



# mountains2016

3-7 october · bragança · portugal

I International  
Conference on Research  
for Sustainable Development  
in Mountain Regions

Book of Abstracts





**I International Conference on Research for Sustainable  
Development in Mountain Regions: Book of Abstracts**

Title: I International Conference on Research for Sustainable Development in Mountain Regions: Book of Abstracts

Editors: Centro de Investigação de Montanha (CIMO)

Published by: Instituto Politécnico de Bragança  
Campus de Santa Apolónia 5300-253 Bragança, Portugal  
<http://www.ipb.pt>

ISBN: 978-972-745-214-9

URI: <http://hdl.handle.net/10198/12135>

Cover design: Atilano Suarez, Serviços de Imagem do Instituto Politécnico de Bragança

# **I International Conference on Research for Sustainable Development in Mountain Regions**

*Book of abstracts*

*Edited by*

Centro de Investigação de Montanha (CIMO)

Instituto Politécnico de Bragança, Portugal  
2016



## Table of Contents

	Pag.
Organization .....	6
Major supporters.....	6
Other supporters and sponsors .....	6
Committees .....	7
Keynote speakers .....	8
Abstracts.....	12
Keynote addresses.....	13
Oral sessions.....	18
Poster sessions .....	147
List of authors.....	212

## **Organization**

Centro de Investigação de Montanha - Mountain Research Center (CIMO) and Instituto Politécnico de Bragança, Portugal

Embrapa, Brazilian Agricultural Research Corporation, Brazil

UNESCO Chair in Sustainable Mountain Development, University of Highlands and Islands, Scotland, UK

Euromontana, the European Association for the Development of Mountain Areas

ADVID, Douro Wine Region Cluster

## **Major supporters**

Câmara Municipal de Bragança

União das Freguesias de Sé, Santa Maria e Meixedo

## **Supporters and sponsors**

Associação dos Jovens Agricultores de Portugal

Crescente Fértil, Brazil

Journal of Mountain Science

Mountain Partnership

Open Agriculture

Sociedade Portuguesa de Ecologia, Portugal

The Mountain Research Initiative

Universidade Estadual do Oeste do Paraná

Universidade Federal de Viçosa, Brazil

Universidade Federal Rural do Rio de Janeiro, Brazil

World Famous Mountains Association – Brazil

## **Committees**

### **Scientific Committee**

Martin Price (Chair) – University of Highlands and Islands, Chairholder, UNESCO Chair in Sustainable Mountain Development, Scotland, UK  
Artur Cristóvão – University of Trás os Montes and Alto Douro, Portugal  
Bernhard Wolfslehner – European Forest Institute (EFI), Austria  
Catherine May Tucker – University of Florida, USA  
Celestino Santos-Buelga – Universidad de Salamanca, Spain  
Connie Millar – US Forest Service, USA  
David Hik – University of Alberta, Canada  
David Molden – International Centre for Integrated Mountain Development, Nepal  
Egidio Dansero – Università Degli Studi di Torino, Italy  
Greg Greenwood – Mountain Research Initiative, Switzerland  
Irasema Alcántara Ayala – Universidad Nacional Autónoma de México, México  
João Honrado – University of Porto, Portugal  
Rachel Prado – Embrapa, Brasil  
Ruijun Long – Lanzhou University, China

### **Organizing Committee**

#### Portugal

Carlos Aguiar – CIMO, Polytechnic Institute of Bragança  
Cidália Lino – CIMO, Polytechnic Institute of Bragança  
Isabel Ferreira – CIMO, Polytechnic Institute of Bragança  
Jaime Pires – CIMO, Polytechnic Institute of Bragança  
João Azevedo, CIMO, Polytechnic Institute of Bragança  
Margarida Arrobas – CIMO, Polytechnic Institute of Bragança  
Orlando Rodrigues – CIMO, Polytechnic Institute of Bragança  
Sílvia Nobre – CIMO, Polytechnic Institute of Bragança

#### Scotland, UK

Martin Price – University of Highlands and Islands, Chairholder, UNESCO Chair in Sustainable Mountain Development

#### Brazil

Adriana Maria de Aquino – Embrapa Agrobiologia  
Gilberto Carlos Cerqueira Mascarenhas – Ministério da Agricultura Pecuária e Abastecimento  
Luis Felipe Cesar – Crescente Fértil  
Marcos Aurelio Saquet – Universidade Estadual do Oeste do Paraná  
Marcos Flavio Borba – Embrapa Pecuária Sul  
Monica Alves Amorim – Universidade Federal do Ceará e Associação das Montanhas Famosas do Mundo  
Rachel Rachel Bardy Prado – Embrapa Solos  
Regina Cohen Barros – Universidade Federal Rural do Rio de Janeiro  
Renato Linhares de Assis – Embrapa Agrobiologia

