entire surface of ABR at the Europe continent level.

According to the latest reference list of the HD, the terrestrial Alpine region of the EU encompasses 121 habitat types of the Community interest. In the area of ABR of Romania the following 49 habitat types are found: freshwater habitats (5), temperate heath and scrub habitats (5), grasslands habitats (11), bogs and fens habitats (7), screes and rocky habitats (6), cave habitat (1), and forests habitats (14). From all these habitat types 17 occur only in the ABR. These are as follows: freshwaters (2), temperate heath and scrub habitats (4), grasslands (4), bogs and fens (3), screes (1), forests (3). Another 24 habitat types occur both in ABR and the Continental biogeographical region of Romania, but several of them are located only in the Carpathians system – mountains range and highlands.

An assessment of the conservation status of all habitat types was carried out following the methodology agreed by the European Commission and Member States that is based on a separate evaluation of four parameters which define the Favourable Conservation Status given in the HD. The results show that the conservative status is favourable for 35 habitat types, unfavourable/inadequate for 10 habitat types, unfavourable/bad for 2, and unknown for 2 others. For all seven bogs and fens habitat types the conservation status is unfavourable but it is favourable for all 10 grassland habitat types.

Regarding habitats that occur only in ABR the conservative status is favourable for 12 habitat types (1 freshwater, 4 heat and scrub, 4 grassland, 1 rocky habitat, 2 forest habitats); it is unfavourable/inadequate for 3 habitat types (1 freshwater, 1 bog and fen, 1 forest), unfavourable/bad for one bog and fen habitat type, and unknown for one bog and fen habitat type.

This paper presents partial results from two projects: POS SMIS 17655 and RO 1567-BB04/2016.

On the importance of Carpathian rivers and lakes in the conservation of Europe's freshwater biodiversity

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Freshwater ecosystems host disproportionately high numbers of species relative to their surface area and are more threatened than terrestrial or marine ecosystems (Dudgeon et al., 2006). Yet freshwater biodiversity is poorly protected globally (Darwall et al., 2011), which necessitates scientifically sound prioritization and evaluation of conservation effort (Linke et al. 2012). We estimated the conservation priority of 18,816 river and lake catchments in Europe based on data on the distribution of 1631 species of aquatic plant, mollusc, odonate and fish. We used the MARXAN systematic conservation planning tool for the prioritisation focusing on the irreplaceability of catchments based on the conservation status and range restriction of its species and on the

uniqueness (endemicity) of its species assemblages. We found highest irreplaceability for river systems and ancient lakes in S Europe (Iberian, Italian, Balkan peninsulas), large rivers and lakes in central and N Europe, small coastal catchments and lakes in NW Europe and karst/limestone areas in the W Balkans, NW Greece, S France, E Alps, and W Bavaria. Three Carpathian countries (Hungary, Slovakia, Romania) had higher-than-average catchment irreplaceability. In the Carpathian Region, high-priority catchments (present in 100% of the MARXAN optimisations) included several transboundary catchments between Austria and Hungary (upper Raab/Rába, Mosoni Duna, Lake Neusiedler/Fertő-tó), between Slovakia and Hungary (Ipel'/Ipoly), and between Romania and Hungary (Ier/Ér, Barcău/Berettyó, Crișul Negru). Other high-priority catchments were in Hungary (Ikwa/Ikva, Répce in W; Pécsi-víz and Gyöngyös in SW; Vidi-ér, Keleti-főcsatorna, Kutas, Ölyvös, Konyári-Kálló in E Hungary) and in Romania (Lăpuș in N and upper Argeș in south-central Romania). Priority catchments (present in at least 85% of the MARXAN solutions) were along the northwestern Danube in Slovakia (left-side tributaries such as Nitra and Hron) and in Hungary (small right-side tributaries), between Slovakia and Ukraine (Latorica/Latoritsya), in Ukraine (upper Tysa) and in Hungary (lower Sió, right-hand-side tributaries of middle Tisza). Other than those highlighted above, rivers and lakes in the Carpathian mountains did not show high irreplaceability/priority, which may be related to our finding that other high-mountain areas or Europe (particularly in the Balkans and northern Alps) were higher-priority areas where mountain species were adequately covered by the prioritisation algorithm. Our analysis of the correspondence between conservation priority and the proportion of protected areas in the catchment showed marked underprotection (high irreplaceability and low protection) in W Slovakia and along the border of Hungary and Romania, and adequate level of protection elsewhere. Our study supports the overall importance of the Carpathian Region in the conservation of freshwater biodiversity and identifies several priority catchments for which increased protection is necessary. Many of the priority catchments were found in transboundary areas, therefore, this study underlines the need to consider transboundary catchments as one unit for biodiversity conservation and water management, for which the conservation responsibility is shared between or among countries.

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Preliminary study on the contribution of EU funds to the sustainable development of Romanian mountain area

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The European funds represent more than a financial instrument addressing development goals, convergence objectives, cohesion and reducing disparities between European regions. It constitutes also the support for shaping a common European identity and therefore are, and shall be addressed with great responsibility.

First, this paper aims to emphasize how the EU funds made contributions to the development of Romanian mountain area, especially the rural territory, trying at the same time to highlight if there

is parity between the benchmark that characterize the Romanian mountain region (e.g. the percentage from the total territory of Romania, percentage of the total population, the number of LAU-2, and the value of European funds it has benefitted).

In the attempt to highlight new features and trends that are shaping the mountain economy, our research focuses on the contributions of both public and private sector, including non-governmental organizations that contrated EU funds and will analyze whether these funds did stimulate the positive externalities of the Romanian mountain area.

Another aspect highlited by the research is the status of implementation and monitoring in Romania of the National strategic suidelines for the sustainable developement of the mountain area (2014 – 2020) and the allocation of EU funds on the objectives and measures.

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About virgin forests structural biodiversity and dead wood from Eastern Carpathians

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Due the global high rate of industrialization, large forest areas had decreased. Few of these natural forests have succeeded to remain untouched by humans. The primary ecosystems have advanced age and have a high biodiversity and because their multi – components they achieved the climax condition. These kinds of forests, so called “virgin forests”, are also found in Buzau Mountains which are a part of Eastern Carpathians from Romania. For understanding and develop the functional principles of virgin forests, from three permanent research plots of one hectare area, useful field information’s were collected. All live trees with diameter at breast height (DBH) higher than 80 mm were measured and the main dendrometrics characteristics (DBH, Height, cenotic class, quality class) being registered. Also was measured standing dead wood with DBH higher than 80 mm and lying dead wood with top diameter higher than 80 mm.

Structural biodiversity analyzes was made with Gini and Camino indexes and the graphic representation was made with Lorenz curve. For all permanent research plots was recorded values of Gini index ($G = 0,68 - 0,84$) and Camino index ($H = 1,62 - 1,74$), which indicate a high heterogeneity. Total volume of dead wood is between $52,15 \text{ m}^3 \cdot \text{ha}^{-1}$ (Penteleu – Viforâta 1) and $123,34 \text{ m}^3 \cdot \text{ha}^{-1}$ (Penteleu – Viforâta 2), most of them came from coniferous (fir and spruce). Also was analyzed the ralationships between dead wood and alive components, using different statistical distributions functions (Beta, Gamma, Weibull). Due the actual concerns of global warming, was also estimated the quantity of dry biomass and CO_2 stok from dead wood.

These knwoledge have high contribution for understanding the natural mechanisms for structuring these types of forests.

Hunting management units and environmental protection in the Romanian Carpathians

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Hunting was one of the primary activity that made the mankind to evolve to an advanced society. This activity, in its beginning, required good abilities in using specialized tools and strong social skills to assure success in harvesting valuable food. Due to increasing of food demand and territorial expansion of human population, some species were overhunted, their habitats and abundance decreased, while other become endangered or extinct. This was the case in Carpathians as well where the examples of Chamois and European bison are well known. During course of time, hunting become more a regulation or leisure activity then a daily necessity, but management in order to assure sustainability of hunting resources become a must.

Our work is aimed at describing the alpine hunting management units using terrain features (eg. elevation, slope, and aspect), degree of human impact (i.e. hemeroby) and landscape metrics (diversity of land cover types) in relation with the occurrence and abundance of large carnivore species of conservation interest. A number of 364 hunting management units from the alpine region were analyzed and classified based on their degree of hemeroby into three classes, then mapped. We found that the less is the human impact the higher the species richness and the abundance of large carnivores. Also, we noticed that wild cat shows no direct linkage with the degree of hemeroby, while other species looks to prefer less impacted areas or specific combination of land covers. We consider that our findings are useful for management activities aimed at sustainable conservation of wild fauna.

Attitudes of involved subjects to the issue of biodiversity conservation in the Protected Area of the Little Carpathians (Results of personal interviews)

Milena MOYZEOVÁ, Zita IZAKOVIČOVÁ

The Institute of Landscape Ecology participates in several projects (ALTER-NET, LTER, OPEN-NESS, APW-0866-12 etc.), where the aim is to integrate the scientific capacities for the sake of biodiversity protection on the European level and in a network serving the European long-term research of biodiversity and ecosystems. Part of the landscape-ecological research is also the active participation of stakeholders in the analysis of developments taking place in landscape, landscape change, biodiversity changes and in search of harmony between the biodiversity protection and land use. Landowners, land administrators and land users whose opinion may contribute to the enforcement of sustainable use of the territory and protection of biodiversity also participate in the assessment of the biodiversity change. One of the model territories for biodiversity research in Slovakia is the mountain range of the Little Carpathians. This mountain range is located in the west of the country and is part of the Western Carpathians, the Fatra-Tatra region. The Little Carpathians consist of the ranges Devínske Karpaty, Pezinské Karpaty, Brezovské Karpaty, and Čachtické Karpaty. It is a core mountain range with the specific development of the crystalline complex with nappe units. Deciduous oak-hornbeam woods and oak woods with *Quercus cerris* prevail here. The Little Carpathians represent the only large-scale protected area in Slovakia with viticultural character. The prevailing part of the Protected Area is under the 2nd degree of protection. The majority of its territory is covered by forest ecosystems that transit into agricultural land on their edges. Seen from the perspective of biodiversity, it is an important territory with abundant

occurrence of many protected species of both plants and animals. The aim of the paper is to identify the possible conflicts of interest and the ensuing problems in implementation of socio-economic activities in this territory. Regarding the nature of the territory conflicts of interest were assessed between:

- Hunting and nature protection
- Hunting and forest economy
- Hunting and agriculture

The methodology consisted of four basic steps:

1. Characteristics of the territory of interest
2. Analysis of accessible literature involved with the theme
3. Sociological survey carried out with the representatives of selected spheres
4. Comparing analysis and assessment of results obtained by sociological research.

The contribution was supported by the project APW-0866-12: Evaluation of ecosystem functions and services of the cultural landscape.

SUSTAINABLE CARPATHIANS III

ORAL PRESENTATIONS

Does ozone concentration influence the tree defoliation in a continental climate?

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Ozone (O₃) is both a greenhouse gas and a secondary air pollutant causing impact on climate, human health, and ecosystems (Shindell et al., 2009). In particular, ground-level O₃ affects trees through visible leaf injury, accelerating leaf senescence, decreasing foliar chlorophyll content, photosynthesis, growth, productivity and carbon sequestration, predisposing to pests attack and a variety of other physiological effects in plants (e.g. Sicard et al., 2016; De Marco et al., 2015). Defoliation is one of the most important parameters that is representative of forest health and vitality. Air pollution effects on forests have been investigated through manipulative experiments as closed chambers, branch chambers, open-top chambers, free-air canopy exposure systems, (Manning, 2005). However the results obtained by such experimental facilities are not representative of the real condition in the field (Braun et al., submitted). In this work we investigated the role of ozone concentrations and its metrics (AOT40 and POD0) in affecting crown defoliation in Romanian forests, in combination with nitrogen pollutants, climatic effectors and orographic plot conditions, applying non-linear modelling approach (RFA and GRM) with the final aim to develop specie-specific predictive models for crown defoliation. We found a correlation between ozone concentration and defoliation that appears to be more important than the ozone uptake by the leaves.

Changes in the riparian vegetation of a river reach in the Apuseni Mountains (Central Romania)

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In central Romania, in the Apuseni Mountains, the Arieş River (drainage area of 2540 km²) crosses the region from Transylvania, and this region, with many villages and towns, is of great biodiversity value. However, mining activities, together with deforestation, creation of waste dumps, settling ponds, and trash made by humans along river valleys and other areas, have affected the riparian vegetation negatively. Apart from these negative drivers affecting the river system, the main pollution factor going directly in Arieş River Valley is acid mine drainage.

The reach of the Arieş River and its adjacent floodplain at the confluence with Seşii rivulet has been studied as a pilot area for the entire river system. The vegetation evolution in time and space were investigated using remote sensing images along three time series, together with a literature survey and desk based analysis of natural riparian vegetation along mountainous rivers valleys and field trips in the pilot area. In 2014, we assessed species composition and coverage of the vegetation in 91 plots, each of 2 m² along the Arieş River Valley. In every plot we recorded the species on the layers with different heights: 0-1m, 1-5 m, 5-15 m and 15-30 m.

Evidence from statistical analysis of the vegetation cover of a riparian area of the Arieş River Valley indicates that, in the inventory plots with low species diversity, there is a dominance of one or two species with the individuals unequally distributed within and between the plots. The layer 1-5 m is dominated by alien invasive species that form compact patches replacing the native riparian vegetation. The riparian zones are the most important structural and functional elements connecting aquatic and terrestrial areas, behaving as filters for nutrients, critical areas for biogeochemical processes, providers of resources and shade, and stabilisation of stream banks, etc.

Once established in natural or semi-natural habitats, the native and alien plant species become invasive when they change and threaten native biological diversity and ecological processes and cause economic losses. The main factors determining the spread of alien species are: disturbance regime gradient, physical, chemical and geo-morphological attributes, and the influences of human and climatic factors.

Species diversity is low in the layer 1-5 m height, this being dominated by alien herbaceous adult species and saplings of *Robinia pseudoacacia* trees. The total coverage of this layer consists of shrubs, saplings of trees, tall perennial herbaceous and annuals. The species density (above ground biomass) in most of the plots allows only a few native shrubs and trees to survive, the only survivors being old trees established before the mass development of alien species. Apart from heavy metal pollution, tree-cutting by humans for firewood or other purposes is an important factor with an impact on old trees. Clearance of the riparian forests creates gaps suitable for alien species and allows them to invade the riparian territory and surrounding areas. The predominantly vegetative reproduction makes them more resistant to the disturbance occurring in the riparian area, including to water and soil pollution. Because the species display a rhizomatous growth and spread clonally, this may lead very quickly to the formation of monocultures, reducing the local species diversity; thus, suggesting that trait of clonal growth can possibly increase the impact and/or invasiveness of introduced species.

Acknowledgement: Data obtained in the framework of Contract 98/2014 project code PN-II-PT-PCCA-2013-4- 2171 financed by UEFISCDI and the project RO1567-IBB01/2016 financed by Romanian Academy.

Ecosystem Services of Traditional Agricultural Landscape

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Natural, semi-natural and cultural ecosystems represent unique islands of biodiversity in agricultural landscape. Special attention is paid to traditional agricultural landscapes (TAL) that create mosaic of small-scale arable fields and permanent agricultural cultivations. The aim of the study is to bring new knowledge concerning to goods and ecosystems services provided by ecosystem in TAL.

Methodological approach was focused on selection of appropriate indicators for quantitative and qualitative assessment of ecosystem services: regulating (climate regulation, water regulation and purification, erosion control etc.), provisioning services (food, freshwater, fiber, genetic resources etc.), cultural (spiritual and religious, recreation and ecotourism, aesthetic, cultural heritage, etc) and habitat services.

Assessment of ecosystem services was performed on four pilot areas, representing different types of TAL, as viticulture landscape, meadow-pasture landscape and agricultural landscape with scattered settlements or orchards.

To study changes in provision of ecosystem services, set of indicators was assessed and compared for different agricultural landscapes, in relation to intensity of their land use: traditional agricultural landscape, large-block intensified landscape, new mosaic of small agricultural plots.

Result shows, that TAL provide more ecosystem services by their diversified pattern. They play an important role in water retention and the prevention of soil erosion – both important with respect to climatic changes. Many ecosystem services and function are provided by these ecosystems, which bring benefits for society. They have irreplaceable ecological, cultural and historical value.

The contribution was prepared within the grant project of the Ministry of Education of the Slovak Republic and the Slovak Academy of Sciences project Grant No. 2/0158/14 "Diversity of agricultural landscape and its ecosystem services".

Patterns of structural and spatial dynamics in old-growth beech-fir-spruce forests in the Western Carpathians, Slovakia

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The unprecedented loss of old-growth forests due to deforestation and fragmentation throughout temperate regions have opened up the necessity for better understanding of similarities and differences in forest dynamics resulting in the delineation of the effective restoration, management and conservation efforts. The Carpathian Mountains provide the largest areas of natural European beech (*Fagus sylvatica* L.) forest. Thus our study sites represent one of few remnants of old-growth mixed beech-fir-spruce forest in the Western Carpathians, Slovakia.

We aim to assess forest structure, dynamics and uncover legacies of the past disturbances causing such patterns and processes on the landscape-level patterns. Starting from this preliminary analysis

we established 60 permanent study plots representing five stands in four landscapes (Lesser and Greater Fatra, Low Tatras and Vepor Mountains). Position and structural characteristics of all trees ≥ 6 cm DBH were recorded. We collected tree cores to reconstruct age structure and past disturbance dynamics of the forest.

These stands were found as mixed species forests with typical old-growth characteristics (multilayered, large and old trees, rich in living biomass and coarse woody debris) and without visible or documented evidence of the past human intervention. Legacies of the past disturbance regime affect the forest structure on the plot and stand level. As a result, most of the studied forest showed structure typical for uneven-aged climax forest. Additionally, high variation in plot level structure was observed even within one stand. For example, the density of living trees per plot ranged from 200 to 1480 stems per hectare and the volume of coarse woody debris from 15 to 474 m³ per hectare. The stands covered an age span from 167 to 265 years. The oldest tree was Norway spruce (*Picea abies* L.) with an approximate age of 435 years. The oldest beech was 400 years old. Some age structures on plots showed continuous recruitment, contrary to other plots with moderate recruitment pulses.

The results suggest that the disturbance regimes in these forests are driven by small-gap dynamics, however larger more severe events have been present in the past. Thus, forest management shall be oriented toward mimicking so called mixed severity disturbance regime (combination of low and high severity disturbances) to fully cover natural range of variability in disturbances and forest structure. We emphasize the need for both conservation of last remnants of old-growth forest and studying these intact forest areas which are representative for different ecoregions.

Evolution of nutrition cycles in Carpathian spruce (*Picea abies* L. Karst) and beech (*Fagus sylvatica* L.) forests

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Dynamics of the forests health has generated widespread concern in the past decades. Following the first report on the health of forests in Europe, released in the late 70's, one of the factors directly and indirectly held responsible for the condition of forests was industrial pollution thus, emerged the need to harmonize specific research monitoring programs extended to European and global level. Monitoring forest health in Romania started in 1990 and was carried out in permanent sampling plots (Badea et al., 2011). Among studied variables (e.g. biometric, defoliation, soil properties) foliar nutrients content highlights qualitative and quantitative used ultimately in assessing the health of trees and offers reliable parameters to determine the general state of the ecosystems. Nutritional status of trees was characterized by the type of nutrition, determined in relation to the content of the absolute foliar mineral element (per unit of dry biomass) and cationic reports between nutrient contents that can reflect potential imbalances. Determination of nutrients contents was achieved by oxidation of the organic matter and solubilization of the residue. Overall, the levels of foliar nutrition for spruce are normal, the beech on the other hand showing a deficit in the supply of nitrogen and potassium, but offset by an adequate supply of calcium and phosphorus, which in turn leads to a balanced nutrition.

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POSTER PRESENTATIONS

Hydrological land use mapping using European Space Agency (ESA) Sentinel-2A orthorectified products in ROSCI0207-Postavarul, Natura 2000 site

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The hydrological mapping of forest vegetation is an activity used for determining one of the parameters used in hydrological modelling. Hydrological land use mapping using remote sensing is one of the fastest and precise method which can be applied on large areas (Nita and Clinciu, 2010; Vorovencii, 2014).

Since the European Space Agency (ESA) has released the Sentinel-2A orthorectified products, the remote sensing results are produced on a 10 m spatial resolution, which will be extremely useful for high resolution mapping.

In this paper we present an automatic approach for hydrological land use map production using remote sensing imagery based on supervised image classification and vegetation indices.

This paper was supported by The Executive Unit for the Financing Higher Education, Research, Development and Innovation (UEFISCDI), project tip PN-II-PT-PCCA-2013 and contract number 96/2014

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Grassland vegetation as a temperature change indicator?

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Global average temperature has increased through the last decades. This change may alter the distribution pattern of plant species. The aim of the paper was to assess the influence of this change on grassland plant species composition based on one of the functional plant traits – Ellenberg's temperature indicator value. We used selected phytosociological relevés done in years 1959-1969 and 2000-2013 in three regions in the Polish Carpathians. Unweighted mean temperature indicator values were strongly correlated with altitude but in contrary to expectation this means were not higher for years 2000-2013 then for the 1959-1969 period in any region. The results suggest that the response of grassland vegetation to climate change has significant delay or it is caused by abandonment of agricultural use of many thermophilic, but low productive plant communities. We conclude that land use change has greater impact on grassland vegetation than climate change.

ORAL PRESENTATIONS

Forest assessment and mapping based on field measurements, airborne laser scanning and UAV techniques - a case study for Romanian Southern Carpathians

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The study presents the potential use of Unmanned Aerial Vehicles (UAV) and airborne laser scanning (ALS) techniques for forest mapping and assessment in a test site located in Romanian Southern Carpathians. The two remote sensing techniques were used to derive tridimensional structure of the forest. The research aims to show an insight and to compare the possibilities of the two technologies for percent canopy cover assessment and to assess their accuracy through reference field measurements. The case study refers to the analysis of dendrometric data collected from a 100X100 m mixed plot (50% Norway spruce (*Picea abies*), 45% Beech (*Fagus sylvatica*) and 5% Sycamore maple (*Acer pseudoplatanus*). The reference dendrometric field measurements were collected using Field Map system, high accuracy GNSS receiver and Vertex inclinometer.

Airborne laser scanning data were collected using a Light Detection and Ranging (LiDAR) Riegl device and were processed using specific softwares (QCoherent LP360 and FUSION (McGaughey, 2014). Thus we extracted digital terrain model (DTM), digital surface model (DSM) and the normalized canopy height model (CHM). Based on airborne LiDAR data, *Canopy Maxima* (Popescu et al., 2002) FUSION implemented algorithm and local significant correlation ($\alpha < 5\%$) between the field measured tree height and calculated crown diameter was possible to identify based on LiDAR data the position, the height and the crown diameter of the plot trees. A root mean square error (RMSE) of 0.89 m was obtained when comparing the field measured spruce heights and the corresponding LiDAR estimated ones. Moreover, a RMSE of 1.76 m was obtained when comparing the field measured spruce crown diameter and the corresponding LiDAR estimated ones. Furthermore, very high spatial resolution images (7cm) were captured by a UAV equipped with a RICOH RGB camera. Specific software (Agisoft PhotoScan) was used to create the UAV based ortorectified images and to extract the digital elevation model.

The percent canopy cover estimated by LiDAR data and the one based on reference field measurements remains about the same level ($\approx 70\%$).

Taking advantage of the very high spatial resolution (0.5 m), the LiDAR based digital terrain model and the UAV based digital elevation model could be easily used for forest mapping purposes.

Both remote sensing techniques bring significant improvements in terms of forest parameter retrieval and forest mapping by gaining precision and by reducing the field work. LiDAR technology has the advantage of providing fine detailed of both DTM and DSM, making thus possible the volume/biomass estimation, but the costs of capturing and processing are relatively high and time consuming. The UAV provides high precision DSM and ortorectified images but no DTM, but is a faster, easier to use and more affordable technology and is suitable also for tree species recognition. Combining the two technologies delivers best results for forest mapping and assessment.

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Satellite based monitoring system for observing natural forest dynamic in the fragments of virgin forest of Carpathian region

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Land cover change dynamic was quite strong in the Carpathian region in the past few centuries. The most affected type was the forest cover (Munteanu et al. 2015). Hopefully some fragments of virgin forests remained for the future and they are providing a great opportunity to study the natural forest structure changes through the time. These fragments are situated in the following countries: Czech Republic, Hungary, Poland, Romania, Slovakia, and Ukraine. They provide better habitats for species with the benefit of higher biodiversity (Fahrig, 2002). Observing the interactions between individual trees, the dynamic of natural regeneration and the habitat requirements of species are helping to do better ecological management of forests (Brang, 2005). The research of virgin forests in Europe started in the 19th century. The old foresters at that time realized the importance of the remaining virgin forests and conserved them for the future. Most of them are under strict protection today (Bartha et al, 2010). In the dynamics of virgin forest we would like to see if the different uneven aged parts could be separated by the different magnitude of change in trends of growing. Assuming that these old-growth forest fragments didn't have any artificial disturbance at least in the last century we couldn't expect any big disturbance event over the study area. Thus we have to use a dense time series of data to study the trends of the structural changes. Earth observation satellites are providing this data with high resolution for the last 32 years in form of spectral information. Also the availability of the images has become much easier since some image database become freely available for research purposes (Townshend et al., 2012). Both Landsat and SPOT are providing great archives and the new Sentinel satellites are producing promising imagery for this kind of purposes. A dense time series of images could be assembled from 1984 until 2016. Working on forests with remote sensing is always challenging. The spectral reflection of the vegetation is highly dependent on topographic position and the local weather conditions. Sparse time series analyze period could be misleading by these effects easily with one image per. The small disturbances could stay unrecognized even on high resolution satellite imagery. In a long term observation with dense time series these small events could be seen. The data availability for some period in the past is still problematic thus we have to use multi sensors. During the cross comparison of the different sensors difficulties could arise. However the dense time series of the study area consist of hundreds of images the studied forests are covering only 78 700 ha. To make analysis more effective we have to store the information of images in different way as it used to. Creating a unified GIS based database with a well designed structure of spatial indexes makes the process faster. Some automated approach had been developed for this kind of trend analyze on satellite imagery (Kennedy et al. 2012) (Cohen. et al. 2010). By creating a new automated method which can handle the mentioned difficulties we could carry out the expected trends and derive the detailed maps of the dynamic in the virgin forests fragments. After a while with recently launched sensors the system will provide more frequent and more detailed information about the interested regions in the future. We could make rough estimations from the trends for the changes which will complete the field observations of researchers in other fields.

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Long term socio-ecological research in Romanian Carpathian forests

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Carpathian Mountains represent one of the most significant natural regions in Europe, being more than 1,500 km long and located in five countries (the Czech Republic, Poland, Romania, Slovakia and Ukraine). They comprise the most representative forest ecosystems in Europe with about 300,000 ha of natural forests and 20,000 ha of primary beech forests still existing (Vădineanu *et al.*, 2008).

Due to the importance of forest ecosystems of the Carpathian Mountains, a framework for joint and more integrated research and monitoring activities, covering the entire mountain range, has been designed and launched in the last 20 years (Bytnerowicz *et al.*, 2004, Bytnerowicz *et al.*, 2005, Badea, 2013). The major objectives established for such activities were related to analyzing the social-ecological systems response to the cumulated effects of natural and anthropogenic control factors and also to their pressures, especially global changes and land use. The describing of structure, functions and processes that take place at ecosystem level requires a specific approach (multi- and interdisciplinary) and methodologies for integrated analysis, leading to the development of support systems for assuring stakeholder decision in a social and ecological management.

The long term research developed in Retezat and Bucegi-Piatra Craiului LTSER (Long Term Socio-Ecological Research) sites are related to climate dynamics, air chemical parameters, forest ecosystems components and effects of proper natural resources management, based on ecological processes and their productive and support capacity.

Although the levels of sulphur pollution decreased since 30 years ago (S and N depositions being at low levels), air pollution (especially ozone and other phytotoxic pollutants) remains one of the most important factor affecting trees and stand health status and growth. Ozone showed a significantly increasing trend in both Retezat and Bucegi-Piatra Craiului LTSER sites (2014 seasonal mean ozone concentration up to 58 ppb in Bucegi Natural Park) for the 2009-2015 period in most of the 33 plots in which this pollutant is monitored. The same phenomenon happened for nitrogen dioxide concentrations, episodes of monthly NO₂ concentrations higher than 3 μg m⁻³ being more frequent in the last years, under the intensification extreme weather events and increase of average temperatures (over 1.5°C in 5 years in both LTER sites) at high altitudes.

In this context, an insightful analysis of climatic parameters and pollutants trends and their influence on forest ecosystems status and tree growth in Retezat and Bucegi - Piatra Craiului LTSER sites for the 2009-2015 period is needed.

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Land cover classification in Romanian Carpathians and Subcarpathians using multi-temporal Sentinel 2 remote sensing imagery

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The aim of this study is to generate a new land cover dataset for two different areas from Romanian Carpathian region, using multi-temporal Sentinel 2 images. The newly Sentinel 2 satellite with a multispectral high resolution sensor provides images with up to 10 meters spatial resolution, useful for land cover discrimination and mapping (Wulder et al, 2015).

For our study area we chose two types of regions: the first one is a high mountain area (Bucegi Massif) from the Romanian Carpathians, that includes protected areas, biodiversity and large forest covered lands that are constantly threatened with built area expansion; the second area covers the Subcarpathian region (between Prahova and Teleajen valleys), characterized by a complex configuration of natural vegetation alongside settlements, roads, industrial platforms, agricultural lands, plantations, quarries, salt mines and oil wells. Thus multiple geomorphic processes, as landslides and erosion, are a constant problem for the locals.

The methodology used implied pre-process of the Sentinel 2 images applying atmospheric and topographic corrections in order to remove the atmospheric effects and the differences of the terrain illumination (Hantson & Chuvieco, 2011; Moreira & Valeriano, 2014). Also we enhanced the images applying stretch corrections and textural filters. In order to map the land cover features we used a pixel-based classification of multi-temporal data to quantify the land resources into thematic categories (Müller et al 2015, Senf et al 2015). The time-series images are acquired in the same year (2015-2016), from winter to summer and they are used together in order to improve the land cover classification and to distinguish between land cover classes (Shao et al, 2015, Gómez et al, 2016).

The land cover classification was validated using GPS-ground control points together with orthophotos and field observations. The results show a higher accuracy than the previous obtained classification using Landsat 8 imagery, with minimum acceptable error in land cover classification. We conclude that use of this land cover analysis method applied to Sentinel 2 imagery is of high relevance for space planning, environmental monitoring and decision making activities.

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POSTER PRESENTATIONS

Accuracy assessment of digital elevation models within low-mountain Carpathians

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Present study deals with accuracy assessment of digital elevation models (DEM) built using topographic maps and other ones based on remote sensing data. We tested the accuracy of three DEMs in comparison with DEM created by digitized data of 1:50 000 paper topographic maps (TM) of 1980s, which after comparison with ground truth data was chosen as a reference DEM. To our knowledge it was the first research which tackles DEM accuracy assessment within Ukraine using topographic map, SRTM DEM with spatial resolution of both 90 and 30 m, and ASTER DEM version 2 as input data. This investigation was performed on test area of ca. 20k ha situated in low-mountain of Ukrainian Carpathians. To calculate the differences of elevation values across three DEMs we extracted out of those geo-layers information on elevation from TM. Then, an analysis of height differences of the DEMs across six possible combinations of three slope classes and two land cover types (forest/non-forest) was performed. It was found that the most accurate DEM is SRTM DEM with 30 m resolution, similar is an accuracy of SRTM 90 m while ASTER DEM was revealed as the least accurate. We also investigated that DEMs tend to overestimate elevation values on 7.3, 8 and 11.9 m average for SRTM 90 m, SRTM 30 m ASTER DEM respectively. We revealed that the highest accuracy has DEM SRTM 30 m on open land within flat terrain ($< 5^\circ$ slope) and the worst result showed ASTER under forest on moderate-to-steep and steep slopes ($\geq 10^\circ$). In general, ASTER DEM is prone to overestimate elevation values more or less across all land cover-slope combinations, while two SRTM DEMs on open land within moderate and flat terrain ($< 10^\circ$) only slightly underestimated elevation values: between -0.9 and -1.4 m. We suggested that three DEMs may be used without major correction within low-mountain regions on deforested land across all range of slopes. However, on steep forested slope for all DEMs correction have to be applied to have uniform accuracy irrespectively to land cover type.

SRTM-based ecological regionalization of the Crimea Mountains: Following the case of the Carpathians

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The goal of the study is to produce geodata sets and ecological metrics, which are compatible with those obtained for the Ukrainian sector of the Carpathians (Kruhlov, 2008). The Crimea Mountains have an area of 7.5 thousands km² and maximum elevation of 1545 m, consist of cuesta ridges composed mainly by limestone and flysch-like deposits, and stretch through five altitudinal bioclimatic zones – from forested steppe to mountain grasslands.

The ecoregion boundaries were manually delineated using SRTM topographic geodata and geological maps. Then, the ecoregions were stratified into altitudinal belts based on the interpolated rainfall data and non-georeferenced information about elevation spans of vegetation zones. The

altitudinal belts of each ecoregion were attributed with natural soil and vegetation characteristics. The ecoregions were clustered into orographic classes using data on mean absolute and relative (within 1 km radius neighborhood) elevations. They were also grouped into ecological classes using cluster analysis on area shares of altitudinal belts.

As result, over 50 micro-ecoregions were delineated and grouped into 14 meso-ecoregions based on the orographic and geological similarity. Two different classes of altitudinal belts are delimited for the Northern and Southern megaslopes as well as one class – for the grasslands of the vast flat ridgetops. The obtained dataset has a much higher positional and thematic accuracy than the previously available medium and small-scale maps. The orographic and ecological classes of the ecoregions can be compared with those obtained for the Ukrainian Carpathians in the previous studies.

Relief sustainability for motorway projects implementation in mountains area. Case studies from Romania

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The mountainous highway would cross several sectors which are difficult from the point of view of the relief but also from the point of view of land use. Thus, the identification of areas which are suitable for the construction of the first mountainous highway from Romania in the context of sustainable development proves to be an extremely important challenge.

The geomorphotechnique analysis aims to harmonize the relation between the geomorphological processes, the construction solutions and the transport infrastructure. The map focuses on the interaction between landforms, morphodynamics and anthropic elements, having as interface the land engineering works. The geomorphological approach involves several stages:

- identifying areas along the existing or planned transport networks, which are affected or can be affected by the geomorphological processes;
- establishing the intensity and the maximum manifestation area of the geomorphological processes;
- determining the necessary protection work types in order to protect the transportation infrastructure;
- determining the manifestation area dimension and the solution adopted in correlation with the geomorphological processes intensity.

The case study aims Olt Valley area, a space where the A1 Pitești-Sibiu motorway sector is implemented. We were used detailed analysis made in the field in conjunction with GIS techniques analysis, in order to establish the required types of construction solutions needed in order to build the project (embankments, excavations, viaducts, rainwater collection and drainage). The current study also takes on evaluating the feasibility of the presented design in terms of radius of the curves and horizontal curvature, extremely important parameters in determining the safest maximum speed. This analysis was carried out as per the European standards in force as presented in TEM Standards and Recommended Practice.

We consider therefore that the geomorphotechnique analysis is an important step from the major project implementation, in areas affected by intense and dynamic geomorphological processes. The geomorphotechnique map can be considered a very useful tool for both designers and engineers.

Activity of Bodaki landslide (Beskid Niski Mts) in 2 years period using terrestrial laser scanning.

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Highland regions have a high activity of exogenic processes, which directly influence on their relief. The area of the Polish Carpathians flysch is heavily transformed by mass movements, especially by the landslides. An area of 19 600 square kilometers has over 55 500 landslides charted, which gives on average 3 landslides per square kilometer. A large number of them at the same time have been causing a huge damage by the activation. Therefore this subject is addressed in numerous domestic and foreign literature. Landslide Bodaki is located in Bartnianka left bank of the stream and was created in autumn 2013. This form has a length of 83 m, and is in direct contact with the riverbed, the landslides toe. For the reactivation of landslides are responsible high sum of participation and high water level in Bartnianka stream. In period 2014 -2016 were performed a series of measurements (April, June, September, November 2014, April, November 2015 and April 2016) using terrestrial laser scanner Riegl VZ 4000. The results obtained in the form of a "cloud points" are treated in order to remove the layer of vegetation and have been generated digital terrain model (DTM). Comparative analysis of terrain models from different periods laid the quantitative and spatial changes in the landslide. The biggest changes were recorded in the period April-June 2014. During this period, through the erosion of the stream Bartnianka landslide has been removed ca. 2,000 m³ of material. Other periods of partial changes were minor, evidenced about a stabilization of the landslide. Only still in the period of June-September 2014 within the landslide registration activation of the parts of the landslide, was particularly the landslide toe which was responsible for the erosion of Bartnianka stream. The results were correlated with the sums of precipitation from meteorological station located 5 km from analyzed landslides. This helped to determine the height at which precipitation occurs activation of landslides.

INCLUSIVE CARPATHIANS

ORAL PRESENTATIONS

The need for Citizen science in the Carpathians Basin – proposal after overview of phenological observation networks

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New approaches, which involve the public in the collection of information about the state of the environment are rapidly evolving around the world. Known as citizen science they seek to involve members of the public as vital partners in the process of generating data to enhance our understanding of the state of the environment. Phenology, the timing of seasonal activities of plants and animals, is perhaps the simplest process, which tracks changes of the seasonal ecology of species in response to climate change. Phenological networks have a long tradition in Europe (Koch, 2010). Most of the European phenological networks have been gathering observations since the 1950s operated by different organisations. On the other hand, the history of collecting

phenological data is much older. Carl von Linné for instance used them in climatology for the first time.

But how could the scientific field of phenology be connected with citizen science within the region? The Carpathians provide an extraordinary opportunity to develop citizen science by observing phenological stages of plants with involvement of schools and volunteers. Such phenological networks bring people together of all ages to monitor the impact of climate change on plants and animals. Furthermore, such observations harness the power of people to collect and share information, providing researchers with far more data than they could collect alone. Therefore not just environmental awareness would increase, but also citizen scientists could contribute meaningfully to scientific research. Environmental education is fundamental for the implementation of the Carpathian Convention, but there is a lack of such projects and initiatives in the region. Or, if existing, they need to receive more support, not just financially, but as well as experience harvested from citizen science projects of other countries.

The participants of this session will learn about the importance of phenology and citizen science. We would like to bring together volunteers, scientist, citizen scientist, stakeholders that would 1) introduce their already existing projects and experiences which are related to citizen science, and 2) share and or exchange their related experiences, furthermore 3) be opened to cooperate on this field. Participants from any of the seven Central and Eastern European Carpathian country (Czech Republic, Hungary, Poland, Romania, Serbia, Slovak Republic and Ukraine) will have the opportunity 3) to give an overview about their phenological networks, and 3) become familiar with the European Phenology Database (PEP725), and the scientific relevance if this database is extended for the Carpathian region.

Governance Networks and Network Governance in the Carpathians

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In 2003 seven countries in Central and Eastern Europe signed a treaty to safeguard and ensure sustainable development of the Carpathian Mountains. The Framework Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention) has been designed as a legal instrument that enables its stakeholders to act jointly: it brings together actors, catalyzes actions, harmonizes policies and thus enhances cross-border cooperation in the region. During the decade since its entry into force the Carpathian Convention has enabled and driven many projects, activities and networks in the Carpathian region at local, regional and international levels. Although the Convention and its four protocols set out grand aims and specify concrete actions to be taken, the actual implementation and effectiveness of the treaty is not so clear. Does the Carpathian Convention lead to strategic action or is it only a project fair?

Collaborative governance theory (Emerson et al. 2011) claims that in cases where socio-economical boundaries cut through ecosystem boundaries, such as the case of the Carpathians, successful conservation of natural resources will depend on international collaboration, and strong horizontal and vertical linkages among actors (Dallimer and Strange 2015). This presentation examines the role that the Carpathian Convention has played in advancing collaborative governance of biological diversity and suggests ways forward to increase governance effectiveness.

The research will present the social network of actors under the Carpathian Convention. Different layers of the social network will be analyzed, including information flow, cooperation and trust; as well as egonets of key actors. The analysis will not only focus on the characteristics of individual actors but also explore their structural network position, since this latter has been shown to be important to understand how individual actors shape the governance system (Bodin and Crona 2009). Preliminary findings indicate that the governance network of the Carpathian Convention is dominated by only a few actors, most importantly UNEP's Regional Office for Europe which also

acts as the Interim Secretariat of the Carpathian Convention and WWF's Danube Carpathian Programme which has been one of the initiators of the Convention itself. Considering the troubled history of the region it is not surprising that two non-party actors have a dominant role in the network, since it can be assumed that significant amount of time is needed for mutual trust and a shared vision evolve among the parties. As we know from other cases, collaborative governance dynamics change over time and in the initial phases a few key central drivers are necessary to keep the processes going (Emerson et al. 2011), the Carpathian Convention after ten years of existence is still likely to be in the early phases of its governance journey, the question is how to move forward into a more mature collaborative network governance system.

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Reconciling nature conservation with regional development in the transboundary Bieszczady (PL) and Poloniny National Parks (SK) region

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Current research project on „Reconciling nature conservation with regional development in the transboundary Bieszczady (PL) and Poloniny National Parks (SK) region“ was developed jointly by Slovak, Polish and Swiss partners.

Following partners are involved:

- Euregion Karpacki – a regional non-governmental organisation promoting and implementing transboundary development in the entire Carpathian region, e.g Carpathian branding - based in Rzeszow (PL)
- Slovak Nature Conservancy – the governmental agency of Slovakia for biodiversity conservation and protected area management and landscape conservation based in Banska Bystrica (SK)
- The Center for Development and Environment (CDE) of University of Bern

This action research project is a follow up of the initiative “Nature based tourism and regional development” conducted by the Swiss Contribution office in Slovakia in June 2015. Action research results propose to add a transboundary development aspect related to nature conservation in large protected areas in the Carpathians. The overall goal of this joint research initiative is to capitalize on experiences gained in transboundary flagship region of Swiss contribution with these two famous national parks. Moreover this region is kind of “hotspot” of biodiversity conservation combined with local development.

Action research and crossborder know-how-transfer focusing nature conservation and regional development are innovative and ideally suited to showcase specific features of the Swiss contribution, building on best practices achieved in PL and SK, being a) bottom-up, b) long-term, c) participatory and considerate of local municipalities' needs, and d) translated and communicated to policy- and decision-makers.

Research Questions:

1. Was it possible to adapt and apply Swiss experiences on „Reconciling nature conservation with regional development“ for the Carpathian transition context?
2. Was it possible to initiate a research Know-How-Transfer on nature conservation and sustainable regional development in a transboundary flagship region – uniting the best practices in both fields of Slovakia and Poland?

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The spa system in touristic arrangements of resort type from the area of Romanian Carpathians

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The Romanian Carpathians imposed themselves in time as the most representative touristic region with spas from Romania. Thermal-mineral water harnessing and then the capitalization of the mineral ones has led to the individualization of a specific type of arrangement – the spa resort, generating human settlements – especially the so-called cities-balneary touristic resorts (Herculane Spa, Borsec, Tuşnad Spa, and partially Covasna, Sinaia and Moneasa) or with a major implications in the urban or rural development and in their functional diversification. The hydrochemical and physical diversity and the varied curative spectrum have led to adapted healing facilities, which have contributed to the physiognomic diversification with an impact upon the landscape of the balneary arrangements integrated in the urban or rural built assemblies. The frequent changes of a socio-political nature from the modern period and especially from the 20th century have determined the reshaping of substance and adaptations of a functional-touristic nature.

Streamlining the Romanian Mountain Zone through Responsible Tourism Paradigm

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The montanology study refers to socio-economic difficulties of the mountain zone from Romania, that may have as a pertinent solution a solving through professional development of the responsible tourism model. The paper integratively approaches structural and functional elements of the systemic components of the responsible tourism field: ecotourism and agro-rural tourism (i.e. rural tourism and agro-tourism).

In the paper there are highlighted present administrative-territorial surfaces (districts) from Romania that consist of significant mountain zones from the Carpathian and Sub-Carpathian region. There have been taken into consideration, in a first group (10 districts) the mountain space of over 1500 km² at an altitude of over 800 m and, in a second group (6 districts), at the same altitude too, with a surface under 1500 km², but over 1000 km² (respectively with heavy geo-climate conditions in a more reduced area than in the first group). Data processing from the mountain surfaces of the nominated districts aimed to aspects based on ecologic, rural tourism and mountain agritourism. Thus, touristic polyvalence, based on eco-bio-geo-economic analysis, makes also possible a structure concerning tourism types and forms specific to responsible tourism.

The aim of the paper is to start from a correct diagnose necessary to processing certain statistic data, specific to the Romanian mountain space, in order to find a series of viable solutions of bioeconomic development through tourism activities, in relation to Nature and biologic and cultural diversity of the Romanian Carpathians. The objectives of the study refer to improving socio-economic conditions in a fragile zone, nowadays subject to unprecedented pressures, both of geo-

climate nature and, especially, of economic and social nature. The proposed solutions aim to economic streamlining and ecologic efficiency.

Next to considerations over the whole Romanian Carpathian chain, as a case study and examples, there is especially approached the area inside the Carpathian chain, respectively Transylvania and, punctually, the Center region. This especially based on biodiversity (through flora, fauna, economic species) and on multiculturalism (through the existence of certain Romanian, Hungarian and German cultural interferences). The responsible tourism is the solution to harmonize the integration of economic activities in the natural mountain environment, but also to develop the mountain civilization. One of the forms that harmoniously combines these aspects is the mountain gastro-tourism, in general traditions and gastronomy, through the study of which become relevant tourism programs for tourism at the country, tourism at the farm and/or combined with green tourism, shaping the paradigm of the mountain responsible tourism.

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Canyoning - an Alternative for Turism Development of Cerna Valley (Romanian Carpathians)

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In last decades appeared a lots of tourism sports linked with the morphology particularities of some relief forms.

Known by various names (canyoneering in USA, kloofing in South Africa, torrentismo in Italy), canyoning is a activity who involves crossing a canyon using various techniques and equipment for jumping and swimming, abseils (rappels), scrambling, climbing, as shown on the existing specialized sites on the Internet. Canyoning is frequently done in remote and rugged settings and often requires navigational, route-finding and other wilderness travel skills.

Usually, suitable for this kind a sport are narrow valleys, with a neregular longitudinal profile. River beds are bounded by very steep rocky slopes with a vertical elevation developed on several hundred meters. This kind of valleys have many rapids with spectacular and beautiful waterfalls. All these features are usually located in the valleys cuted in hard rocks, very resistant to physical erosion, like limestones, granites, basalts or sandstones very strong cemented.

Romanian Carpathians offer favorable conditions for the development of such valleys, especially in limestone areas from south-west.

The highest density of valleys suitable for practicing the canyoning are located on the rocky slopes from Cerna Valley. With a length of almost 60 km, Cerna River crosses a mountainous limestone area, along a tectonic graben, between Cerna-Godeanu on the one hand and Mehedinți-Vâlcan Mountains on the other hand, providing a denudational major potential in both slopes.

The level differences up to 500 m between the bottom of the valley and surrounding peaks, combined with the underground waters circulation, justify the existence of rivers with a fast flowing rate (especially in rainy periods of the year). Valleys as Râmnuța cu Apă, Țesna, Drăstănic,

Prisăcina or Bobot find their origins in surrounding mountains units (Mehedinți, Cerna) and fragmenting their limestone slopes, digging deep valleys with canyon aspect. The aims of this study is statistical analysis of morphological parameters of these tributary valleys, to emphasize the high potential of Cerna Valley for canyoning. Proper technical equipment of these valleys might allow a diversification of tourist activities practiced in this area and offer new possibilities to develop the local economy.

POSTER PRESENTATIONS

Assessment the impact of hiking in high alpine region between 1981 and 2014

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In our contribution we present a methodology of assessment the sensitivity of mountain environment and the impact of tourism with special emphasis on hiking trails in high alpine region. Destruction of hiking trails and their surrounding in highly sensitive alpine regions often leads to acceleration of other geomorphological processes causing disruption of soil and vegetation cover and reducing the stability of slopes around trails (Kurucová, 2012). Our methodology was based on comparative analysis of selected indicators describing the sensitivity of mountain environment and negative impacts of hiking in surrounding of hiking trails (Hrnčiarová, 2000). All the indicators were monitored in 1981 (Hrnčiarová, Maláriková, 1981) and 2014 using the 100 meters grid network. Thus, we were able to compare the positive/negative development of environment along hiking trails. The results were verified using the vegetation data reflecting the trampling impact and also the data from automatic visitors counters reflecting the tourism pressure.

The contribution was prepared within the grant project of the Ministry of Education of the Slovak Republic and the SAS Nr. 2/0025/13 "Current utilization of high mountain landscape, its impacts on change of environment and assessment of carrying capacity of selected national parks of Slovakia"

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An analysis model of Romanian ski resorts. A sustainable development perspective

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To achieve this project we were studied all the resorts from Romanian Carpathian Mountains. They were analyzed and it was given a score in order to evaluate the ski areas form Romania. In this analysis were taken into account more information such as: the position in correlation with the major urban areas from Romania, the accessibility, the altitude, the ski slopes disposition in correlation with the slopes aspect, the slopes that influence the diversity of the ski areas, the ski areas visibility on the internet, the services provided by the ski areas administrators, related tourism services, the state of the ski slopes, the types of the existing tourist facilities and more.

The ski areas position and the accessibility are important factors in the ski areas evaluation. The condition of the ski slopes, the type and the state of cableway installations influence the perception related to the ski infrastructure of the resort. The diversity of the existing ski slopes in the resort as well as the existence of related touristic services is key factors in order to determine the attractiveness of the ski resorts. The greater is the diversity, the wider variety of tourists will attract the ski resort.

An efficient management of the ski resort involves providing of a wide range of activities, a good maintenance of the ski slopes. The existence of an attractive event for the athletes but also for the spectators can increase the score of the ski resort in the evaluation. All these factors determine an increase of ski resorts score in our analysis.

From the analysis achieved in the field, we observed that the improvement of the provided services and the proper management of the ski area determines tourist's loyalty and thus increase their number.

Băile Herculane spa resort - between a promised rejuvenation and an inevitable decline

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Băile Herculane, one of the oldest and most famous resorts in the Romanian Carpathians, entered an obvious decline in the postcommunist period. Founded since Roman times the resort was significantly developed during the Austrian Empire as well as in the communist epoch and entered a long and rather random than coordinated transformation process after the change of political regime in 1990. The decline phasis explained in Butler's life cycle theory applies to a great extent in its case and it is a response to inappropriate management, caused mainly in Romania by a long and defectuous privatization process. The lack of investments aiming tourism development and of a tourism planning and marketing strategy in this resort lead to the transformation of old and valuable heritage buildings into ruins, jeopardizing the future of Băile Herculane as a leisure destination in general. The present study aims consequently to illustrate Băile Herculane's lifecycle combining field research and landscape observation methods with analytic data mining tools focusing on tourism relevant indicators (e.g. the ponder of accommodation places on comfort category, the yearly number of spa treatment vouchers granted by the state insurance system). All results conclude that the resort entered after 1990 and especially after 2000 on an obvious decline phasis in spite of its valuable resources which were rather promising a rejuvenation on the growing global consumerism trend oriented to spa and wellness tourism. The last decaying phasis in resort's evolution amazingly contrasts both its previous ones, the global trend of rejuvenation for health tourism as well as the development tendencies for green mountain areas in Romania in particular.

The dynamics of the accommodation units in the context of developing mountain tourism - Case Study: Bucegi Mountains

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By its geographical position, relief and tourism potential, Romania can be considered the favorable development of mountain tourism since ancient times. Mountain tourist areas are concentrated around the Carpathian Mountains (Romanian Carpathians) represents the country, 43% of the total area of the mountain.

The diversity of mountain tourism in Romania promoted in recent decades through the development of national and european projects has fostered a relationship between capabilities much better accommodation, transport, surface ski area, other recreational activities and a number of visitors in transit.

Carrying tourist activities in the context of sustainable development primarily involves the existence of the primary functional elements: accommodation, food and entertainment for all tourists. This paper proposes a multi-temporal analysis of the spaces (units) for accommodation in the area Bucegi the last 100 years and finding new solutions for promoting quality tourism and protecting the mountain environment in equal measure.

GIS technology used in this study, allows you a "inventory" and classification of all types of receiving structure for tourist accommodation in this the mountains, the carrying out of a data base that allows you to obtain a history of these sites and find new accommodation solutions applicable to other mountain areas.

Viability of human communities in Trascău Mountains, Romania

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Small rural communities in Trascău mountain range are primary communities characterized by major imbalances between main age groups and an accentuated aging trend, without the chance to replenish the initial population number naturally.

The issue of settlement viability in Trascău Mountains implies, besides demographic and migration aspects, also economic, cultural, psychological and political ones, which are mainly those that require durability of these settlements over time.

An important objective of this study is highlighting the diversity of ways to display the rural development in Trascău Mountains. Analysis of the way in which the localities are distributed in territory is important for organizing them and contributes in identifying certain aspects related to finding solutions of design, human settlements system integration, etc.

The need of thorough knowledge of the realities on site has lead to the present research, in order to seize what is essential, namely how human settlements, economic and demographic phenomena evolved, their complexity and manifestations in territory and evolution trends.

The main goal of this study is knowledge of particular features, potential, restrictions and future directions of development of human communities in Trascău Mountains, as support in developing a model of integration and functionality in regional context.

Research methodology of settlements was based on the analysis, processing and interpretation of relevant statistical data, geographical studies, documents, elaboration of maps and field research. The results of the study reflect the need for cooperation between people, governing authorities and local economic operators in order to ensure the stability and development of human communities in the analysed area and not their disappearance.

Habitat suitability, loss and connectivity of capercaillie populations in the Carpathians

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Species extinctions are occurring at a rapid rate as a consequence of human activities, particularly the loss of natural habitats due to alteration of disturbance regimes. Forests harbour most of the global terrestrial biodiversity, and the alteration of natural disturbance regimes in form of deforestation and forest management continue to exert pressure on forest biodiversity in many parts of the globe. In Europe's temperate zone, forest extent has been increasing lately, but so have harvesting intensity that result in further increase of fragmentation and new conservation challenges for these areas.

The Carpathians, constitute one of the largest remaining continuous forest ecosystems in Europe, harbor most of Europe's remaining temperate old-growth forests, and are therefore of outstanding conservation value. In the biodiversity-rich Carpathians, capercaillie (*Tetrao urogallus*) is an increasingly threatened umbrella species. It is a forest dwelling species with relatively low dispersal abilities, high requirements on habitat conditions, and it is sensitive to large scale logging and old-growth forest loss. To inform an effective conservation strategy, we studied capercaillie habitat at different spatial scales using three methodological approaches including dendroecology, population monitoring, and species distribution modeling. We compared the habitat suitability between managed forests, clearcuts, and old-growth forests. The highest habitat suitability values were obtained in old-growth spruce forests, where suitable habitat structures, such as lower tree densities, higher ground vegetation cover, gaps and deadwood, are created by windthrows and barkbeetle outbreaks. The natural mixed-severity disturbance regime created heterogeneous and complex environment for the capercaillie.

However, the capercaillie densities at the landscape level were best explained by the human activities, especially the logging. Much of the forest landscape is currently managed, and the proportion of forest clearcuts had a strong negative landscape level effect on capercaillie numbers. Suitable habitats have rapidly declined over the last few decades across the Carpathians. In total, 1109 km² of potential suitable habitats were lost since 1985 due to intensive forest harvesting, with highest values in Romania (565 km²), Slovakia (324 km²) and Ukraine (180 km²), independently on the status of protection. The functional connectivity of capercaillie habitats decreased significantly by 33 %, which threatens the population viability.

Our study highlights the non effectiveness of protected areas in the Carpathians that should be considered by the management authorities. Network of large protected forest reserves is crucial for the long-term persistence of biodiversity hotspots, such as the Carpathians, where allowing natural events and natural disturbance processes across multiple scales is likely the most effective way for biodiversity and capercaillie conservation in the mountain forests. We suggest including adopting

policies to better protect natural forests inside protected areas, to limit large-scale clear-cutting and salvage logging in capercaillie areas, to implement natural-disturbance-based forest management wherever possible, and to restrict fragmentation of core forest through of new roads.

Carpathian Forests' Health Status and Risks

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The Carpathians are the second longest mountain range in Europe (approx. 1500 km), a unique natural treasure of high ecological and economic value, and home for several major rivers. The Carpathians are an important cultural and social environment in the very heart of Europe, an important asset for the inhabitants of seven countries. This region is an important reservoir for biodiversity, a sanctuary for many unique habitats and Europe's last refuge of well-known large mammals (e.g. bear, wolf) (Szaro *et al.*, 2004; Chapron *et al.*, 2014). Post-communist economic difficulties and the transition to a market economy challenge a delicate balance with regard to sustainable development and conservation of the natural and cultural heritage for future generations. In this context, the Carpathians hold a significant strongpoint set against global change within a wide national and European stakeholder interactions, as support of social and ecological systems (Gurung *et al.*, 2009; Kozak *et al.*, (eds.) 2013).

The main objective of the paper is to outline the Carpathian forest health status over their entire range, across the borders of the countries Czech Rep., Slovakia, Poland, Ukraine, Hungary, Romania and Serbia. The starting assumptions are related to the significance of the main driving forces of the forest health status (e.g. air pollution, meteorological parameters, extreme events, biotic factors).

The health status of an organism or biological system cannot be boiled down to the absence of diseases or injuries/damages of any kind, nevertheless would include indicators approximating the ecological integrity, ecosystem services, sustainable management, and wellbeing of human population. Knowing the natural ecosystems' health status (e.g. forests) is paramount to its management, as the consequences of previous and current malpractice may affect the long-term future. The concept of forest health is elusive, and in the search of a pertinent definition one might consider the forest as being 'healthy' under the assumption of the capability of withstanding its internal structure and functions in relation to the changing environment.

The crown condition dynamics over the mountain range will be assessed considering the biotic, abiotic and anthropogenic disturbances, using data from ICP-Forests network (16x16km grid and level II). The results will be discussed in terms of specific conditions of vegetation, air pollution, climate, preliminary results indicating a potential growth loss ranging between 15-75%.

The risks are identified based on scientific literature analysis and shaped as a function of probability and intensity of damaging factors upon the forest condition, and the outcomes are discussed in relation to the sustainability of management policies, underlining the vulnerable regions.

Acknowledgements are due to the UNECE ICP-Forests contributing countries, European Commission (Life+) and the Romanian Authority for Research (Nucleu Program).

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Spatiotemporal synchrony in episodic disturbances in primary Norway spruce forest across Europe: legacies and consequences

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Climate change scenarios with increased frequency of windstorms and droughts, which could trigger large-scale bark beetle outbreaks, are predicted in temperate forest landscapes. Understanding whether these events are part of the historical range of variability or induced by climate changes and past management practices are of crucial importance for future forest management towards higher resilience and resistance.

There is a continuum of disturbances in forests ranging from occasional death of canopy trees caused by pathogens, to widespread low severity mortality caused by drought or herbivory, or severe stand-replacing fires, blowdowns, or insect outbreaks, to name a few. While we have gained a deep understanding of disturbance regimes on the local scales (up to few hectares), we have still limited knowledge on large scale synchrony of disturbances and teleconnections (Jarvis and Kulakowski, 2015; Pederson et al., 2014).

Our aim is to uncover 300 years of disturbance history in primary mountain Norway spruce forests along the Carpathians range (1000 km west-east and 1000 km north-east gradient) based on dendrochronological methods. We used highly spatially and temporally resolved dendrochronological data of over 15 000 trees from ca. 500 plots to reconstruct past disturbance history on plot, landscape and mesoscale levels. We use tree growth response to abrupt decrease in competition induced by disturbance to identify and quantify disturbance events at the tree, stand and landscape levels.

Our study determined that a mixed disturbance regime prevailed in the past. Importantly, despite high spatio-temporal variability of historical disturbances on the plot level, we found strong evidence of disturbance synchronisation at the mesoscale level. Broad mesoscale peaks of disturbances were evident across many sites in the 1820-1830, 1850-1890, and 1910-1930 periods. We discuss possible processes and agents that caused such disturbances, including windstorms and bark beetle, and the role of past climate extremes as a possible trigger or co-agent of such events. We conclude that alongside climate change or anthropogenic factors, these past synchronized mesoscale level disturbances are likely be a driving factor of current forest structure and potential susceptibility to new events.

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Relationship among phoretic mites and Norway spruce bark beetles - *Ips typographus* and *Pityogenes chalcographus*, from Romania

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The Carpathian forests, which are dominated by Norway spruce, have suffered continual damage due to pests such as spruce bark beetles. Due to the huge impact of bark beetles on the health and economics of forest ecosystems, the ecology of their natural enemies has been the subject of many studies throughout Europe (Gwiazdowicz et al., 2015; Penttinen et al., 2013; Čejka & Holuša, 2014).

During the last decade 274,444 ha of the 3 million hectares of the State forests in Romania have been affected by conifer bark beetles annually; 27% seriously (Simionescu et al. 2012). The disasters generated by the very large explosions in the beetle populations have led to the development of special research programmes for integrated biological control, based on autoecological studies of the beetles. These studies have revealed that *Ips typographus* L. is one of the most harmful pests of Norway spruce stands in Romania (Mihalciuc & Olenici 1999). A major omission in these investigations has been the lack of studies of the diversity of phoretic mites living in the bodies of bark beetles or their galleries in the trees, in the Romanian forests. New information about phoretic mites is important because several specialists in forestry management and forest pathology have affirmed that the mites could be a useful biological control tool for bark beetles, the Acari being able to feed on their eggs and larvae (Penttinen et al., 2013).

Present paper presents the relationships of Norway spruce bark beetles (*Ips typographus* and *Pityogenes chalcographus*) and their phoretic mites in south-west Carpathians, in two Natura 2000 sites: (Țarcu Mountains-ROSCI0126 and Rusca Montană- ROSCI0219). For the first time in Romania, seven species of mites (Acari, Mesostigmata) have been found in relationship with the two bark beetles: *Pleuronectocelaeno austriaca*, *Trichouropoda polytricha*, *Dendrolaelaps quadrisetus*, *Uroobovella ipidis*, *Trichouropoda orzaghi*, *Proctolaelaps fisheri* and *Vulgarogamasus oudemansi*. Five of them are reported as new for Romania.

Ips typographus has been carried almost eight times more mites than *Pityogenes chalcographus*. The most important mite species were *Dendrolaelaps quadrisetus* (eudominant on *Ips typographus*), *Trichouropoda polytricha* and *Uroobovella ipidis* (codominant on *Pityogenes chalcographus*).

Species *Proctolaelaps fisheri* and *Vulgarogamasus oudemansi* were found only in sediment. Mite localization on host body was complementary - *Dendrolaelaps quadrisetus* exclusively under elytra, while *Trichouropoda polytricha* and *Uroobovella ipidis* were more frequently on coxa (on *Ips typographus*) or on thorax (on *Pityogenes chalcographus*). *Dendrolaelaps quadrisetus* displayed a relatively uniform distribution from 600 to 1400 m elevation, but *Trichouropoda polytricha* and *Uroobovella ipidis* showed an exponential decrease with altitude. Development stage corresponded in majority to deutonymph on all phoretic interactions, especially on Uropodina mites.

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Thinning of young spruce stands in areas affected by spruce decline

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Norway spruce is one of the most important commercial forest tree species in central Europe. This species is, however, also prone to suffer from many pests and harmful agents, especially in areas beyond its natural ecological conditions. This is case of non-native spruce stands in forest vegetation zones naturally dominated by beech and fir in the Czech Republic (Holuša 2004, Šrámek et al. 2008), Slovakia (Hlásny et al. 2010, Sitková et al. 2010) and Poland (Modrzyński 2003). At the beginning of 1990s, there has been a large-scale decline of spruce forest. The decline manifests itself by yellowing, defoliation and by dying of trees in all age stages. The main reasons are probably unsatisfactory state of forest soils, precipitation deficiency and high temperature in growing seasons connected with global climate change. Honey fungus and bark beetle attacks are just accompanying factors.

Change of forest species composition toward mixed stands is one of the most important and promising measures (Spittlehouse, Stewart 2003; Mason et al. 2012). Properly conducted thinning in the young spruce monocultures is a prerequisite for improving both stability and vitality of trees and for making stand structure appropriate to introduction of other forest species. However, thinning in the affected young spruce stands are questioned today due to concern about deterioration of spruce health shortly after thinning. The main objective of the experiments (established in 2010) is to propose appropriate thinning techniques in young spruce stands currently affected by declining. Four experiments were found in NE part of the Czech Republic, one of the most affected areas exhibiting the spruce decline today. Experimental treatments were situated to spruce thicket and small-pole stands. We evaluated growth and health status of target spruce trees (1500 and 1000 trees per hectare in thickets and in small-pole stands, respectively).

Thinning contributed to modest acceleration of diameter increment. Relative diameter growth rate was about 2-5% higher in thinned treatment. Mortality in thinned treatment was slightly higher compared to control one, but the mortality has not endangered future stand development yet. Initially, health status of spruce trees, expressed by yellowing of needles, was similar in thinned and unthinned treatments, but we observed slight improvement of health five years after thinning.

Supported by projects NAZV QJ1620415 and RO0116 (10462/2016-MZE-17011).

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POSTER PRESENTATIONS

The control of parasitic diseases of spruce plants from silvicultural nurseries and cultures through the usage of new generation fungicides

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Forest protection work aims to establish and implement the necessary methods to prevent the damaging effects of abiotic factors, in order to avoid mass-breeding of pests or the proliferation of some diseases. If they occur, the necessary repressive methods are chosen.

In the plant production activity or in their first years in silvicultural cultures, parasitic diseases caused mainly by pathogenic fungus occur with a high frequency. Advancing to the disease state is a multi-staged process, which has an intermediate stage that can be reversible, with a return to healthy condition, if the factors that induced it disappear or their degree of action is reduced (Bobeş, 1983). Based on the evolution of the pathologic process, plant diseases can be acute – when the development is fast, causing death of the attacked organ or of the whole plant in short time, and chronic – with a slow, long-lasting development, which causes gradual weakening of the diseased plant (Baicu, Sesan, 1996).

The decisive criterion for practical usage of a pesticide is mainly the economic one. For attaining maximal economic efficiency, many factors contribute, which have to be taken into consideration. It must have quick action, selectivity only for the target group, be stable for storage and usage, etc. Until now, no substance that satisfies all of these conditions has been found and so the magnitude of current and perspective research for finding a substance that possesses characteristics as close as possible to those mentioned above is explained. Testing of new products and treatment methods/techniques will offer new solutions for managing stands affected by infectious agents consistent with the new internal and international regulations.

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The control methods of the pest *Stereonychus fraxini* Degeer (Coleoptera: Curculionidae)

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The ash plantations of different ages from in Siret River's basin and in principal placed in the Bârlad River's meadow, were damaged, in the last decade by the attack of the beetles and larvae of the pest *Stereonychus fraxini*, Degeer (Coleoptera: Curculionidae).

Concerning the damages produced by the *Stereonychus fraxini* pest adults attack both buds and leaves causing massive defoliation in spring.

The discovery can be done starting with the blooming phase of the ash tree buds when we can observe adults on buds branches and also in larvae state by observing them on leaves. The larvae are covered with characteristic mucus. Beside the active period of the pest, the discovery is done by the characteristics marks of the larvae attack (they chew the interior part of the leaflet, and the thin

layer of the superior of epidermis remains untouched. In the final ages, the larvae produce holes in leaflets, passing on the superior part, the sides usually starting to get brown).

The control experiments have been done separately for the larvae as well as the adults. To combat in larvae state, very good results were obtained by applying synthetic pyrethroids (Sumi-Alpha ULV, Decis, Karate Zeon) and also growth inhibitors (Nomolt, Dimilin 48 SC). Adults have prawn themselves sensible at any pesticide, a mortality of 95-100% being obtained.

The control treatments can be applied with good results only in the base of close watching of the ash trees phenology in correlation with that of the pest trees being indicated in two special theme periods. The 1st treatment can be early applied in adult stage for the 2nd hibernating generation, in the moment when the flight is maxima and when the leaves have reached 1/3 to 1/2 from its normal size. The 2nd treatment is recommended to be done in the larva stage from 1st generation, when the first larvae of the 2nd age have appeared in nature and the leaves have normal size.

CARPATHIANS: SMART AND SUSTAINABLE I

ORAL PRESENTATIONS

Hydraulic conditions of flood flows in incised, channelized, and multi-thread reaches of a mountain river, the Czarny Dunajec, Polish Carpathians

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Channel regulation and incision were the two most important changes of Polish Carpathian rivers in the 20th century, with profound effects on biotic (e.g. Wyżga et al., 2009) and sedimentary processes in their channels (Zawiejska et al. 2015). The resultant changes in the conditions for flood flows have been documented for some water-gauge cross-sections, but little is known about changes in hydraulic conditions of flood flows outside gauging stations. Channel morphology of the Czarny Dunajec River, Polish Carpathians, has been considerably modified as a result of channelization and gravel-mining induced channel incision, and now it varies from a single-thread, incised or regulated channel to an unmanaged, multi-thread channel. We investigated effects of these distinct channel morphologies on the conditions for flood flows in a study of 25 cross-sections from the middle river course where the Czarny Dunajec receives no significant tributaries and flood discharges increase little in the downstream direction. Cross-sectional morphology, channel slope and roughness of particular cross-section parts were used as input data for the hydraulic modelling performed with the 1D steady-flow HEC-RAS model for discharges with recurrence interval from 1.5 to 50 years. The model for each cross-section was calibrated with the water level of a 20-year flood from May 2014, determined shortly after the flood on the basis of high-water marks. Results indicated that incised and channelized river reaches are typified by similar flow widths and cross-sectional flow areas, which are substantially smaller than those in the multi-thread reach. However, because of steeper channel slope in the incised reach than in the channelized reach, the three river reaches differ in unit stream power and bed shear stress, which attain the highest values in the incised reach, intermediate values in the channelized reach, and the lowest ones in the multi-thread reach. These patterns of flow power and hydraulic forces are reflected in significant differences in river competence between the three river reaches. Since the introduction of the channelization scheme 30

years ago, sedimentation has reduced its initial flow conveyance by more than half and elevated water stages at given flood discharges by about 0.5-0.7 m. This partly reflects a progressive growth of natural levees along artificially stabilized channel banks. By contrast, sediments of natural levees deposited along the multi-thread channel and subsequently eroded in the course of lateral channel migration and floodplain reworking; as a result, they do not reduce the conveyance of floodplain flows in this reach.

This study was completed within the scope of Research Project DEC-2013/09/B/ST10/00056 financed by the National Science Centre of Poland.

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Hydromorphological assessment of Malinowski Stream in the Western Carpathians using RHS method

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Difficulties in water resource management in mountain areas, presence of deforested and reforested areas in the surrounding of the catchment area influence the physic-chemical and biological quality of surface waters as well as their hydromorphology.

In order to determine the quality of Malinowski Stream, Western Carpathians, hydromorphological assessment was carried out using a River Habitat Survey (RHS) method. The analysis of quality parameters was obtained based on synthetic evaluation using Habitat Modification Score (HMS) and Habitat Quality Assessment (HQA). The first indicator determines the degree of transformations in the morphology of the watercourse, while the second is based on the presence and diversity of natural elements of the watercourse and river valley. The study was based on the observations of well-defined elements of the environment of the river during the growing season.

The assessment, including evaluation of the dominant attributes of the edges and the bottom of the channel and the river valley, was made in the 10 spot-checks spaced evenly on a 500 m section of the RHS site. Spot-checks were determined at regular 50 m intervals. The assessment took into account various characteristics, among others: characteristic profile of the valley, the presence of water structures, the material of the banks and the channel and their modifications, the type of flow, natural morphological elements of the channel, channel vegetation types, banktop and bankface vegetation structure, valuable natural elements of the environment of the river, number of riffles, pools, point bars, channel dimensions, features of special interest, assessment whether the channel is choked, notable nuisance plant species. The results of the hydromorphological assessment referred to reference conditions allowed the classification of the stream in terms of its hydromorphological quality in accordance with the Water Framework Directive.

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Twentieth-century incision of Polish Carpathian Rivers: recognition, spatial pattern, and impacts on the hydraulics of flood flows

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Rivers in the Polish Carpathians, and in many other mountain regions of Europe, deeply incised over the 20th century. One of the effects of channel incision has been a reduction in water storage in floodplain areas, leading to increased flood hazard to downstream river reaches. Channel deepening may result from channel incision or river metamorphosis changing a wide and shallow channel to a narrow and deep one. As only the first type of channel change leads to increased flow capacity of the channel, a lowering of water stage associated with a given discharge rather than a lowering of river bed should be used to identify channel incision. A lowering of minimum annual stage at gauging stations is typically used to assess the relative importance of channel incision along a river or within a particular region. Rivers of the Polish Carpathians incised by 0.5–3.8 m over the twentieth century, with the amount of incision being greater in their lower and middle courses than in the upper ones (Wyżga, 2008). 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 gauging stations located along the seventh-order Dunajec River. Despite a lower absolute amount of channel incision in the upper river course, here incision has increased channel conveyance and reduced the frequency of valley floor inundation considerably more than in the lower course. Hydraulic effects of channel incision depend also on lateral stability 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 (Wyżga, 2001). Low-energy rivers from the eastern part of the Polish Carpathians 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 decreased considerably. In high-energy rivers from the western part of the Polish Carpathians, alternation of incision and lateral channel migration 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.

This study was completed within the scope of Research Project DEC-2013/09/B/ST10/00056 financed by the National Science Centre of Poland.

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Environment-friendly reduction of the erosional threat caused by a dynamic mountain river, the Czarny Dunajec, Polish Carpathians

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Migration of a mountain river channel may cause erosional risk to infrastructure or settlements on the valley floor. Following a flood of 2010, a cutbank in one of the bends of the main channel of the Czarny Dunajec, Polish Carpathians, approached a local road by 50 m. To arrest the erosion of the laterally migrating channel, water authorities planned construction of a ditch cutting the forested neck of the bend, reinforcement of the ditch banks, and damming the main channel with a boulder groyne. However, this hard-engineering solution would affect the environment and was disapproved by environmental authorities. This river reach is typified by high abundance and diversity of fish fauna (Wyżga et al., 2009) and high taxonomic diversity of benthic macroinvertebrates (Wyżga et al., 2012). In order to avoid channelization of the highly valued, multi-thread river reach that would deteriorate its ecological status, an alternative approach to prevent bank erosion was proposed. The new scheme, applied in 2011, included opening of the inlets to inactive side braids located by the neck of the bend of the main channel. This solution reestablished the flow in the steeper low-flow channels, allowing us to expect a cutoff and abandonment of the main channel during subsequent floods. Gravelly deflectors were constructed directly below the inlets to the reactivated side channels to divert the flow into the channels and prevent the water from entering the main channel. Hydraulic measurements performed before and after the implementation of the scheme confirmed that it enabled shifting the main water current, with the highest average velocity and bed shear stress, from the braid closest to the road to the most distant braid. Similar surveys of fish and benthic macroinvertebrate communities indicated that flow reactivation in the side channels was beneficial for these groups of river biota, increasing their abundance and taxonomic richness in the reach. Not only was the implemented solution significantly less expensive, but it also enhanced ecological functions of the multi-thread channel and the variability of physical habitat conditions and maintained the role of the reach as a wood debris trap. However, avulsion of the main channel in the river bend immediately upstream during the flood in May 2014 again caused erosional risk to the road, although at another location. This indicates that with the highly unstable, multi-thread channel pattern of the Czarny Dunajec, the best practice of river maintenance in a relatively unmanaged valley reach would be allowing free channel migration within the floodplain area and reinforcing, where necessary, the boundary between the erodible river corridor and the managed terrace.

This study was completed within the scope of Research Project DEC-2013/09/B/ST10/00056 financed by the National Science Centre of Poland.

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Response of fish and benthic invertebrate communities to constrained channel conditions in a mountainous Biała River, Polish Carpathians

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Following considerable hydromorphological degradation in past decades, the gravel-bed Biała River, Polish Carpathians, is to be restored through establishing erodible corridor in two river sections. In these sections, relatively long, unmanaged channel reaches alternate with short, channelized reaches located in the vicinity of bridges. Effects of the alternating morphologies on physical habitat conditions, fish and benthic invertebrate communities, and ecological river quality were investigated in 10 pairs of unmanaged and channelized cross-sections located between significant tributaries. Unmanaged cross-sections with an average of two low-flow channels exhibited significantly greater variation in depth-averaged and near-bed velocity and bed material size than single-thread, channelized cross-sections. Summer, autumn and winter surveys of benthic invertebrates indicated that the unmanaged cross-sections typically hosted three times more taxa than channelized cross-sections, and this was reflected in distinct appraisal of the two cross-section types by means of invertebrate-based BMWP-PL index. Electrofishing indicated no statistically significant difference in the number of fish species between both types of river cross-sections, and the resultant similar scores of the European Fish Index allowed both cross-section types to be associated with the same class of ecological river quality. This study indicated that short channelized river reaches do not disrupt continuity of fish populations, although they provide worse habitats for fish, reflected in the lower numbers of individuals, especially juveniles. It also highlighted the need of investigating various groups of river biota to determine the response of river biocoenosis to environmental stressors and evaluate the ecological status of the river.

POSTER PRESENTATIONS

Assessment of a restoration possibility for braided rivers in the Curvature Subcarpathians (Romania)

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River restoration should be based on allowing natural fluvial processes to take place. One of the techniques of restoration refers to reintroducing sediments to give the river the possibility to recreate the natural braided pattern constituted of several channels separated by islands or bars. Before any decision, it is necessary to characterize river's transport capacity in order to estimate sediment volumes which could be moved by small floods with moderate sediment transfer velocities, susceptible to allow the restoration of a braided pattern. Therefore, one may compute the sediment transport competence at the low-bank stage and the bankfull stage based on cross-profiles and hydraulic relations between cross-section parameters (e.g., Manning's, and Meyer-Peter and Muller's equations). This technique might be appropriate also for braided rivers in the Curvature Subcarpathians (Romania), which lost sediments due to various human pressures. As an example, the Prahova River in the Subcarpathian reach almost lost the braided pattern, retracted the active

channel's width by 50%, and incised by approximately 1 m at the Câmpina gauging station in the last 35 years. Consequently, the Prahova River near the Câmpina gauging station might be restored by reintroducing sediments with a maximum diameter ranging from 24 mm for the low-bank stage to 170 mm for the bank-full stage, which correspond to sediments volumes of 18,063 m³/yr (or 1.3 kg/s for 12 m³/s) to 121,732 m³/yr (or 9.2 kg/s for 455 m³/s). Due to high volume of sediments transportable by bank-full floods, probably impossible to reintroduce, such a restoration project on the Prahova River downstream of the Câmpina gauging station will have only a slight morphogenetic effect. Therefore, similar to other Carpathian rivers, on the Prahova River, the heavy human impact limit the feasibility of the restoration back to natural braided channel morphology.

Water quality changes in the Ialomița River under the influence of human settlements and activities

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This study analyzes the evolution of the Ialomița River's water quality between 2005 and 2014 under the impact of several factors such as human settlements located along its course, human activities that generate wastewater which is subsequently dumped in the river and the practice of uncontrolled waste disposal on the banks or in the waters of the river.

The study presents various sources of domestic, agricultural and industrial pollution, detailing their point source or diffuse character. In relation to these pollution sources, we analyzed the repartition of the Ialomița River waters into quality classes. The most significant human pressures come from diffuse sources such as settlements lacking sewage collection and treatment systems or agricultural activities. The final part highlights a number of future projects that aim to protect the quality of the Ialomița River waters.

This study has been created by a team of second-year students from the Climatology and Water Resources Master (from the University of Bucharest's Faculty of Geography), coordinated by Associate Professor Dr. Valentina-Mariana Mănoiu.

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Surface ozone at Lomnický štít - the highest monitoring site of the Carpathians

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In this work, we present surface ozone (O₃) data according to continual measurement of O₃ concentration (1 minute average recording from 2B Tech Ozone monitor 106-L) at Lomnický štít

(2,634 m a.s.l.) from January to December 2015. This O₃ monitoring site is situated on the Slovak part of the High Tatra Mts. (49° 11' 43.10" N, 20° 12' 47.10" E), in the alpine zone of the Western Carpathians. Surface O₃ is a secondary air pollutant that forms in complex combinations of chemical processes and meteorological influences. The concentration of O₃ typically increases with altitude in the first kilometres of the troposphere, higher concentrations of O₃ can therefore be observed at high-altitude stations (EEA 2014). In remote alpine areas, long-range transport of O₃ from urban source regions and/or downward mixing of O₃-rich air from above – rather than local photochemical production – can play a significant role (e.g. Bytnerowicz et al., 2003). The aim of this research is to examine the role of climate and meteorological conditions in variability of O₃ concentration and long-range transport of O₃ air pollution for remote mountain site of the Carpathians. In addition, data from muon detector SEVAN for detection of cosmic rays observed around the time intervals of thunderstorm activity in the vicinity of Lomnický are discussed. This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0429-12 and by the Grant Agency of the Slovak Republic under the project VEGA No. 2/0053/14 and No. 2/0026/16.

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SUSTAINABLE CARPATHIANS V

ORAL PRESENTATIONS

Adaptive genetic potential of forest tree species under regional environmental changes: a case study on Norway spruce and European silver fir in Romania

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Mountain ecosystems are among the most vulnerable to climate change. The real potential for adaptation depends upon the existence of a wide genetic diversity in trees populations, upon the adaptive genetic variation, respectively. Genetic diversity offers the guarantee that forest species can survive, adapt and evolve under the influence of changing environmental conditions.

The aim of this study is to evaluate the genetic diversity and adaptive genetic potential of two local species, Norway spruce and European silver fir in the context of regional climate change. Based on data from a long-term provenance experiments network and climate variables over last 50 years, we have investigated the impact of climatic factors on growth performance and adaptation of tree species. Our results indicate that climatic and geographic factors significantly affect forest site productivity. Mean annual temperature and annual precipitation amount were found to be statistically significant explanatory variables, which accounted between 25 to 65% of the growth traits variation at the age of 35 years.

Combining the additive genetic model with analysis of nuclear markers we obtained different images of the genetic structure of tree populations. As genetic indicators we used: gene frequencies, genetic diversity, genetic differentiation, genetic variance, plasticity. Spatial genetic analyses have allowed identifying the genetic centers holding high genetic diversity which will be valuable sources of gene able to buffer the negative effects of future climate change. Correlations between

the marginal populations and in the optimal vegetation, between the level of genetic diversity and ecosystem stability, will allow the assessment of future risks arising from current genetic structure. Therefore, the strategies for conservation and management of forest genetic resources in these regions have to rely on the adaptive genetic variation and local adaptation of the valuable genetic resources.

Unique postglacial evolution of the hornbeam (*Carpinus betulus* L.) in the Carpathians and Balkan Mountains revealed by chloroplast DNA

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The hornbeam has an interesting and distinct postglacial evolution in the Balkan area (Carpathians and Balkan Mountains) compared with Western Europe.

Palynological studies revealed a unique episode in the European forests history, with a distinct hornbeam layer between oak and spruce forests, specific for the Carpathians and Balkan Mountains (Fărcaş *et al.*, 2006).

Phylogeographic methods with chloroplast DNA markers proved to be reliable and applicable to get new insights into the history of many species during glacial cycles (Provan, Bennett, 2008).

Chloroplast DNA (cpDNA) variation was studied with PCR-RFLP method to describe the present population genetic structure and to investigate postglacial recolonisation of hornbeam populations from the Carpathians and Balkan Peninsula.

A remarkable and distinct phylogeographic structure was detected in the Balkan area (Carpathians and Balkan Mountains) compared with Western Europe.

The location of isolated and effective glacial refugia of hornbeam in the Balkans is presented.

The revealed genetic structure and the identified glacial refugia in the Balkans may have direct consequences in the management and conservation of hornbeam forest genetic resources.

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Biodiversity of selected invertebrate groups in different managed non-forest habitats in the Poloniny National Park (Slovakia)

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We present results of the research of selected communities of non forest habitats in the Slovak part of the trilateral National Park Poloniny. For the period last decades the studied territory came through significant political and economic changes that give traces up in the country. The studied area consists with area of the Horná Cirocha Catchment which was evicted in the 1970's due to construction of water reservoir and the Uličská Valley where majority of agricultural land was

abandoned after 1989. The accession of Slovakia into the Europe Union (2004) is associated with the restoration of support for preserving typical landscape character of this region (application agro-environmental programs), what caused using of many abandoned agricultural parcels. A invertebrate research was carried out in 20 study sites in 2011-2013 by using pitfall trap method and in one plot by using Malaise trap method for flying and ballooning species. Spiders and beetles were chosen as model taxonomic groups. Selected investigated plots represent six characteristic types of non-forest ecosystems, namely mountain meadows, fens and wet meadows, mesophilic meadows, abandoned grasslands, nitrophilous ruderal communities and permanent grassland and mesophilic meadows with specific management.

Spiders (Araneae)

During research period more than 47,297 spider specimens belonging to 246 species and 24 families were captured. Of the identified species, 29 species are listed in the Carpathian Red list in different categories of threat. Also finding a one new species (*Micaria coarcata*) for the Slovak fauna is important result of our research. We evaluate the composition and diversity of the studied communities, their changes in two annual periods of research and altitudinal gradient effect. From evaluated habitat types the mountain meadows are the most important for composition of spider communities concerning their biodiversity and zoological aspect. Differences in the composition of the studied communities are influenced by many factors and on the bases of the direct linear gradient analysis (RDA) it was verified that the factors moisture, mowing, coverage E1, altitude, nutrients in the soil, solar power and light are statistically significant. Also we analyse spider fauna of the habitats which was selected as the important site from nature conservation viewpoint (different subsidies and special management).

Beetles (Coleoptera)

Also we studied beetles in the research period 2011-2013 and recorded 552 species in pitfall traps in 20 sites and 434 species in the Malaise trap for flying species situated on 1 monitored study plot. Out of them, we identified 474 species new for the region and thus contributed significantly to the knowledge of the beetle fauna of this National Park (1,476 species were known from the area in the past). We found abundant occurrence of *Carabus zawadzskii* and *Carabus. variolosus* which both species are listed in Annex II of the Habitats Directive.

The results of this analyse confirm the special management has positive influence on biodiversity can be taken into account in the agro-environment schemes Common Agricultural Policy. Also, we can conclude that the most important habitats concerning the ecological significance in terms of invertebrate diversity are mountain meadows called ("poloniny").

The research leading to these results received funding from the grant agency VEGA, project No. 02/0117/13.

Conservation strategies for largest brown bear population in the Carpathians

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Europe is characterized by a fragmented natural landscape, interspersed with high human population densities. In Romanian Carpathians, one of the largest population of brown bear (*Ursus arctos*) in Europe exists, more than 6000 individuals are occurring at the highest densities reported in Europe: between nine and more than 24 bears/10,000 ha. Large carnivores need large surfaces to satisfy their ecological/ethological needs and a high pressure is put on them. At the moment, human activities, infrastructure development and habitats fragmentation give birth to major challenges in elaborating conservation strategies. To mitigate these pressures, long-term conservation strategy is compulsory and should take into consideration the influence of anthropogenic/ecological factors correlated with species ecology and ethology and to be implemented into species management. Here we analyzed 320 brown bear samples genotyped for 17 microsatellite markers; univariate modelling

of effective landscape resistances and multivariate modelling based on relative support values and multiple regression analyses (MRM) were used to determine the influence of landscape features on gene flow. This study highlights the power of landscape genetics tool in detecting individual based structuring within one large continuous population demonstrating that the landscape composition becomes an important predictor of spatial genetic variation in brown bear population. Fine-scale landscape genetic analysis of the brown bear population in the Romanian Carpathians has highlighted the importance of ensuring habitat connectivity in compliance with European legislation and the need to maintain demographically viable populations in favourable status. Modelling outputs can act as a decision support tool to improve brown bear conservation; this approach should in principle be implemented before highway construction, thus helping to avoid subjective mitigation planning and encouraging evidence-based conservation.

Carpathian landscapes changes during 1775-2012 period. A case study : Bucovina

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For the sustainable management of ecosystems and for the nature protection, the pattern of distribution of forests and the trends observed in the last centuries can provide very useful information.

Forest has always been an important resource for renewable products and energy and nowadays for habitat protection, biodiversity conservation and water sources. Maps made by the military surveyors in the period 1773-1775, using a poor equipment succeeded in surveying and mapping of the occupied territory by the Habsburg army during the Russian – Ottoman war. The maps shows the locations, roads and rivers and present the contour of forested areas using clear signs. The ground control points were easy to locate and the accuracy of military maps is 50-100m. For the land use assessment the information are quite useful but for the locations the errors remains large.

Change in the area, structure and functioning of the forests under the human pressure remain less known in the absence of a long-term monitoring. Indicators concerning the forest coverage at a certain period of time depend on the quality of data sources and applied assessment techniques. The main goal of study were to analyze the possibility of using historical maps and Google Earth imagery for the assessment of forest cover and forest cover change in a 235 years period in Bucovina, a former province of Habsburg Empire actually in Romania (S) and Ukraine (N). The results obtained shows that it is possible to reconstruct forested areas and to compare with actual land use. The comparisons carried out that for the studied area (over 1 mil ha) shows that in the planar-hilly area the forest cover changed from 35.1% in 1775 at only 15.6% in 2010. In the low mountainous area the forested massifs diminished from 83.5% in 1775 at 64.5% in present and in the high mountainous area the forest represented 74% in 1775 and 60.8% in 2010. For the southern part of Bucovina (in Romania) the forested area changed from 63.8% in 1775 to 46.2 in 2010, while for the northern part of Bucovina (today in Ukraine) forested area changed from 43.6% in 1775 to 28.3% in actual time.

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POSTER PRESENTATIONS

Your Steps Towards Ecological Connectivity. The GreenAlps Project

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Mountain environments provide high-quality ecosystem services, if the connections between the different habitats are established and maintained. GreenAlps investigated the knowledge and the involvement of local stakeholders, experts and people in European projects dealing with ecological connectivity. Ecological connectivity is seen as a solution for landscape fragmentation, the loss of

local identity and the promotion of local economy and tourism. However, since the large public still poorly understands the connectivity concept, GreenAlps developed an infographic poster showing connectivity at the heart of the interactions between humans and nature. The “human-nature-being” wants to bring the spectator into a journey in the feelings experienced by wildlife species when facing a barrier that impedes free movements. The poster invites the reader to open the mind to a new contact with nature, seeing ecological connectivity as a new opportunity, especially for humans. From the neck down to the legs, how would you feel if something, out of your control, would impede your will to move freely? We are used to have no barriers in our environment and rarely think that wildlife species have our same rights to live on this planet. The audience is driven to a truth: humans and wildlife share the same need – free movement for a working brain and a healthy life.

The project GreenAlps has proved that ecological connectivity is still unknown to the most people and that it holds the opportunity of joining nature protection with regional development, but only if experts, local people and stakeholder work together in a public participation process.

Is it possible to imagine a world where humans and wildlife species live in harmony?

What can YOU do for ecological connectivity?

The climate change and the evolution of *Lymantria monacha* L. population in Romania

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To study the effects of climate change on the populations of *Lymantria monacha*, the evolution of potential evapotranspiration by Thornthwaite (ETP) was analyzed, as a climatic parameter controlled by the solar and atmospheric radiation, air temperature and humidity, atmospheric pressure, wind, etc. which are the same climatic factors that influence the evolution of insects (Sandu, et. al., 2010, Simionescu et al., 2000). On the basis of the values of the monthly potential evapotranspiration calculated for 26 weather stations, representative for the spruce forests across the Romanian Carpathian, potential evapotranspiration for the period of the year considered to be active for species of *Lymantria monacha* (May-September) was calculated. Using statistical strings made up of ETP values (May to September), calculated for the period 1961-2010, and the average number of butterflies captured annually on panels with pheromones (Atralymon), located since 1974 in a rectangular network of observation points around the meteorological stations concerned (Mihalciuc, 2011), the trend of evolution of the populations of *Lymantria monacha* in direct connection with the values of the ETP has been established (Tomescu et al., 2011). The statistics show an increase about 10 mm of the average values of the ETP for a period of 20 years, and a gradual increase in the number of male butterflies captured using the bait blends pheromone (from an average of 10 butterflies/panel in the 1980s to an average of 23 butterflies/panel after the year 2000). Also, independent of the year, there is a significant correlation between the level of ETP from the period May-September and the average number of male butterflies captured on the panels with pheromones.

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Threats on the Romanian Carpathians biodiversity: *Rana temporaria* (European common frog)

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Biodiversity conservation of ecosystems and species is a priority at international level, in the context of human impact on biotic cover has reached alarming levels. Maintaining biodiversity creates prerequisites for long-term existence of life on Earth, helping to restore the regional and global ecological balance, regeneration of biological resources and ensure environmental quality corresponding to the needs of human society (CBD, 1992).

The study aims at identifying threats to biodiversity in the Carpathian mountain area, generated by poaching in general and the issue of common frog (*Rana temporaria*) poaching in particular. This amphibian is marketed and consumed in restaurants in the localities which are close to the study area.

Rana temporaria is a predominantly terrestrial species very resistant to low temperatures. It lives in forests and natural grasslands or in any habitat humid enough to ensure its survival, at elevations up to 2000 m (Cogălniceanu et al., 2013). Although ranked as of least concern on the IUCN Red List (Kuzmin et al., 2009), the species is vulnerable in the Romanian Carpathians and requires special protection during the breeding season, when adults gather on the large surface water areas used for this purpose (Fuhn, 1969; European Directive 92/43/EEC; Law 13/1993; Government Emergency Ordinance 57/2007).

The study area is focused on several protected areas: Retezat National Park and Biosphere reserve, ROSCI0188 (Natura 2000 site in Parâng Mountains) and Piatra Craiului National Park, where the species is protected. The research methodology was based on field survey, quantitative and qualitative methods (social inquiry) and GIS techniques.

The study results revealed the following: the ecological characteristics of mountain red frog habitat; the main causes of poaching species: poverty locals in proximity of the area of study that captures copies of frog for marketing; poachers' low education level; lack of awareness campaigns among the local population, on protected species in the region and environmental benefits for the populations of amphibians (e.g. pollution indicators, consumption of insects and mosquitoes, diminishing the flowering from lakes by eating algae, etc.).

Amid poverty offs of the population in the industrial sector, lack of education and 'recovery' in gastronomy, *Rana temporaria* population of Romania is seriously threatened and requires more action to enforce legislation.

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CARPATHIANS: SMART AND SUSTAINABLE II

ORAL PRESENTATIONS

Leaves and xylem phenology of oaks, a tool of evaluate forest ecosystems from Eastern Carpathians tableland in the context of climate change

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Our research aimed to show the influence of climate change on oaks forest ecosystems and the changes that can occur in the seasonality and phenology of biological processes, considered as the most sensitive and prominent responses to global climate change. In the context of increasing temperatures and decreasing precipitation amounts (Simota et al., 2014), the thermophilic and xerophyte, or relatively thermophilic and mezoxerophyte taxa of genus *Quercus* represent a future solution for the afforestation in extreme site conditions, specific for forest steppe contact zone. 300 trees belonging to seven taxa (*Q. pedunculiflora*, *Q. robur*, *Q. petraea* ssp. *petraea*, *Q. petraea* ssp. *dalechampii*, *Q. petraea* ssp. *polycarpa*, *Q. pubescens* and *Q. virgiliana*) (Apostol et al., 2015) were identified and evaluated in Fundeanu phytocenosis, situated in Covurlui tableland, at the contact with external forest steppe. Phenological observations were made in the superior part of the crown every two-three days for all the trees and wood microcores were collected weekly from sixteen trees at breast height (1.3 m) (Semeniuc et al., 2014). The results show significant correlation between bud burst, cambium activity and the environmental factors. The photoperiod and water access play a dominant role in the leaves and xylem phenology and influence the time and period of the phenological phases (bud burst, flushing and flowering). The presence of the taxa in all three phenological categories: precocious, intermediate and tardy shows a good plasticity and adaptability of the natural population. The tardy provenances can avoid the late frost (especially in the flowering period) and the early spring *Tortrix viridana* defoliator (Nețoiu, 2005). The identified adapted genotypes are recommended as forest reproductive base material for the corresponding provenance region.

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Evaluation of Carpathian walnut (*Juglans regia* L.) ecotypes

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The English walnut (*Juglans regia* L.) is the most horticulturally developed and widely cultivated among walnut species. The most resistant and winter hardy ecotypes are generally considered to be of Carpathian heritage. Therefore, the aim of the presented study was to compare some morphological nut traits and quality of promising English walnut (*Juglans regia* L.) ecotypes and cultivars. Over 50 specimens originated from southern Poland were elaborated for the research. Each walnut type was represented by four replications 25 nuts each. The following morphological traits were assessed: the average mass of nut [g], mass of kernel [g] and its share [%], the height, width and nuts' depth [mm]. Moreover, the kernels were ascertained for their mineral content. Macro- (P, K, Mg, Ca, S), microelements (B, Cu, Fe, Mo, Zn) as well as heavy metals and trace elements (Al, Ba, Cd, Cr, Li, Ni, Pb, Sr, Se, Ti and V) content of kernels was assessed using ICP-OES technique.

The investigated types of walnut were widely differentiated in their morphological properties, as well as concerning the mineral content of kernels. As far as the weight of nuts is concerned, the highest values were obtained for types BKOP and BPTP (22.3 and 22.8 g, respectively). As reported Majewska et al. (2003), the mean mass of nut's endocarp varied from 3-10 g. However, in our study we found also specimens with nuts < 10 g. One of the most important properties is the kernel weight and its share. For investigated types, the average mass of the kernel varied from 2.96 (ŁUW) to 10.6 g (the highest value type CB). Also the share of kernel was extremely differentiated. Again with the lowest record for ŁUW 24% and the best results for U16 (50%), U19, NXV (49%) and CB (48%). The average values for Serbian and Turkish nuts were around 43 to 58% (Cerović et al. 2010, Akca et al. 2015). Assuming these parameters the most interesting (also highly palatable) are types CB and KRA.

Among the investigated nuts the highest height was noted for U06 (51.4 mm), which could be assumed as 'mammoth size' nuts. The opposite was recorded for WIII (3.27 mm). The width varied from 45.2 mm (BKOP) to 28.5 (U16), while depth 45.7-28.4 mm (WGW and MCH, respectively). The mineral content differed widely: from 2341-4260 mg K kg⁻¹ d.m., 2030 to 7814 mg K kg⁻¹; 496 – 1800 mg Mg kg⁻¹, 110-114 mg Ca kg⁻¹ and 296 – 1100 mg S kg⁻¹. The values for microelements ranged from 0.53 to 19.1 mg Cu kg⁻¹, 5.64 – 26.9 mg Fe kg⁻¹, 4.97 to 55.6 mg Mn kg⁻¹ and 6.77 to 42.1 Zn kg⁻¹. The content of selenium ranged from 10 to 46 µg Se kg⁻¹ d.m.; mean values are similar to reported by Cosmulescu et al. (2009) for Romanian walnuts.

The great diversity of Carpathian walnuts gives a great opportunity for further selection and breeding of walnuts revealing high resistance along with high fruit quality and nutritional value.

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Evaluating forest landscape connectivity in the Romanian Alpine Biogeographical Region

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Maintaining and increasing landscape connectivity, especially of forest landscapes are some of the main concerns regarding biodiversity conservation and conservation planning (Niculae et al., 2016; Pascual-Hortal and Saura, 2008). Implementing sustainable forests management may reduce the forest fragmentation and habitat loss caused by human activities and natural factors (Rubio et al., 2012), the main causes which determine a lower connectivity of different terrestrial forest species. At the same time, the connectivity of protected areas for different species is important, and represents an indicator for evaluating the efficiency of the Natura 2000 network.

Our research aims to evaluate the connectivity of forest landscapes in the Romanian Alpine Biogeographical Region (ABR) for various species. The objectives of the present study are: (1) to evaluate the distribution of forest patches and Sites of Community Importance (SCI), as part of Natura 2000 network in the Romanian ABR, (2) to analyze the structural and functional connectivity of forest sites terrestrial species and (3) to identify the forest patches with significant contribution to the maintenance and improvement of the connectivity and the critical forest patches for the conservation goals. We used two approaches in this study: firstly, we analyzed the forest patches across the ABR, and secondly, we analyzed the forest patches included in the Natura 2000 network in the ABR.

We used the graph theory approach to measure the connectivity of forest patches and the CONEFOR 2.6 software (Saura and Torné, 2009) and ArcGIS 9.3 for spatial analysis. Forest connectivity was determined by dividing the aggregate area of forest patches in the largest component to the total area of forest in the ABR (Scenario 1) or to the total area of Natura 2000 forest included in ABR (Scenario 2). The resulting values ranged from 0 (disconnected) to 1 (connected). To quantify the importance of each node (forest patches), we calculated the dPCconnector fraction derived from the Probability of Connectivity index (dPCconnector higher than 0 it means that the node is part of the best path used for species dispersal)(Gurrutxaga et al., 2011).

Of the 125 SCIs in the Romanian ABR, 71 protected areas have over 1000 ha and 124 protected areas cover smaller surfaces, but still larger than 1 ha.

The connectivity scores are influenced by species category and dispersal distance. We found that the forest surfaces included in the ABR are well connected in comparison with the Natura 2000 forest patches. Also, in both scenarios, the forest patches are well connected especially for the species with a large dispersal distance. For the species characterized by a medium or small dispersion distance, the connectivity is lower.

Our results evidence that the connectivity objective of the forest surfaces protected through the Nature 2000 network is not totally achieved. Furthermore new protected areas are needed where the forest are still present for increasing landscape connectivity for species.

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Soil organic carbon and nitrogen pools along a disturbance gradient in a natural spruce-dominated volcanic-mountain forest in Romania

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Knowledge on the effects of natural forest disturbances on soil organic carbon (SOC) and soil nitrogen (SN) pools is essential for smart and sustainable management of forest resources, and for reliable predictions of future climate changes. Although many studies evaluated SOC and SN pools in soils on volcanic materials or in mountain spruce forests, no study so far examined the pools in a natural spruce forest on a volcanic rock.

We have studied soil morphology within a 40-ha site of a natural mountain spruce forest in the Calimani National Park, Romania (Valtera et al., 2013). Further analysis and comparison with dendroecological data revealed close relationship of soil morphology with the disturbance history of the forest stand (Valtera et al., 2015). In this study we present new results from detailed analysis of 4 well-developed soil profiles at plots representing a gradient of different disturbance histories at the site (from small-scale gaps to a large-scale stand-replacing event) to uncover local effects of different disturbance regimes on soil C and N sequestration.

Both the SOC and SN pools in the mineral soil showed negative correlation with the time since maximum canopy disturbance (165–105 years), and positive correlation with the disturbance severity (49–100 % canopy area). Total pools from forest floor up to 0.5 m mineral soil ranged from 203 to 298 Mg C ha⁻¹ and from 6.6 to 11.5 Mg N ha⁻¹. Our results indicated that on a volcanic rock, regime of more severe canopy disturbances followed by natural succession may promote C and N sequestration in the mineral soil.

The SOC pools at Calimani were superior to any other known records from European mountain spruce forests (Spielvogel et al., 2006; Wiesmeier et al., 2013; Prietzel and Christophel, 2014; Seedre et al., 2015; Pötzelsberger and Hasenauer, 2015), confirming the significance of volcanic mountain forest soils in regional C balance (Dinca et al., 2012), and raising a question on the contribution of the spontaneous forest development to SOC stocks at the site.

We are grateful to Parcul National Călimani and to Academia Română for permitting research in the protected area. This study was funded by the Czech Science Foundation (project No. GA15-14840S).

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POSTER PRESENTATIONS

Prediction of land use and biodiversity development in highland landscape of the most western part of Carpathians (Hostýnské vrchy, Czech Republic) under climate change

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Several GIS tools to assess and predict the changes in biodiversity in the Dřevnice catchment were applied. Firstly the GIS layer, consisted of natural and near to nature habitats (system Natura 2000) and Corine Land Cover for more anthropically influenced habitats, was created. The Land Change Modeler was used to predict the development of land cover on the basis of comparison of data in several historical periods and included temperature changes. To determine the areas with high threat to biodiversity the modified model GLOBIO 3, working with five basic drivers (habitat naturalness, infrastructure presence, distance from communications, nitrogen pollution load and modelled climatic change parameters) was applied. The last GIS layer enables us to select up to now unprotected areas with a high value of biodiversity and naturalness of habitats for environmentally friendly agriculture and forestry management by model Marxan. The model combines the existing categories of natural reserves, biodiversity values (expressed in EUR according to Biotope Valuation Method) and the penalty for any nature degradation due to inadequate protection, abundance and distribution of the valuable and preserved habitats). The output is a layer identifying the refugia for preservation and spreading of wild plants and animals to the cultural landscape, especially with regard to climate change. These tools can contribute to improve the status of natural and near to nature ecosystems in the Czech forest-agricultural landscape.

Genetic variability in European beech (*Fagus sylvatica* L.) seed stands in Romanian Carpathians

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European beech covers about 6,900,000 ha spread along the Carpathian Mountains (Biriş, 2014) and about third part of these forest are situated in the Romanian Carpathians. The aim of the present study was to assess the genetic diversity within and between European beech seed stands in Carpathian Mountains. Altogether 437 trees were sampled in ten populations distributed along the whole Romanian Carpathians. DNA was extracted from cambium using the ATMAB method (Dumolin et al., 1995). Genotyping was done with 10 highly polymorphic nuclear microsatellites combined into two PCR systems: multiplex A: loci mfc11, FS3-04, FS1-15, csolfagus19, csolfagus31; multiplex B: loci mfs11, mfc5, mfc7, sfc0036, DE576_A_0.

For PCR amplification the Qiagen-multiplex-Kit was used. An automated sequencer (CEQ8000 Beckman-Coulter) was used for fragment length assessment followed by allele assignment using the fragment analysis tool of CEQ8000 (Beckman-Coulter).

All ten tested nuclear microsatellites were polymorphic. High genetic variation within and low genetic differentiation between the analysed populations was observed. Positive correlation was found between geographic and genetic distance. High genetic variation is a positive prerequisite for adaptation. Intensive gene flow by pollen and seed in the continuous distribution range of European beech in the

Carpathians could be an explication for these genetic patterns. The findings are similar with other genetic studies for European beech (e.g. Konnert 1995, Müller-Starck et al. 1992).

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Genetic diversity of common beech (*Fagus sylvatica*) in the Carpathian region

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Genetic diversity is essential to local adaptation and species long-term survival. European beech (*Fagus sylvatica*) is the most common forest tree species in the Romanian Carpathians. We analyzed natural populations situated in Eastern and Southern Carpathians along altitudinal transects by means of eight genomic SSR (*simple sequence repeat*) markers. Our results suggest that the gene pool of European beech is very homogenous accross Carpathians and low altitude populations show a higher genetic diversity than high altitude populations.

Habitat suitability of capercaillie in the Romanian Carpathians

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Starting 2011, Romanian legislation has listed capercaillie as a game bird species, but without a hunting period because of the population decline in Europe, however now is essential to determine forest habitats used by the species in order to design long-term conservation measures. The aim of this study consists in mapping the leks used by the species, and modeling habitat suitability across Carpathians. Our initiative represents the first study conducted in Romania, being a very important step towards, for ensuring the conservation of a viable population. Locations of the leks were collected from the field, further we have used different size circles to determine the potential habitat used by the species. An area of approximately 491354 ha, evenly distributed along Romanian Carpathians has been shown suitable for the species existence. Spruce forests are very well represented being found in 59% of the total suitable habitats for capercaillie. At habitat type level, best represented habitat code used by the species is low acidophilus mixed norway spruce-silver fir beach forests, which is expended on 16% from the total identified habitats. When combined analysis of altitude and forest habitats was implemented, we have identified 4 potential zones for reduction/fragmentation of gene flow between individuals/populations, which certainly needs to be tested with genetic analyses. These results from habitat modeling, combined with genetic analyses regarding the Romanian capercaillie population, has lead to a precious determination of the favourable/vulnerable zones for the species existence. These should be translated in long-term conservation measures, in order to ensure sustainable development.

Trends in uses and ecosystem services of hardwood floodplain forests of Transcarpathia (West Ukraine): perceptions of locals

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Rural communities in West Ukraine have detailed knowledge about non-timber forest products (Stryamets et al., 2012) and the sustainable management of the forested landscape (Elbakidze et al., 2007). This traditional or local knowledge played an important role in managing forest resources and has led to form ecologically, economically and culturally valuable eco-cultural landscapes (Parotta & Troster, 2012). Pedunculate oak and narrow-leaved ash dominated forests are the European hotspots of biodiversity and provide benefits to society from local to regional levels. Present study shows how local people perceive changes in forest management and ecosystem services of forests over the past century.

We conducted our study in the hardwood floodplain forests and among the local communities that use them in the lowland regions of Transcarpathia (West Ukraine). The landscape constitutes a transition between the Pannonian region and the North-Eastern Carpathians.

We conducted 40 semi-structured interviews with local foresters, forestry workers, fishermen, hunters and rangers between 2013 and 2015 and collected data from the key informants with participatory fieldwork. We used questions by which we investigated the perception of the locals related to the changes in forest use from the 1930s.

Our results suggest that forests of the region provided and still provide a wide range of ecosystem services to forestry and local communities as well. Ecosystem services of oak dominated forests, however, changed under the pressure of socio-economic changes and raising demands. Traditional forest management systems like extensive pig grazing and smallholder selective logging contributed to local well-being till the collectivization of land in 1948. Production of barrel staves and pork generated valuable income for local community before they were deprived of the right to manage their forest resources. Firewood, forest grass (for cattle grazing), non-timber forest products (NTFP) (especially mushrooms) are ecosystem services that have been utilized for centuries similarly as on the other part of the Ukrainian Carpathians (Stryamets, 2012). Due to the recent economic regression they are becoming more and more important in rural livelihood. Among provisioning ecosystem services, the mixture of forest litter and mud accumulating after regular floods is used as an alternative way to manure arable land. Besides the supplying services, forest patches with large veteran trees and diverse structure continue to provide crucial cultural services. They were considered as a *temple* or *sacred site* both by local foresters and inhabitants. We found that this habitat was managed in diverse ways even in the not too distant past (e.g. for pig masting, livestock grazing, selective logging). Nowadays, however, one can notice the homogenization of the ecosystem service utilization (focussing on timber). At the same time, biodiversity, in the sense of western science, have started to be recognized by local foresters as an important value of these forests.

The legal/political, social-economical and technological trends of a region significantly affect which ecosystem services are recognised and used by a community at a given time (Bürgi et al., 2015). Some of the basic supplying services have been constantly recognized and used for centuries by the local population and forestry, others were abandoned or emerged. Although the legal

circumstance of the forest sector in Ukraine creates a loophole for corrupt management of forest resource, it also provides opportunities for free access of different ecosystem services.

Within this dynamic socio-cultural system traditional/local knowledge about forest ecosystem services and their management has a potential to contribute to local livelihoods and decision making process when considering multi-purpose forestry. Therefore, the emerging new legislations should take better account of the needs of the local communities and involve their knowledge into the decision-making processes related to forest management (cf. Carter and Voloshina, 2010).

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Land-use changes and environmental conflicts in Natura 2000 sites. A case study: basins from the Iron Gates Natural Park

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Land-uses changes are the most visible process by which human society transforms the landscape and one of the five main causes of climate changes (EEA, 2011). Over time, natural ecosystems were converted into agro-silvo-pastoral ecosystems or built-up areas that have different structure and/or function. These changes were specific especially for areas with high favorability for human settlements and agriculture. In the Iron Gates Natural Park, part of the Natura 2000 network, the most dynamic areas in terms of land-uses changes are in the large basins, along the Danube River. The aim of the study is to test whether the areas with more stages in land-use changes over time have become less vulnerable to environmental conflicts than the areas with natural ecosystems. Using historical maps and aerial images (1856, 1900, 1955, 1977, 2005, 2012), land-use changes have been analyzed in Moldova Nouă, Liubcova, Orșova, Mraconia and Bahna basins. For comparison, natural reserve from the Iron Gates Natural Park, with low level of land-use changes have been selected. An inventory of actual environmental degradation sources has been realised for these areas. Using the database of Iron Gates Natural Park administration, we realise a typology of environmental conflicts for the case study areas. Our results show that the major environmental conflicts are related with industrial activities (extractive industry), renewable energy investments (especially in wind mills), and built-up projects. A general conclusion can be made that fewer environmental conflicts are observed in areas characterized by more stages in land-use changes. These findings emphasise that landscape changes decreases the level of reaction of population and institutions to environmental degradation. The social governance has to include these conclusions for better management of environmental conflicts and of protected areas.

Precipitation regime - factor with determinant and direct impact on the development of natural regenerations and plantations

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In the context of climate change, characterized by decreasing rainfall and increasing temperatures (Simota et al. 2014), the study aimed to show the importance of identifying solutions to increase the resistance of natural and artificial regenerations of the state forests administered by the National Forest Administration - ROMSILVA, which is currently expanding an area of 3,202,656 ha. Our concerns consist in testing and implementing these solutions on upgrading technologies for seedlings production, increasing the quality of cultivations and maximizing the high potential of the available seed sources with high adaptability and plasticity (Enescu et al., 1997) for the production of forest reproductive material, as one of solutions that will mitigate climatic stresses of the managed forest.

Following evaluation of the main issues identified in the controlled annual regeneration areas occupied by natural and artificial regeneration of forests, across the period 2011-2015, were identified unfavorable climatic factors acting features each year and those with a direct impact on the success of regeneration. The results of the forest regeneration activity are strongly influenced by climatic factors, among which rainfall plays a dominant role for the success of the installed forest cultures and the natural regenerations. In the context of a more pronounced climatic stress on forest vegetation is crucial to pay attention for natural and artificial regenerations which serve to increase the sustainability of forest ecosystems.

Heat and cold waves in the Carpathian Mountains region (1961-2010)

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The Carpathians are the largest, longest, most twisted and fragmented segment of the Alpine system, stretching between latitudes 44°N and 50°N, and longitudes 17°E and 27°E, and represent a climatically transitional region between major atmospheric circulation source areas of the Atlantic Ocean, the Mediterranean Sea and the continental Europe. The Carpathian Mountains region contains over one third of all European plant species, being a European biodiversity hotspot.

The present study investigates the long-term variability and change in heat and cold waves in the Carpathian Mountain region, using a gridded daily dataset of maximum and minimum temperature at 0.1° resolution, freely available online within the framework of the project CarpatClim (Climate of the Carpathian Region) for the period 1961–2010. Connections with large-scale atmospheric circulation are also investigated by means of rank-based correlation coefficients for several circulation indices.

This work was realized within the framework of the project GENCLIM (Evaluating the adaptive potential of the main coniferous species for a sustainable forest management in the context of climate change), financed by the Executive Agency for Higher Education, Research, Development and Innovation Funding, grant number PN-II-PC-PCCA-2013-4-0695.

The relationship between relief and spatial dynamic of Stone Pine (*Pinus cembra*) associations in Făgăraș Mountains (Southern Carpathians, Romania). Case study: Capra and Buda Valley

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The Făgăraș Massif is situated in the central part of the Meridionali Carpathians and are the highest in the Romanian chain with its peak at 2544m. Our approach is aimed at emphasizing the ratio between the relief and the distribution and especially the spatial dynamic of the stone pine patches. The data was obtained through numerous field trips, the study of various cartographic materials of different scales and editions, as well as processing aerial images.

The stone pine (*Pinus cembra*) is a glacial relict and its most favourable development conditions are steep ridges and edges that are exposed to solar radiation, sheltered from wet winds and generally podsol type soils. Due to its scientific importance and rarity it has been declared a “nature’s monument”. On the Capra and Buda valleys the subalpine floor comes into direct contact with forest clearings (spruce trees appear as up as 1800m and stone pines up to 1950m on Moldoveanu). Stone pines clearings are frequent on the southern slope of Făgăraș where it grows above the forest superior limit together with mountain alder, juniper and rare specimens of spruce. Isolated trees or streak of stone pines were identified in areas like Piciorul Moldoveanu, Orășneanu, Piciorul Mircea, Podul Giurgiului (from the Buda hydrographic basin) and Călțun, Paltinu, Piscul Negru (from the Capra hydrographic basin).

On the Buda Valley at 1800-1900m (above the forest superior limit) the stone pine grows as a belt of isolated trees, stunted because of the climatic conditions and the anthropic impact with them dominating over limestone cliffs. Above 1900m, the stone pines grows isolated alternating with dwarf spruce on the base of glacial cirques and some peaks and cliffs that dominate the patches of denudational areas (Mesteacănu, Ciocanu, Museteica).

In the superior sector of the Capra hydrographic basin the stone pines grows in areas (Comarnici, Florea, Piciorul Piscului) that dominate patches of the levelled surfaces.

Bridge clogging and wood-related risks during floods: the Czarny Dunajec River (Polish Carpathians)

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Besides high water levels in the drainage network and important channel changes, the transport of large quantities of woody material must be considered an additional factor of flood hazard in forested areas. At critical sections such as bridges, the effect of the transport and deposition of large quantities of wood during floods is mainly a reduction of the cross-sectional area, triggering a quick succession of backwater effects with inundation of the adjacent valley floor, bed aggradation, channel avulsion and local scouring processes that ultimately may cause embankment/bridge collapse and bank erosion. Therefore, the aim of this work is to analyse potential hazards related to wood transport and deposition in the reach of the Czarny Dunajec (Tatra Mountains foreland, Polish Carpathians) where the river flows through the village of Długopole. Buildings in the village are

located very close to the river and the bridge has a very narrow cross-section and is thus threatened by wood-related phenomena. The approach is based on the combination of numerical modelling and field observations. A numerical model which simulates the transport of large wood together with flow dynamics is applied and inlet and boundary conditions are designed based on field observations. We established several scenarios for flow conditions and the wood transport. Results provided data to compute bridge clogging probability under the designed scenarios and the potential impacts of the clogging on hydrodynamics, flooded area and effects on the bridge. This information will be very useful for flood risk assessment and management of the river.

Where do fluvial processes begin in the Western Tatras (Poland)?

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There are two morphodynamic sections of the valley: section whose evolution is dominated by slope processes and a valley section whose evolution is dominated by fluvial processes. This study attempts to answer a question: where is the boundary between the slope subsystem and the fluvial subsystem with the example of the Western Tatras in Poland? The theoretical upper boundary of the dominance of fluvial processes can be identified based on the relationship between the catchment axis gradient and the catchment surface area at a point where the direction index for this relationship starts to assume values below zero. The study area consists of the Potok Chochołowski stream catchment up to the boundary with Tatra National Park and includes 50 subcatchments ranging from first order to third order based on the Horton-Strahler classification system. Analysis of catchment morphometric parameters allows for the identification of the effects of various morphogenetic processes in the course of a long period of time. Mountain stream channels in the Western Tatras found in catchments with an area bigger than 0.2 km² and with a gradient less than 0.49 m m⁻¹ are classified as part of fluvial subsystem. Ultimately, the boundary between a slope subsystem and a fluvial subsystem is somewhat fuzzy. The transition from one predominant morphogenetic process to another occurs gradually via a transitional stream channel section. The boundary can be sharp at sites where there exists some type of barrier such as a rock step or large gradient change.

Acknowledgements: This research was funded by Institute of Geography and Spatial Management at Jagiellonian University. Additional funding was received from Project “Doctus – Małopolski fundusz stypendialny dla doktorantów” co-funded by the European Union.

Channel heads location in the Polish Flysch Carpathians

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One of the key topics in modern geomorphology is the identification of locations where the drainage network begins. However, there still exists a gap in the research literature in the area of channel initiation in flysch regions characterized by unique hydrogeological conditions. It is likely that the identification of the true location of channel heads in the Polish Flysch Carpathians will provide for a better understanding of the functioning of catchments, and as a result, will help improve the management of water and forest resources as well as the organization of tourism in the region.

In this study, we have identified the location of channel heads and determined threshold values of morphometric parameters for catchments contributing to channel heads in the Połonina Wetlińska Range in the Polish Flysch Carpathians. We surveyed a total of 401 channel heads on the main ridge. We compared field data versus the drainage network produced using a topographic map and DEM. Most channel heads have a very small catchment areas. The threshold value for catchment size has been shown to be about 0.01 km². The mean slope gradient responsible for channel head formation is 0.4 m m⁻¹ in the study area. Given the very small size of catchment areas contributing to channel heads in the study area, remote sensing methods are not useful. The channel head density based on field mapping is five times higher than the density estimated using a topographic map, and 250% lower than that obtained from a DEM. Fieldwork is still the best method of mapping channel heads. Correlations between topographic attributes that are common in other physiographic regions are not very clear in flysch areas.

CARPATHIANS: SMART AND SUSTAINABLE III

ORAL PRESENTATIONS

Modern mechanized logging as a threat to sustainable use of natural and cultural resources in the Carpathians

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Technological advances in forestry operation over the last decades have contributed to the strong increase in labour productivity. The power of men and horses has been replaced long ago by mechanical power. Logging can be carried out at all seasons, even in difficult to access mountainous areas. The hardest part of the work associated with the transportation of large logs from the cutting site to a landing alongside a paved road is done nowadays by the skidders. A skidder is any type of heavy vehicle used in logging operation for pulling cut trees out of a forest in a process called "skidding". Since partial cutting method developed by H. Leibundgut (1981) (currently most often used in commercially-exploited forest in the Polish Carpathians) requires large forest areas to be frequently penetrated by skidders, woodland is covered by a dense network of skid trails.

As the felling of trees takes place all year round and the skidders have to cut through the steep Carpathian slopes composed of soft flysch and covered with muddy brown soil, skid trails are often carved meters deep into the ground. A single path after a few skidder courses is so deep and marshy that it becomes unsuitable for any further use. Therefore, numerous parallel paths are created that altogether significantly modify the environment. It has been shown already that mechanical skidding cause serious disturbance of soil surface and prolong natural regeneration (Ballard, 2000; Modrý & Hubený, 2003). Particularly big changes arise when skidders operate in the V-shape valleys along the streams where the soil is highly saturated with water.

We hypothesized that such interference with the terrain is not without importance for the functioning of forest ecosystems. In addition, a substantial part of the Polish Eastern Carpathians (Bieszczady Mountains, Lower Beskid, and Przemyśl Foothills) which is forested today, used to be farmland and settlements before the mass expulsions of 1940s. The remnants of past landscape are still well visible in the microtopography (field margins, rural roads, foundations of buildings, wells etc.) and constitute a unique cultural heritage of former inhabitants (Affek, 2015). Soon, post-agricultural pine forests planted after World War II will reach felling age and skidding will begin on

large areas of former villages. That is why we also hypothesized that the unprotected cultural heritage recorded in the microtopography might be the subject of destruction by skidders and definitively lost.

The aim of this work was to:

- characterize skid-trails in the Polish Eastern Carpathians (forms, density, arrangement in the topography)
- determine the effects of mechanized skidding (especially deep skidder paths) on the natural environment and on the cultural heritage recorded in microtopography.

The impact of skid-trails on runoff, soil erosion and sedimentation, and habitats of selected rare species of plants and animals were taken into consideration. The official forestry data from 15 forest districts in the area of Polish Eastern Carpathians were used. In depth case studies were carried out on the selected study areas with the use of high resolution digital elevation model derived from Airborne Laser Scanning (ALS), historical spatial data on the pre-war landscape pattern, monitoring of habitats of endangered species and own fieldwork data.

The project was financed by the Poland's National Science Centre [Dec. No. DEC-2012/05/N/ST10/03520]

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Concept of the Galicia and Austrian Silesia Interactive Database (GASID) as an example of historical and geographical clearinghouse for the Central Europe

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In recent years, one could observe increasing availability of the historical documents mostly through the Internet. However, many collections are distributed by local services and archives, and very often the electronic form of the documents is not easily editable and useful for further analysis (Kowal & Přidal, 2012). By harmonizing data we collect consistent information, in order to build complex, actual long life database. Building one database enable organizing data and then avoid the redundancy. What's more, information available via spatial data infrastructure reaches a large number of users and the spatial aspect of historical data increase the analytical capabilities. There is a need to include such data for various analyses in geography, history, demography, economy and other disciplines.

In this paper we want to present the framework and objectives of the interactive database for Galicia and Austrian Silesia, which will present the historical socio-economic data from the period of 1857-1910 for nearly 84 000 km². The territory covers partly contemporary Poland, Czech Republic and Ukraine incl. the Carpathians. So far such initiatives are known in e.g. United Kingdom, Switzerland or United States, but not for the territory of historical Galicia. The database will be based on the historical data presented in the yearbooks and other statistical documents for different administrative units available for users by the geoportal. Available data will present e.g. demography, confession data and occupancy. Additionally informations from historical maps (incl. e.g. second military survey and third military survey) will be included in the form of downloadable

and editable vector layers like road network, railway network or post office locations. Statistical data will be presented for the administrative units valid for the period of data creation.

An important part of the planned geoportal is the critical analysis of the sources and potential uncertainties related to use of such data, especially for comparisons over time. Presenting of the paper among Carpathian specialist will be a great opportunity to discuss methodological aspects and constraints among the researchers working on historical data created in the former Austro-Hungarian Empire.

Research funded by the Ministry of Science and Higher Education, Republic of Poland under the frame of “National Programme for the Development of Humanities” 2015-2020

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CentralHEMP. Boosting green economy reconsidering a high-valuable resource

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Industrial hemp has been growing for many hundreds of years, but today it is considered a niche crop in Europe, mainly due to the lacking of societal awareness on the wide range of its potential applications. However, hemp represents a valuable crop for the bio-based economy, particularly because of the high yielding natural technical fibres and the beneficial effects for the environment. The fibre is vastly used by the tobacco industry, as well as in building and recycling, for the realization of insulation material and bio composites. The shives, the woody inner core of the stem, are used for animal bedding and construction. Row and processed hemp products are of particular interest for the human food and animal feed industry. Hemp seeds, small nuts, as well as processed products have a high nutritional value, while hemp oil has an excellent and unique acid profile balance.

To enhance hemp cultivation, processing and use, to give new value to marginal and abandoned lands and to boost green economy in Europe, EURAC Research is developing a project proposal for the INTERREG Central Europe.

The project focuses on smallholder farmers providing local people the technical knowledge to give them the opportunity of revaluating fields not used for food, feed productions, and create local business, contrasting the phenomenon of land abandonment and depopulation. Hemp is highly suitable to revitalize disused or disadvantaged fields, and always more studies are proving its multi-purposes and adaptation to different climate regimes.

The Agronomic assessment will test different hemp varieties in order to improve the methodology of cultivation, harvesting and processing, adapting to the different environmental characteristics and identifying the best destination use for each pilot area.

Information will be collected on the historical use of hemp in the different countries, promoting the rediscovery of old processing techniques. Partners will use this knowledge together with the new technologies to develop prototypes machineries for small-scale production, harvesting, processing and oil extraction. Additional activities will be based on testing current hemp-based construction materials to show the potentials of hemp to end-users and make concrete application tests for the renovation of historical buildings.

The capacity building and job creation process will develop a multi-sectorial training in all the pilot areas, promoting the exchange of knowledge, the dislocation of people to learn other expertise in other pilot areas, organizing local laboratories for the development of new capacities based on easy hemp-based materials (i.e., paper, food, building, textile, cosmetics, feeding).

The socioeconomic and legal implications will concentrate on the definition of the social acceptance and on the economic opportunities deriving from an increased awareness about hemp applications. A specific part will assess the economic potentials of unlocking the European Market, exploring the gaps in the fragmented national and European normative regulating hemp cultivation, processing and trade. The establishment of an European Platform of Hemp experts for technical consultant and dissemination of technical information and to call attention to local, regional, national and European policy makers, will contribute to initiate a favourable context for the development of a hemp-based economy, taking into account the specific bottlenecks and challenges of the regional product chains and the market development.

All the results will be disseminated in the countries object of the project and spread them into other channels, as the Carpathians and the Alpine Conventions, in order to highlight the potentials of this plant for the green economy in the whole Europe.

Assessment Of Future Forest Cover Changes In The Romanian Carpathians. Regional Scenarios Using Clue-S Model

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The current paper represents a study on forest cover dynamics and prediction modelling in the Romanian Carpathians based on data derived from Corine Land Cover Database (1990, 2000 and 2012). The study aims to examine and analyse the various explanatory variables associated with forest pattern dynamics and predict forest cover change using CLUES-s model (the Conversion of Land Use and its Effects at Small regional extent). The forest cover for the period 1990-2000 was used to analyse past dynamics and predict the forest cover for 2000-2050. The predictive performance of the model was assessed based on a comparison between the predicted forest cover results and the actual forest cover for 2012. Also, the statistical validation was tested using ROC (Receiver Operating Characteristic) approach. In order to explain the effects of bio-physical and anthropogenic influence on forest pattern, this study took into consideration several variables related to relief particularities, soil, climate, protected areas, accessibility, major wood exploitation and processing centres, as well as demographic indicators as explanatory variables of forest change. The analysis showed that forest cover has undergone continuous change, with significance dynamics at regional units. Generally, are expected forest cover increases with 4.5%, especially in the Southern Carpathians, central part of the Eastern Carpathians and the Curvature area. Significance declining is estimated in the Apuseni Mountains, northern part of the Eastern Carpathians and depression units.

POSTER PRESENTATIONS

Complex landscape-ecological analysis of the river arm Klátovské Rameno National Nature Reserve

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National Nature Reserve of the river arm Klátovské rameno represents a unique ecosystem of a slowly flowing meandering river in the Danube basin. It represents a geomorphological, ecologically and biologically valuable complex of the aquatic ecosystem and of the typical floodplain forests ecosystem. It is part of the Danube Floodplains Protected Landscape Area, which

is a declared Ramsar site. The river flows across an intensively cultivated farmland which presents a big pressure on the area.

The presented work was aimed to analyze the current status of the territory. According to the analyses it presents the evaluation of alternative hydrological and ecological measurements for the improvement of water quality and quantity, and, to eliminate the sources of deterioration of the National Nature Reserve.

In the analytical part we focused on the analyses of the thickness of the bottom sediments, on the collection of the water samples for physical-chemical analysis, on the sediment samples for the physical-chemical analysis, on the inventory of aquatic macrophytes, on the identification of the potential sources of pollution.

The evaluating part of the work started by the selection of threatening and limiting factors of the land use. They are as follows: the sedimentation on the arm bottom, the bank erosion, the impact of agricultural use, the impact of human settlements, the impact of the roads, and, generally the absence of the nature-friendly activities which had been practiced in the past around and on the Klátovské rameno river arm.

The result of the study is a recommendation of a complex set of measurements for the territory, which includes the application the optimal form of management of ecosystems to the practice and better utilization of the ecosystem services. Our proposals should lead to the mitigation of the unwanted processes and phenomena in the territory.

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River basin management to improve hydric significance

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The hydric significance of river basin is determined by analysis of hydric functions, which are the characteristics of the landscape, which influence ability of the landscape to retain precipitation, slow the runoff and promote its infiltration into ground (Lepeška, 2010).

We used the methodology according to Šatalová (2014) of scoring and weighting hydric functions. The characteristics of river basin are: geomorphological conditions (slope), hydrogeological characteristic (transmissivity), soil conditions (soil types and texture), meteorological conditions (precipitation, potential evapotranspiration), land cover characteristics (the current landscape structure), forests character (degree of forest threat).

Results are four categories of hydric significance (excellent, good, average, limited), which classified study area of Poprad river basin and also its sub-basins.

In sub-basin of Ľubica River we worked with various land management scenarios and its combinations – land-use changes at the level of meadows and pastures, arable land, forest, non-forest woody vegetation. Subsequently, we submitted proposals of management in study area (for each type of land-use, measures in landslide areas, in erosion risk areas, in urban landscape), which will increase the hydric significance of study area, what represent flood prevention.

The hydric significance can thus be understood as an ecosystem service. According to the classification of CICES (<http://cices.eu/>) we could include it among the regulation and support services.

Acknowledgement: This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0866-12: Evaluation of ecosystem functions and services of the cultural landscape.

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The structural diversity of pine stands on degraded fields in Vrancea Subcarpathians

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The investigation's main objective was to acknowledge the structural diversity of forest ecosystems installed on degraded fields from Vrancea's Sub Carpathians.

Investigations were realized in 22 experimental plots situated on pure pine stands or mixtures ones with broad-leaves.

The stand's composition together with tree distribution on diameter categories and diversity indicators (Camino, Shannon and Gini) were analysed.

The composition diversification and tree distribution on diameter categories is directly correlated with the number of species and with the effect of abiotic factors (snow). When the presence of other species besides the ones initially used for the creation of the culture isn't noticed and when the influence of abiotic factors was insignificant, the tree distribution on diameter categories is realized according to normal and Beta distribution. When there are more species installed on a natural way, the diversification tendency of horizontal and vertical (on multiple layers) stands is evident.

The Camino, Gini and Shannon diversity indexes are emphasizing a weak to average homogeneity degree which shows that these stands are presenting a high risk for harms caused by abiotic factors (snow, wind). Mixture stands tend to evolve towards diversified structures with positive consequences (biodiversity degree increase). The stands with a full consistency and in which the pine occupies over 70-80% of composition have a homogenization tendency.

The increased diversity of pine and broad-leaved mixture stands expresses a higher stability, their capacity to adapt at site conditions, to naturally regenerate and to exert protection functions.

The analysis of these indexes emphasized the evolution towards complex structures especially for pine and broad leaved mixture stands once they advance in age. The ones with high diversity have double layer and/or multiple layer structures based on the reduction of pine percentage and through the growth of natural regeneration percentage for the broad-leaved species.

Object-oriented analysis on the recent development of resorts in mountain environment (South Carpathians, Romania)

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Mountain environment is largely vulnerable to human-induced changes. Recent disturbances of the coniferous forest and subalpine vegetation levels in Southern Carpathians (Romania) were found. These changes were mainly caused by inadequate spatial planning for a long-term urban development of mountain resorts in the Parâng and Căpățânii Mountains, where forest cover has rapidly changed due to shifts in Romanian economy during the last decades (Marinescu et al., 2013). The present study outlines the fundamental changes induced to subalpine and coniferous forest environments by the spatial development of two resorts - Râncea and Vârful lui Roman. We

applied the object-oriented analysis on high-resolution orthophotographs in order to emphasize the invasion of built-up areas on subalpine vegetation and spruce forest. The high-resolution orthorectified imagery (0.5 m) is a very useful tool to detect the human-triggered transformations that rapidly occurred in a fragile mountain environment, where the smallest imbalance induces irreversible changes to ecosystems. Understanding the complexity of our land-use/land-cover classes, we performed a multi-scale/multi-level hierarchical image segmentation (Batz and Schape, 2000), in which we created objects more appropriate for finer-scaled and detailed class separability, but also to extract small, medium and larger classes. The results of OBIA classification show a milestone sequence development in both cases, fostered by the high accessibility. The recent development of Râncă resort has already experienced two phases, whereas the Vârful lui Roman resort has hardly begun its territorial expansion in the spruce forest and subalpine vegetation levels. Besides the old ridge roads having both forestry and pastoral significance, a roadways network that anticipates the configuration of the future resorts was created. Our analysis highlights a specific pattern of territorial expansion of the built space that tends to generalize in the South Carpathians. There are two different generations of settlements showing the same invasive, irrational model of spatial development, with a potentially high environmental imbalance. The phenomenon shows how accelerated and disorganized is the mountain space exploited in some areas, especially on the Carpathians southern rim.

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Using the fuzzy analysis in order to develop the ski areas in Carpathian Mountains

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For practicing winter sports in good conditions, the snow cover on the ski slopes must be flat and continuous (at least 30 centimeters). By the geomorphological aspect and the characteristics of each ski area, we can identify areas where the snow has deficiencies in record minimum thickness. Both geomorphological and climatic factors are defining factors in areas where the snow does not reach the required parameters. Depending on the relation between the incidences of sunlight degree with the surface terrain, on the geodeclivity, the hypsometry, and the solid precipitation we can identify the areas that face these problems.

For the sky slopes sections where we identified the problems on the thickness of the snow, a surface determination was made followed by the calculation of the present snow cover volume and the ideal snow cover volume.

A fuzzy analysis was used in order to determine the artificial snow systems efficiency. The intake of artificial snow needed is represented by the difference between the original volume and volume representing ideal snow cover needed for practicing winter sports in good conditions. The analysis enables to group values in intervals (solid precipitation, solar radiation, geodeclivity) and establishes rules in order to determine the snow intake, depending to the initial minimum level snow required.

The fuzzy analysis aims to determine the artificial snow systems efficiency by achieving the energy savings and by sizing the water supply basin necessary for the ski area.

ORAL PRESENTATIONS

The impact of hydration of massif on spatial differentiation and spring water chemistry in the small Carpathians watersheds in Gorce Mts. (Poland)

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Springs, which are natural outflows of groundwater to the surface area, can be classified as important indicators of condition of the environment because they react well to any changes in natural ecosystems. The present study has tested the influence of hydration of massif on the spatial differentiation and changes in spring water chemistry. The study was conducted in the upper parts of Jaszcze and Jamne catchments (Gorce Mts.) and water sampling was performed at various massif hydration stages: after the spring thaw, after a period of heavy rain and after a period of no rain in the years 2011 and 2012. In the collected samples electrical conductivity (EC), pH value, the concentrations [$\text{mg} \cdot \text{L}^{-1}$] of basic anions: F^- , Cl^- , NO_3^- , SO_4^{2-} , HCO_3^- and basic cations: NH_4^+ , Na^+ , K^+ , Ca^{2+} , Mg^{2+} were measured, and mineralization was calculated.

The spring water of Jaszcze catchment showed seasonal variation depending on the hydration of the massif. In the period of low hydration of the massif, higher concentrations of Ca^{2+} and Mg^{2+} as well as higher values of conductivity, pH and mineralization were observed; but they were lower following the spring snowmelt and rainfall, after which higher concentrations of NO_3^- and SO_4^{2-} were also found. Therefore, new hydrochemical water types with a substantial share of nitrates ($\text{HCO}_3\text{-(NO}_3\text{)-Ca}$, $\text{HCO}_3\text{-SO}_4\text{-(NO}_3\text{)-Ca}$, $\text{HCO}_3\text{-SO}_4\text{-(NO}_3\text{)-Ca-Mg}$, $\text{SO}_4\text{-(NO}_3\text{)-Ca}$, $\text{(NO}_3\text{)-Ca}$) developed there.

Building a holistic efficiency indicator for the optimization of forest governance in Romanian Carpathians

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The protective, the productive, the aesthetic and other functions of any ecosystem are separable only at theoretical level. Practically a forest cannot be managed to fulfil only one forest function without any other. This reality raises the problem of choosing an optimum forest stand structure whenever there is more than one possible sustainable option.

The aim of the research is to build an indicator to quantify, in an objective manner, the functionality of different forest stand structures. For doing so some existing scientific knowledge concerning forest ecology and mathematics is integrated into an adaptable efficiency indicator. At this stage of knowledge, in order to prove the functionality of the applied principles and to test the developed method, the indicator was based on (i) productive, (ii) protective and (iii) aesthetic functions. These three forest functions can be quantified in an objective and dynamic way, but the results are very inhomogeneous ones; still not linear independent ones.

The inhomogeneous results are integrated into a holistic indicator using new methods based on statistics, discrete analysis and linear algebra, which I called holistic integrated field theory.

Such an indicator is a possible criterion for optimizing forest governance and stands structures, according with their given functions, and also offers the possibility to estimate the overall value of a certain forest ecosystem.

The activity regarding the spatial and temporal optimization of possible forest functions emerged as the increasing interest in the late 1960's in analysing and evaluation of multiple benefits determined by the ecosystems. This process was induced by the undervaluation of these benefits in the decisional processes that led sometimes to unsustainable forest management. In order to be able to manage forest sustainably there is a different number of criteria that should be considered corresponding to different authors. According to UNPEF there are 6 criteria that should be considered. Briefly these principles are referring at least to the maintenance of forest resources, vitality, production, biodiversity, protection functions and socioeconomic functions, other than the ones mentioned before. According to Romanian authors there are four main principles to be considered in sustainable forest management planning, these principles are: the continuity principle, the functional efficiency principle, the rational use of all the available resources and the ecologic principle.

In order to optimize the forest management according to sustainability idea, these criteria are evaluated first separately and then integrated all into a holistic indicator. This is possible due to the integrity of the forest ecosystem and of the integrated field theory developed purposely to cope with the system heterogeneity.

However, nowadays, most of the studies that are dealing with the optimization of the ecosystem functions are rather unilateral ones, done throughout a single component of the system such as: environmental effects, productive effects or aesthetic effects.

There are also studies that are trying to analyse the whole forest ecosystem in order to examine the sustainable forest management.

One of the reached conclusions is that for being able to build an applicable methodology for evaluating the sustainable forest management, the number of used indicators should be reduced.

The method and indicator performed very well in a case study, carried out in Cindrel Mountains, in Romanian Carpathians. The fact that the indicator has the capacity to integrate all perceived outputs of the ecosystems makes it highly general, with potential for further applications.

Evaluating the relationship between urban forest location and urban functions in Romanian cities from the Carpathian region

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Urban forests are important elements of the green infrastructure network in the urban landscape (Riitters et al., 2012). While cities are changing due to the economical development, the urban planning of open spaces is becoming more complicated due to the mix of land uses needed to be managed (James et al., 2009; Niță et al., 2015). That is why the urban forests are now seen as strategical areas providing multiple benefits for the community enhancing the quality of the urban life (Emborg et al., 2012). The management and planning of it as an integrated part of the city still needs further research, especially in the Romania. The evolution of cities in the Romanian Carpathian region is closely linked to forested areas in and around them. Understanding the environmental connections which derives from the spatial configuration of urban functions can give useful information to promote a sustainable development of urban areas (Baptiste et al., 2015).

This study aims to assess the relationship between the location of urban forests and the spatial distribution of urban functions at city level. A spatial analysis was conducted in order to evaluate which urban functions are commonly planned in the proximity of urban forests. The data used consisted in aerial imagery and the city masterplan. We computed several configuration metrics

such as proximity index, dispersion and contagion indices, euclidean nearest neighbor distances in order to identify the urban landscape patterns and how the urban forests connect with the rest of green infrastructure network.

The results highlight the spatial relationship established between urban forests and the rest of the city showing areas with a high complexity in terms of urban functions. Integrating the green infrastructure elements into the urban planning process remain an important objective to achieve for the sustainability of urban areas in the Carpathian region.

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Variability of the highest monthly precipitation in the area of Ukrainian and Polish Carpathian Mountains in the years 1984-2013

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The identification of the precipitation variability constitutes the essential issue of the climate change adaptation in the mountainous regions. According to the last IPCC report on Europe, climate related hazards like heavy rains are supposed to increase with a high level of confidence in intensity and frequency over next decades (Kovats et al. 2014). The trend is determined in mostly all the months in Continental Europe, except summer. The previous studies have discovered the appearance of the short-term fluctuations (3-4 years) of precipitation regime in the 21st century in the Ukrainian Carpathians (Kynal, Kholiavchuk, 2016). The precipitation hazards in the Ukrainian and Polish Carpathians reflect the outcomes of complex interaction of heterogeneous topography with the surface air layer and their impact on the regional climate change background. The deformations refer to specific local synoptic situations or the reinforcement of the regional frontal processes not only over mountain ridges, but also in the foreland areas. The high possibility of pseudo-adiabatic processes and the anticyclone patterns with thermally-related rainfalls are also present in summer.

In the present work, the authors studied the multi-year and annual course of the highest monthly precipitation in Polish and Ukrainian Carpathian Mountains based on the data from 27 measuring stations from the years 1984-2013 (in the area of Polish Carpathians the data from 14 stations have been considered, the data comes from Institute of Meteorology and Water Management - National Research Institute, and in the area of the Ukrainian Carpathians – the data from 13 stations). It has been indicated that the highest monthly sums of precipitation occur most frequently from May to September, and in the remaining months they occur occasionally. During the study period, three highest values of monthly precipitation were detected in almost every decade. Alongside, the last decade is noticed for the increased frequency of heavy rainfalls of the monthly scope. The multi-year variability of the precipitation does not indicate statistically-significant trends; however, the short-term fluctuations may be observed (Twardosz, Cebulska, 2012). Besides, conversely to the

general trend for Continental Europe, the high monthly precipitation amounts in Ukrainian Carpathians are dominant in summer. In particular, 77% of the highest monthly precipitation over the period of 1984-2013 took place in summer.

In the Polish part of the Carpathians, in Wisłok Wielki and in Tylicz the highest precipitation occurred in July: 13 and 12 times respectively (43,3% and 40%), and in the remaining stations from 6 times (20%) in Koszarawa to 11 (36,7%) in Jordanów and Lutowska. The highest sums of precipitation in May 2010 in many stations of the Polish Carpathians considered exceeded 250%, and in Stróża and Górki Wielkie it was 400% of average monthly precipitation sum. Moreover, the rainfalls in May 2010 were characterized by both the large absolute sums and the relative terms (Twardosz et al., 2015). Also in July 1997 and 2001, in many stations of the Polish Carpathians considered, the highest rainfalls of the three decades occurred. The most typical years of the highest monthly precipitation were 1989, 1998 and 2008 in the Ukrainian Carpathians. The highest monthly amounts of rainfall that are higher than in the previous decades were observed in 2001, 2008 and 2010 in the Ukrainian Carpathians. In July 1997, 2008 and in May 2010 the highest monthly sums of the precipitation occurred at all Polish stations. The highest monthly precipitation was observed in July in 11 out of 13 weather stations of the Ukrainian Carpathians. The most significant year of the highest July monthly precipitation is found to be 2008 in the Ukrainian part. The findings point to the significance of the decadal differences, short-term variability, and the warm period in the occurrence of the highest monthly precipitation in the Carpathian regions of Ukraine and Poland.

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POSTER PRESENTATIONS

The changes of hypsometric distribution of *Ischnura elegans* (VanDer Linden, 1820) of the Slovak part of Carpathian Mountains

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As a result of climate change, the latitudinal limit of some dragonfly occurrence is shifting to northwards. *Crocothemis erythraea* is the model species of dragonfly expanding into northern areas of Europe (Khrokalo 2010). The hypsometric distribution other dragonfly species changes too. Oertli (2010) confirmed the increase of dragonfly species richness in connection with the average annual temperature in Swiss mountain water habitats. In Slovak Carpathians the average annual temperature is increasing as well. E. g. in the meteorological station Poprad (northern Slovakia, 694 m a. s. l.) trend of increasing temperatures has been recorded: the average annual temperature was 5.8 °C in period 1961 to 1989 while it was 6.7 °C in period 1990 - 2015 ($R^2 = 0.35$, $r = 0.59$, $p =$

0.0000 (source SHMI). *Ischnura elegans* is a eurythopic damselfly preferring particularly lenitic waters. We analysed 412 records in the Slovak Carpathians with the average altitude 371.8 m a. s. l. In the years 1977-1996 hypsometric occurrence was 383.46 m a. s. l. (minimum altitude = 103 m, max. 936 m a. s. l. SD = 174.5 m, N = 67). Remarkable is that in period 1997 - 2015 the occurrence of *Ischnura elegans* is even lower than in previous period: 369.90 m a. s. l. (min. 96 m, max. 921 m a. s. l., SD = 172.9 m, N = 344). Kruskal-Wallis test hasn't confirm the statistically significant difference of hypsometric data between periods 1977-1996 and 1997-2015 (KW test = 0.1113, p = 0.74). However, further research of hypsometric change needs to be carried out.

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Characteristics of rill erosion caused by heavy rainfalls on the experimental slopes in Szymbark (Polish Flysch Carpathians)

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The arable lands are the dominant forms of land use in the Carpathian Foothills. In the summer half-year, when the fields are devoid of vegetation cover, the slopewash is the most important morphological process. The runoff water causes rill wash and soil erosion during heavy rainfall. The rill erosion forms are formed. These are oblong forms of small width and depth (<1 m), characterized by V-shaped or flat-bottomed cross profile. Their longitudinal profile is irregular, it consists of many thresholds, eversion hollows and alluvial cones. Rills may be transformed into a ravines forms, however the most of rills with the small sizes are regularly removed by agrotechnical operations.

The forms of rill erosion are typical for agricultural areas in different climatic zones. In Poland rills occur most frequently in the south of the country (mountain, foothill and upland areas). Forms were created within the experimental plots, used as black fallow on the slope of Research Station in Szymbark (near Gorlice) as a result of heavy rainfall in days: 3.05.2013, 3.07.2013, 15.05.2014, 25.07.2015 and 24.09.2015. The rills were formed within the plot with a length of 32 meters and 11° slope slanting. Forms were accurately measured in the profile section. Also precise plans of rills and numerous cross sections were always plotted. The parameters of forms (width - at the surface and the bottom, depth of forms) were measured with an accuracy of 5 mm. The volume of eroded material (for different fragments and whole the form) was calculated on the basis of the measured values. The results were compared with the total amount of soil material deposited in the storage tank.

In the literature, most of the rills descriptions was made for Carpathians. Most authors mention only the most basic parameters of erosion forms: length, medium and maximum depth and width. Only Świąchowicz (2012) presented the plans of the rills. In most cases, the width of rills was 20–100 cm, while the maximum depth was 20–120 cm. The length of whole the form was 100–150 meters. Forms observed in Szymbark are 8-52 cm widths and 2-20 cm depth. The maximum density of rills is 95m/m². The largest sizes of rills and the highest density of forms usually occur in the lower and middle part of the plot. The average weight of the material eroded as a result of rill washing is 6.5 kg/m².

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Characteristic of false acacia stands installed on bad lands from Romanian steppe and forest steppe

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False acacia is the most commonly used species for the afforestation of degraded land with moisture deficit from Romania (Traci, C. 1985., Constandache et al., 2006).

It has been used on a large scale for the afforestation of eroded lands, mobile sand and even on salty soils.

In present research we follow the behavior of false acacia on bad lands from steppe and forest steppe at national level for the plantations which were executed after 1980.

False acacia has been used mainly for the creation of pure stands and less as main species in the mixed stands. Has been used in a 79 percentage of for the afforestation of the wind deposits and 65 % for the land affected by sheet erosion.

It has been found that the state of false acacia stands is generally normal only in the case of acacia installed on severe to excessive sheet eroded lands the condition is poor.

False acacia proves a good capacity for root suckers regeneration on moderate to severe eroded lands, where stands are affected by extensive phenomena of drying after they reach the age of 20-25 years old.

This paper was supported by The Executive Unit for the Financing Higher Education, Research, Development and Innovation (UEFISCDI), project tip PN 09460309

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Slopewash as the main process of soil erosion on the slope with bare fallow (Polish Flysch Carpathians)

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Slopewash is the most important geomorphological process, which transforms the slopes of the Flysch Carpathians. In the Beskidy Mountains and at the Carpathian Foothills total weight of soil material displaced as a result of slopewash is several times higher than the transport of suspended sediments and splash.

The intensity of the process depends on the amount and intensity of precipitation and the inclination and length of slopes. However, a fundamental influence on slopewash has land use and land cover. The largest erosion occurs in agricultural areas on the fields with black fallow and potatoes. The slopewash interact to a lesser extent on soil on the plots of cereals, meadows and pastures, while the lowest values characterize forest areas. In Jaworki (Pieniny Mts / Beskid Sadecki Mts) the average annual values of slopewash amounted to: in the field of potatoes: 63.2 t/ha, on pasture: 4.1-81.8 kg/ha, in the meadow: 3.1-11.8 kg/ha (Gerlach 1976). In the Gorce Mts the total annual amount of slopewash in forest areas amounted to 1.9-6.2 kg/ha (Gerlach 1976). Basing on research conducted in Szymbark in the years 1969-2000, the average annual volume is: for potatoes: 25.7 t/ha, cereals: 1.4 t/ha, clover: 203 kg/ha, meadow: 76 kg/ha (Bochenek, Gil, 2010). On the other hand, for the whole summer period in 1969 the following values have been notified: potatoes - 73 t/ha, cereals - 32.9 t/ha, meadows - 26.4 t/ha, pastures: 17.5-39.5 t/ha, forest - 0.07 t/ha (Gil 1976). At the Wiśnickie Foothills, in 2009 the total size of slopewash amounted to: on black fallow 171.5 t/ha, on

the plots with potatoes and beets: 22.5 t/ha, on plot with wheat: 151.3 kg/ha, in the meadow 35.8 kg/ha (Świąchowski 2012).

Measurements of soil slopewash was carried out in 2011-2015 on the foothill experimental slope of the Research Station in Szymbark, situated in the lower part of the Bystrzanka catchment, at an altitude of 310-330 m a.s.l. The area is located in the Flysch Carpathians (Outer Carpathians), on the border of the Beskid Niski Mts and the Jasło-Sanok Basin (the Carpathian Foothills). The bedrock is built with shales and sandstones (inoceranian layers), it is covered with the rocky-loamy waste mantle (thickness of 1-1.5 m in the upper part of the slope to 2.5 m at the bottom). The material of waste mantle has the mechanical composition of medium silty clay. The total percentage of silt and sand fraction is about 60%. The average annual precipitation in Szymbark is 820 mm.

The study was carried out within the slope with 11° inclination and south-western exposure, on five experimental plots with varying length, used as a black fallow. The plots of size: the width of 2 meters and a length of 2 m, 4 m, 8 m, 16 m, 32 m are enclosed by steel plates. with complete gutter drain rainwater along with the soil material to storage tanks. These are gutters draining the rainwater and soil material into the tanks, located in lower part of the plots.

In the five-year study period a total of 127 rainfalls with surface runoff and 91 rainfalls with slopewash have been recorded. 2012 was an exceptional year, when the highest overland flow (almost 5 000 dm per year), the highest run-off index (245 mm) and the highest overland flow index (42.7%) have been observed. The lowest values were noted in 2013 and 2015. The largest total erosion of soil material was measured in 2012 (a total of 811.7 kg), but the greatest unit erosion was recorded in 2014 (29.3 kg/m²). The largest amount of eroded soil mass during a single rainfall took place on 07.09.2011, 05.18.2014 and 08.08.2014, when in the storage tank of longest plot more than 450 kg of soil were deposited. Results indicate that the quantity of soil material eroded by slopewash increases with the length of the plot. The process of slopewash has the highest intensity within the steep slopes, used as black fallow or potato field, while the smallest erosion occurs in forest areas.

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The participation of a splash in the total soil erosion on the foothill slope (Polish Flysch Carpathians)

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The splash is one of the most important processes shaping the denudation system of the Flysch Carpathians. Soil erosion, caused by falling raindrops depends mainly on land cover and land use. The features rainfall (intensity, duration and thickness drops) are also very important for the scale of the process.

Researches of the splash were carried out in different parts of the Polish. The results of Gerlach (1976) in the Gorce Mts indicate the advantage of soil material eroded by splash in forest areas than in arable fields. The author explained the results by a greater kinetic energy of raindrops and a higher incidence of falling in the forest. The study of Śmietana (1987) on Cementary Hill in Gorlice (the Carpathian Foothills) emphasizes the significant impact of the rain intensity on the splash size. During heavy rainfall, the greatest erosion of raindrops took place in a field of potatoes (254.8 g/m²) and oats (99.7 g/m²). However, in the course of a short precipitation with low intensity, the most of

the splash were recorded in the field of oats (7.13 g/m²) and in the forest areas (7.18 g/m²). In both cases there was no raindrops erosion within the meadow. Froehlich and Słupik (1980) in the Beskid Sadecki Mts compared the size of the splash in the plowed field (1.9-8.3 kg/m²) and cart-road (2.9-16.5 kg/m²) for the period from July to November 1984. Annual volume of splash in 2007-2009 on the Wiśnickie Foothills ranged from 2.8 to 6.7 kg/m² (Świąchłowicz 2012). Measurements of Rejman (2006) on the Lubelska Upland amounted to 0.15-6.76 kg of soil material per square meter (total 36.4 kg/m² for the period from 14.06-22.08.2004 r.). At Western Pomerania Szpikowski (2010) measured the size of the splash on five plots of different use. Average annual values are: black fallow - 3.25 kg/m², potato - 2.09 kg/m², rye - 1.53 kg/m², oats - 1.35 kg/m², meadow - 0.04 kg/m².

Research was carried out in years 2012-2015, in the summer hydrological half-year. The measurements were conducted on the slope used as a meadow and black fallow (slope: 11°, exposure south-west) and within the floodplain on the plot with black fallow. Since 2013, tests are performed only on the black fallow. Screen method and funnel method were used.

Total mass of splash on black fallow was even 95 times higher than in a meadow, and from 2 to 20 times higher than in the flat field used as black fallow. The average values of splash are from 0.08 to 0.49 kg/m² on a inclined plot and 0.02-0.27 kg/m² on a flat plot. The total annual volume of material displaced by raindrops was the highest in 2014 on a plot located on a steep slope (28.95 kg/m²), and on the flat plot in 2015 (12.98 kg/m²). It was calculated that on the slope with gradient of 11°, the soil particles are being displaced for a maximum distance of 40 cm down the slope, and 30 cm up the slope during heavy rain.

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SUSTAINABLE CARPATHIANS VI

ORAL PRESENTATIONS

Management structures of protected areas in Romanian's Carpathian mountains

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Protected areas are the cornerstone of biodiversity conservation biodiversity. In Romania, European ecological network Natura 2000 cover over 22 % of the country, so that the competition between the conservation and development activities has extremely vast and diverse spaces and manifestations forms. The Natura 2000 sites were declared since 2004 without the consultation of the public or local stakeholders. The tensions related to the use of water, energy, forest and non-renewable resources are many in the Romania's Natura 2000 sites. Their ignoring or neglecting has already serious implications at the level of sectorial policies and socio-economic activities, which are currently facing blockages or

significant expenses caused by the uncertainties promoted by the network. The aim of the paper is to assess what is the structure of the actors involved in the management of protected areas from the Romanian's Carpathian mountains. Using the Ministry of Environment database, a Social Network Analysis was used to understanding the profile of management structure of all protected areas from selected area (administration, Scientific Council, Council for Administration). Using management plans of protected areas, we identify where these actors are really involved in management activities. Major findings of our paper show that the forestry management of the protected areas is dominant. The NGOs have registered a significant increasing and tend to become the main structure that coordinates the management of protected areas. The universities and research institutes have limited connection with several protected areas. These emphasizes that the Natura 2000 network management has to be reoriented for increasing the protected areas efficiency.

Causes and effects of spatial chaos in the Polish Carpathians – a difficult path to sustainable development

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Sustainable development of each area must correspond with the desire to achieve a spatial order. However, it is particularly crucial in the mountains where effects of spatial chaos are much more serious than in less diversified, flatter areas with weaker natural connections and less attractive landscape. Although, legal international instruments applicable in Poland such as “EUROPE 2020 A strategy for smart, sustainable and inclusive growth” or “Framework Convention on the Protection and Sustainable Development of the Carpathians” (Carpathian Convention) emphasise the need for sustainable development, it seems that the spatial chaos occurring in the Polish Carpathians significantly hinders the possibility of sustainable development of these lands. Therefore, this report attempts to diagnose the causes and effects of a spatial chaos in the Polish part of the Carpathians and then assesses spatial disorder effects in terms of their incompatibility with the idea of sustainable development. The “Three Questions Method” was used in here which is based on answers to the following three questions: 1) whether the given phenomenon in the area does not excessively disrupt a functioning of the environment, 2) whether it is socially acceptable and 3) whether it is economically viable in the long term.

The spatial chaos in the Polish part of the Carpathians is mainly due to a poor functioning of spatial planning and inability of communities living in the mountains to perceive their space as a common good which is also exhaustible. The primary reasons underlying the above seem to originate in an administrative tool called “Decision on Building Conditions” and in a fact that local authorities are not obliged to prepare local spatial development plans. Among other main causes of spatial disorder we can identify the economic and political transformations in post Second World War Poland which in their first phase took forms of land merging, expropriation and resettlement of the population followed by a poorly coordinated command-and-distribution economy and unification of architecture not adapted to the mountainous landscape. In the next, modern phase, the phenomenon of urban sprawl along with a high individualism of Poles manifesting itself in constructing bizarre looking buildings (“gargamelisation”) can be held responsible for a spatial chaos.

The effects of spatial chaos are of the landscape, economic, social and environmental nature. The main negative phenomenon in the area combining all the above aspects of spatial chaos is building dispersion often leading to: interruptions of animal migration corridors, decrease in landscape touristic value and loss of areas for transhumance shepherding, weakening of social and increased expenditures on infrastructure and commuting. Other negative phenomena illustrating a spatial chaos are the intensified geomorphologic processes occurring on slopes overloaded with buildings

and devastating effects of floods in improperly arrainged bottoms of valleys. A ski infrastructure is also a significant problem because it may threaten precious wildlife habitats and ecological corridors.

To minimise the manifestations of spatial chaos and to conduct spatial planning in the spirit of sustainable development it is necessary to amend Polish law in such a way that it reflects the provisions of the Carpathian Convention.

Forests in spatial policy of Polish Carpathians municipalities

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Environmental, social and economic aspects of alterations in the woodiness level are an important signal of transformations occurring in the area. Municipalities located in the Polish Carpathians are characterised by a diverse forest cover index and dynamics of its changes. According to the Polish law communes are independent in spatial planning. This implies that, although planning documents produced by municipalities must be in accordance with documents of a higher rank, communes still have a right to autonomous choice of tools for realizing spatial policy objectives. Forest protection as well as the enhancement of forest cover index can be both an aim in spatial policy as well as an implementation tool for other purposes such as those related to the protection of environment or sustainable development of the area.

Main goals of the research are identifying major patterns in the approach to forests in spatial policy at the municipalities level and an indicating elements influencing their choice. Therefore, spatial policy with respect to forests is presented, among others, in accordance with the level of woodiness, features of the municipalities spatial position and operation of legal forms of protection on their territories. Text mining in relation to planning documents at the level of Spatial Development Conditions and Directions Study is the main method used in the research.

Empowering Carpathian communities for forestry heritage management. A preliminary approach to several selected communities

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The long-term existence of the living realm as a whole and of the human society in particular are possible only to the extent that intraspecific and interspecific relationships are protected and preserved. Within the planetary ecosystems, the forests – and especially the primary and quasi-primary ones – provide the most favorable living environments for preserving the direct and indirect values of genetic diversity, either specific or eco systemic (ecosystems' productivity; water and soil protection; climate mitigation; pollutants and nutrients retention; interspecific relationships responsible for keeping alive the species of economic value; recreation and ecotourism; ethno cultural, educational and scientific values, etc.).

However, people are often poorly aware of the heritage value of the living forest, which is why their involvement in its sustainable development is quasi-inexistent.

The aim of the study is to identify the ways in which the local communities may get actively involved in the management of forest heritage, starting from the results of a survey meant to assess the endogenous perception of the people on the heritage value of the Carpathian forests, as well as on the threats they are confronted with.

The methodology used for this purpose consisted in : reviewing the bibliographic works on the study area; selecting the pilot plots and choosing the appropriate GIS techniques for their cartographic representation; using the survey method, based on a specific interview, in order to assess people's endogenous perception on the mountain forests.

The results have emphasized the need for a continuous adjustment of forest management strategies to the requirements of the socioeconomic clusters of the mountain communities. This fact has been revealed by the high occurrence of the answers that expressed agreement on the economic exploitation of the forest, which in its turn suggests that people are poorly aware of the value of the living forest.

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POSTER PRESENTATIONS

Phenological observations with volunteers and students in Carpathian region

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Phenological observations brings good insight into ecosystem relationships and structure and can help us to understand the climate change impact on phenological development of plants and animals. Information about phenological processes from one experimental plot could be informative but view from the bigger perspective, from various sites with different climate conditions could be much more useful.

The aim of our work is to bring phenological information from the Carpathian region from various phenological sites. Students from Czech Republic and Slovakia (from Mendel University in Brno and University of Central Europe in Skalice) were involved in this phenological project in the first step (since 2015). Since the start of year 2016 the phenological observations are widely presented also to the public and volunteers. In 2015 and 2016 we have more than 200 observers each year for the Carpathian region. Observers collect information about phenological phases of common woody species and crops during spring and autumn and their results shared on phenological website www.fenofaze.cz. Results are elaborated continuously and showed phenological differences among all sites.

Combining of basic geomorphological monitoring and terrestrial laser scanning in evaluation of erosion within the tourist paths (Kasprowy Wierch peak, Tatra Mts.)

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Mountain areas especially attractive to tourists, include the Tatras, are significantly exposed to degradation of the natural environment. The Kasprowy Wierch peak is among the three most affected area by tourists in the Tatras. One of the reasons is cable car there. The number of tourist continuously increases, particularly since 2009 when capacity of the cable car increase after its renovation. For example about 200,000 peoples were transported in summer 2014 (June-September).

For this reason monitoring of erosion within the tourist paths started in 2009, on 12 study sites located within the tourist path. Basic geomorphological methods like marked points, marked lines etc. are used in the studies. The study sites were checked two time every year. The results of monitoring proved erosional changes within the paths, which are spatially differentiated both horizontally and vertically. Denudation of the paths in size of 2 cm/year in average was found as well as their widening 20 cm during 5 years in size.

Since 2014 terrestrial laser scanner Riegl VZ4000 was used in the studies. The digital terrain models of tourist path surfaces in 2014 and 2015 were obtained. The analysis of difference between them showed significant differences in magnitude of erosion belonging of type of paths surface (natural surface or surface artificially harden by stone pavement) and its inclination. The digital terrain models adjustment carried out 1.5 mm. The greatest erosional changes were measured on not harden paths with large inclination. Difference in rate of erosional changes between harden and not harden fragments of the paths was found. The not harden path fragments was lowered 1 cm/year on average, while no changes was identified on paths with stone pavements.

The use of sea buckthorn (*Hippophae rhamnoides* L.) for improving Romania's degraded lands

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An important percentage of Romania's agricultural area is represented by degraded agricultural lands can no longer be used for agriculture but can be ecologically and economically improved.

One such method, respectively the use of shrubs, is supported by research conducted in Vrancea. Sustained by the concept of agro-forestry, this method is used for the improvement of the degraded lands. In comparison with the ecological exigencies of forest species, there is a great diversity of degraded lands that are suitable for the culture of some species of shrubs. The most affected degraded and unproductive lands (eroded land or landslide) can be improved and enhanced by using sea buckthorn plantations (*Hippophae rhamnoides* L.). Sea buckthorn is a multipurpose fast growing species which is serving as a measure of biodiversity conservation, lands improvement, medicines and food. It has an extraordinary capacity to grow and has extensive subterranean rooting system with strong soil binding ability useful for soil stabilization.

The sea buckthorn (branches, stems) has been used successfully to stabilize / consolidation of advanced degraded fields before afforestation. The research has shown that mixtures of Scots and black pine with sea buckthorn or pine plantations on consolidated lands with sea buckthorn, led to significant increases growth of pines compared to pure cultures of pine, as a result of enrichment in soil nitrogen due to the symbiosis with the mycorrhizal fungus (Frankia). Sea buckthorn has attracted a great deal of attention from researchers because of its concentrated ecological and socio-

economical benefits, providing long-term benefits as: soil enhancer, anti erosion protection, a landscape management tool, maintaining ecological balance, food industry, medicine, etc. It is estimated that the earnings generated by capitalizing sea buckthorn fruits are exceeded over 10 times by earnings generated by selling wood resulted from other forest cultures.

GIS application for the identification of any potential routes for the development of mountain tourism - Case Study: Retezat Mountain

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Latest Research concerning in the development of mountain tourism have shown that lack of main mountain resorts in Romania is the development of a diversified entertainment infrastructure. In general, any transport infrastructure is a key element in the economic and social development of a country, no matter what the route is (onshore or offshore).

Organizing recreational activities for both the summer and in the winter requires a separate analysis in terms of tourist routes, due to demand their approach by degrees of complexity depending on the season.

Sustainable development of mountain tourism requires not only the skiing area for winter but also diversification of recreational activities during the summer such as excursions organized trails with different degree of difficulty, cycling tourism, mountain biking, etc. enduro-tourism. This paper aims at identifying some potential in Retezat mountain routes for diversification of leisure tourism in the warm season (summer).

GIS analysis methods will allow the assessment and quantification of all elements (geology, terrain, slope, hydrography, vegetation etc) favorable (required) identification of new trails from Retezat.

WORKSHOPS

EDUCATION FOR SUSTAINABLE DEVELOPMENT IN THE CARPATHIANS

The role of Carpathian Convention in Education for Sustainable Development

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The Carpathian countries: -have committed to the sustainable development of the region by becoming parties to Carpathian Convention. The Convention acknowledges the importance of “Awareness raising, education and public participation” in Article 13, and the Secretariat to the Convention coordinated several Education for Sustainable Development (ESD)-related activities in the past years. (Carpathian Convention, 2016).

The *Move4Nature* initiative was the first result of the cooperation of ESD experts of Carpathian countries, Funded by a private donor. It focused on teacher training and development of training materials in the Carpathians focused in Romania, in cooperation with the Ministry of Education and school inspectorates. The initiative resulted in 6 ESD trainings in schools located in rural mountainous areas, and the Carpathian Mountain ESD Training Tool Kit. The important aspects of this project were: its focus on Vocational Educational Training (VET), on networking (e.g. via connecting local schools and protected areas) and its participatory approach.

Another example of the ESD - related initiative was the EU - funded project *Big Foot. Crossing Generations, Crossing Mountain*, focused on intergenerational learning and sustainable development, which tested this approach in Greece, Italy and Bulgaria, and the results of which have been introduced to the Carpathian countries. While a non-formal learning project, it involved schools in every pilot country, and introduced ideas of using local seniors as an educational resource, as well as the importance of lifelong learning (Mitrofanenko et al. 2013).

The most recent example of a Secretariat - supported ESD-related project is the EU – funded project *Innovation in Rural Tourism (InRuTou)*, focused on Vocational training of rural tourism stakeholders in community-based sustainable tourism development and promotion, using ICT, with pilot sites in Austria, Italy, Poland, Romania and Ukraine. The project created an online learning course, and tested its training approach, based on background analysis and on the European competence frameworks (Inversini et al. 2015). It resulted in actual sustainable tourism product creation in most pilot areas (Katelieva-Platzter et al. 2015).

Conclusions

In addition to the projects presented above, , numerous ESD – related initiatives have been carried out by various organizations in the Carpathian countries. However, unfortunately, many of them are not widely publicised and information about them is not always available to the interested parties so their efforts often remain fragmented.

We therefore propose that a regional effort is needed to support exchange of knowledge and best practices in ESD throughout the Carpathians, supported on the policy level, and open to participation from all stakeholders.

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Education for Sustainable Development in the Carpathians – state of arts and opportunities

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The UN Decade for Education for Sustainable Development (ESD) 2005-2014 (UNESCO 2015) and the Global Action Program (UNESCO 2016) as its continuation has been a clear evidence of growing global recognition of ESD. The UNECE Steering Committee on ESD gives a regional framework for the realisation of these global efforts. As all of the Carpathian countries are represented in the Steering Committee, it could also provide a basis for Carpathian co-operation in ESD.

The presentation briefly summarizes the main conclusion of a report made by The Carpathian Convention Secretariat in cooperation with the UNECE focal points from the Carpathian Countries, based on the national UNECE Strategy for ESD implementation reports (UNECE 2015) submitted to the Steering Committee in 2015 and on relevant Carpathian Convention activities in the field of ESD.

The most important conclusion is that there is a strong need for cooperation among the Carpathian Countries and exchange of experience on ESD as an instrument devoted to sustainable development of the Carpathian countries. Although the Convention in itself and its numerous activities is a source of information and basis for co-operation highly relevant for ESD, it is also obvious from the reports that professionals and officials responsible for ESD in Carpathian countries are not fully aware of the opportunities the Convention offers.

On the other hand it is also evident from the reports that there is a great potential for integrating ESD into sustainable development (SD)-related initiatives and projects in the region. Any SD initiative could be successful only if its result is professionally channelled into educational systems. Both ESD and SD initiatives could reach their full potential only if they are interconnected: separated ESD activities could not significantly contribute to tackling the environmental challenges of the region, and SD initiatives without an ESD component could not develop the social awareness needed to change social patterns which cause environmental problems.

On the basis of the national ESD implementation reports the following areas were identified where the co-operation of ESD and SD experts and activities could be realized:

- Creation and distribution of tools and materials

More and more communication tools about SD issues are available in the Carpathians, but developing their tailored versions for various regional target audiences, different age groups and stakeholders along with a strong dissemination strategy (e.g. using media, local NGOs, teacher training) could multiply their impact.

- Local tradition

Conservation, use and promotion of knowledge of indigenous peoples, as well as local and traditional knowledge is a very important task for ESD and a key basis for SD initiatives at the same time.

- Cooperation with protected areas

Protected areas are hot spots for SD and ESD as well. Their aims and tasks could only be achieved if the developed management methods are known, agreed to, and respected by the inhabitants and visitors of these areas. Without complex, well planned and organized ESD efforts these goals are unachievable.

Fortunately there are a number of possible funding programmes, which could be targeted to support cooperation in the field of ESD in the Carpathians, including the following:

- Horizon 2020
- Erasmus+
- VisegradFund (limited to the Czech Republic, Hungary, Poland, Slovak Republic)
- Interreg Europe

References:

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UNESCO 2016: Global Action Programme on ESD <http://www.unesco.org/new/en/unesco-world-conference-on-esd-2014/esd-after-2014/global-action-programme/>

Assessing educational conservation projects implemented in the PNs and PNAs of the Romanian Carpathians

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In the Romanian Carpathians there are 12 PNs and 10 PNAs, which have an estimated extent of 8.972,2 km² (13,54% of the entire mountainous area). They have been designated as APs beginning from 1938 (Retezat and Piatra Craiului PNs) and until 2005, but most of them have been endowed with administrative offices only after the year 2000.

Education is a primary objective in the management strategies of these APs – which are in different stages of approval –, this fact being in agreement with the Romanian legislation (Act no. 49/2011) and also with the UNECE Strategy on Education for Sustainable Development. Education conducted in informal environments such as those represented by APs could help to advance the principles of sustainable development, by helping children and even adults to grasp basic concepts such as: the protection of environment is not incompatible with development, people are responsible for securing the viability of other species and APs have a high significance for education and the development of local communities.

Following the endowment of APs from the Romanian Carpathians with administrative offices, there have been some attempts on developing educational projects, most of them however being focused on narrow aspects, with an associated content addressed to a small-sized target group and being coordinated by individuals without proper pedagogical training.

In order to evaluate the educational efficiency of conservation projects we researched all available sources (activity reports, websites of APs and NGOs which implemented such projects, news from mass-media). The second stage involved the development of a database which encompassed a list of projects and target groups, the number of attendees to specific activities listed by type, the number of people involved with implementing the projects and a list of deliverables (guidebooks of good practice, course books). This information has been classified using the Multiple Correspondence Analysis method and proved that the topics on which various educational projects relied were rather focused on acquisition of knowledge about different ecosystems and biotopes, the development of thematic educational trails and visitor centres, as well as the creation of junior ranger camps. This thematic narrowness could be caused by: the absence of coordination between The Strategy on Education for Sustainable Development approved by the Ministry of Education and the guidebooks created by various subsidisers, the insufficient importance granted by civil society to sustainable development and to education for environmental responsibility in APs, the lack of guidebooks of

good practice and particularly the absence of qualified staff and specialized departments in the managerial structures of APs.

The projects which have been implemented so far only raise local awareness, and their results have rarely been visible after the financial support has ceased. Moreover, even if the educational materials were of exceptional value, they have not been presented as examples of good practice, so that the educational experience could be multiplied at the lowest possible expense.

Various research studies have proved that Romanian APs are being administered inefficiently, and this fact is also determined by the narrowness of educational content and low impact of these pedagogical experiences. Certain solutions for providing an efficient educational environment throughout the PNs and PNAs of Romania, but also for integrating a higher number of graduates with didactic competence would be: the creation of specialized departments at the level of administrative offices of APs, a long-term agreement for the provision of governmental financial support and the emergence of a school network in the proximity of APs, in order to display examples of good practice, according to the design suggested by the Europe 2020 Strategy for APs.

THE POTENTIAL OF A CARPATHIAN CONVENTION PROTOCOL ON SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT (SARD) FOR FOSTERING INNOVATIVE AGRICULTURAL INITIATIVES TO PROMOTE THE VITALITY OF RURAL AND PERIPHERIALS AREAS IN THE CARPATHIANS

Reconciling nature conservation and local development in the Carpathians: Participatory management of Carpathian Protected Areas: Call for examples of Carpathian countries

Christian HOFFMAN, Harald EGERER, Filipo FAVILLI, Eleonora MUSCO

The Carpathian Convention Protocol on Sustainable Agriculture and Rural development (SARD), currently under development, builds the stimulus for the Workshop. It aims at discussing potentials for fostering innovative agricultural initiatives or sustaining the vitality of rural and peripheral areas in the Carpathians.

Representatives from UNEP Vienna SCC will introduce the meaningfulness, the opportunities and the sphere of influence the protocol has in stimulating the management of traditionally cultivated land in a sustainable manner to bring benefits to present and future generations. Each single article of the protocol provides new development paths for small structured and multifunctional orientated farms in the Carpathians. With its innovative and sustainable approach, the protocol intends to match the CAP requirements as well as the latest developments of Bio- and Green-Economy. It stimulates horizontal and vertical cooperation as well as rural urban linkages and the distribution of typical organic products to the global market, which will create an additional value-added for the Carpathians.

The protocol, apart from food and feed production, also supports the development of “green lifestyle” that targets on minimizing the impact on the environment by choosing alternative fibre products that may gather a great attention for the Carpathian agriculture. For emphasizing the opportunities on the future implementation of the Protocol, the newly developed and submitted project “CentralHEMP” to the Central Europe INTERREG Programme will be presented. Hemp is a multi-purpose plant growing in a variety of climates and soil types that may offer new green solutions for local regional development, producing cloths, food, building-facilities, paper and cosmetics to the industry.

Finally, the Workshop targets to elaborate a statement that summarizes the comments and remarks the participants raised for each single article of the protocol during the discussion. These commonly

agreed inputs from the statement are circulated among the members of the Carpathian Convention Implementation Committee, before the meeting on the 21st and 22nd of November 2016 in Vienna.

ENHANCING ECONOMIC, SOCIAL AND TERRITORIAL COHESION IN THE CARPATHIANS

The Roma pupils' access to education in the mountainous areas of the counties Suceava and Neamt

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The lack of interest for education is an important issue in the national and international public system, especially when marginalized groups are concerned. In Romania, approximately 40% of the Roma population of school age does not attend school at any level and only less than 5% manages to complete secondary school and university.

The study aims to analyze data obtained from interviews and surveys applied in the living areas of Roma population and in schools of four towns that are part of the mountain area of Neamt and Suceava counties (Dodenii - Bicaz, Stanca-Pipirig, Mironu – Valea Moldovei, Vama) in order to observe the level of the education and health of the Roma pupils. We applied questionnaires to Roma population and interviewed health and school mediators to collect data. Survey data were correlated with information received from school mediators, health workers, school principals, school inspectorates and data provided by the National Institute of Statistics of Romania. Statistical handling of the data obtained was performed with the SPSS and MS Excel software. The preliminary results of research highlight both positive and negative aspects, regarding the Roma population's access to education. We see a rather high percentage of Roma students who have completed secondary education and a relatively low interest for them continue their studies on high school and university.

Interestingly, although school units in the studied settlements have only the primary level, Roma students travel a considerable distance to continue their studies in secondary schools in the bigger villages or towns, and their classes frequency is quite high among them.

The issue of Roma students' access to education has determined authorities and associations in the field to develop special programs whose aim is to reduce disparities between Roma children and the non-Roma population in terms of school attendance, improving Roma pupils' low school performance, their socio-economical conditions and reducing cases of discrimination in schools. In the end these will offer adults the chance of a better future integration into society and insertion on the labor market.

Demographic vulnerabilities in Romanian Carpathian area

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Keyword in contemporary society, the concept of vulnerability was installed over time, especially in recent decades in many current issues. Interdisciplinary term, vulnerability is defined as a characteristic of a space, a population or even a society to anticipate, cope with, resist and recover from the impact with a stressor. The vulnerability was frequently characterized as a result of the interaction between a system's exposure and sensitivity and the ability to absorb or cope with

stressors. However, any of these attributes or relations is clearly defined. Clarifying the meaning and use of the concept of vulnerability has become such a focal point in recent cross-disciplinary efforts.

In demographic studies, applying the concept of vulnerability brings forward various current challenges: population aging, rapid population growth, decreased fertility rate, changes in the age structure, overdependence, migration etc.

The main directions of this paper are constituted by a clear demarcation process, as well as determining influencing factors of the demographic vulnerability in Romanian Carpathian space. In order to detect vulnerabilities, I will analyze some geo-demographic indicators at LAU 2 level, using spatial analysis methods, multivariate multilevel regression models and advanced methods for estimation and testing.

Demographic and Social Dynamics in the Rural Area of the Eastern Carpathians

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Romania's population has undergone major transformations after 1990, generated by the changes in the demographic behavior and also by the increase in the mobility rate, especially abroad. Because of the general reduction of the number of inhabitants, the population in the rural area has resented in different manners these changes, depending on a series of elements, such as the accessibility and the functional profile of the settlements, their closeness or remoteness to the main cities. As a consequence, areas of deep demographic decline have appeared, marked by aging and even depopulation, as well as dynamic areas, attractive, whose demographic vitality has been maintained or has even increased. In this context, the present article aims to identify the individuality of the rural space of the Eastern Carpathians in the Romanian demographic landscape during the last quarter of century. Are there, at the level of an area that can be characterized as peripheral and isolated, areas of demographic vitality? Which demographic changes triggered the transformation of the functional profile of some rural settlements in the Eastern Carpathians? Aiming to answer these questions the transformations that have marked the evolution of the demographic behavior of the population have been analyzed through the study of some demographic indicators such as the birth rate, death rate, marriage rate, divorce rate etc. at the level of rural settlements in Eastern Carpathians territory. There have been also analyzed aspects related to the territorial mobility of the population as well as the evolution of its structural aspects at the level of the same studied territory.

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ISBN 978-606-28-0486-2