## Keynote speakers

**Julia Klein**, Colorado State University, USA



Julia Klein is an Associate Professor in the Department of Ecosystem Science & Sustainability and a Research Scientist at the Natural Resource Ecology Laboratory at Colorado State University. She received a B.A. in Political Science from Cornell University and an M.S. and PhD in Ecosystem Science from the University of California at Berkeley. Upon receiving her doctorate, she was awarded a NOAA Postdoctoral Climate and Global Change Fellowship. The broad goals of Dr. Klein's research are to understand how interacting global changes affect pastoral and mountain ecosystems and livelihoods; to detect the patterns and underlying mechanisms driving these responses and feedbacks; and to identify actions and pathways to increase adaptation opportunities to global change. Her projects typically combine diverse methods, including experimental manipulations, landscape analysis, local ecological knowledge and modeling. The main geographic focus of her research has been the eastern and central alpine grasslands of the Tibetan Plateau; however, she also works on the shortgrass steppe and alpine region of Colorado and conducts global syntheses of grassland, arctic/alpine and mountain systems worldwide. Dr. Klein is a member of the Scientific Leadership Committee for the Mountain Research Initiative, and lead-PI of the Mountain Sentinels Collaborative Network, an international research coordination network (RCN) composed of transdisciplinary, globally-representative teams of mountain scientists and stakeholders, using biophysical and socio-economic observations and models to engage in knowledge co-creation and coordinated practice for mountain sustainability.

**Georg Gratzner**, University for Natural Resources and Life Sciences (BOKU),  
Vienna, Austria



Georg Gratzner is Associate Professor and deputy head of the Institute of Forest Ecology at the University for Natural Resources and Life Sciences (BOKU), Vienna. His research interests are forest dynamics and the nexus of dynamic processes in forests with sustainable forest use and the livelihood of forest users. His research spans many continents, including Asia, Africa and Europe, providing a unique global perspective on mountain forest ecosystems and human communities. At BOKU he also directs the Mountain Forestry Graduate Program, which brings masters students together from around the world – particularly mountainous regions of Africa, the European Alps, and the central Asian Himalayas – each working in their native countries but taking classes and defending their theses in Vienna, Austria. Currently, Georg Gratzner's research focusses on the effects of monsoon failures on mountain forests in the Himalayas and their effects on ecosystem services. With his partners in Bhutan, he conducts large-scale drought experiments in order to identify stress tolerances of ecosystems and tree species in less studied, albeit critical monsoon driven forest ecosystems. In Ethiopia, he implements a long-term, participatory, community based CO<sub>2</sub> compensation project, which aims at reconciling pro-poor livelihood approaches with increasing carbon stocks in mountain landscapes.

**Harald Bugmann, ETH Zurich – Institute of Terrestrial Ecosystems, Zurich,  
Switzerland**



Harald Bugmann was Assistant Professor of Mountain Forest Ecology from 1999 to 2004. Since October 2004, he is Associate Professor of Forest Ecology at ETH Zurich. Born in Solothurn (Switzerland), he studied systematics and ecological biology at ETH in Zurich. After a M.Sc. in limnology, he obtained his Ph.D. under the supervision of Professor Hannes Flühler and Dr. Andreas Fischlin at the Institute of Terrestrial Ecology of ETH, dealing with the impacts of climatic change on mountain forests in the Alps. His dissertation was awarded with the medal of ETH in 1994. From 1994 to 1998, he worked on the regional impacts of climatic change at the Potsdam-Institute for Climate Impact Research in Potsdam, Germany. In 1998/99, he did research on the ecology of Rocky Mountain forests at the National Center for Atmospheric Research and the Institute of Arctic and Alpine Research in Boulder (Colorado, USA). His main research interests are in the long-term dynamics of forest ecosystems under environmental change, particularly successional dynamics in mountain forests and changes in the disturbance regimes (e.g. wildfires). From 1997 to 2007, he was involved in various parts of the International Geosphere-Biosphere Programme (IGBP), including the project Global Change and Terrestrial Ecosystems (GCTE), the Mountain Research Initiative (MRI) and Human Impacts on Terrestrial Ecosystems (HITE). He was a Contributing Author or a Reviewer for the second, third and fourth Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC) in Working Group II.

**Martin F. Price**, Chairholder of the UNESCO Chair in Sustainable Mountain Development, University of the Highlands and Islands, UK



Martin F. Price established the Centre for Mountain Studies at Perth College, University of the Highlands and Islands (UHI), UK in 2000 and has been as its Director since then. He was appointed Professor of Mountain Studies by UHI in 2005, Chairholder of the UNESCO Chair in Sustainable Mountain Development in 2009, and Adjunct Professor at the University of Bergen, Norway, in 2013. He worked previously at the University of Oxford; the University of Bern, Switzerland; and the National Center for Atmospheric Research, USA. He has a PhD in Geography from the University of Colorado at Boulder. The primary emphasis of his research has been on mountain people and environments. He has acted as a consultant on mountain issues to many international organizations, and has coordinated studies on Europe's mountains for many European organisations. He also has a strong interest in knowledge exchange, having played key roles in the Mountain Forum and the Mountain Partnership, organised four international interdisciplinary conferences of mountain scientists, and written and edited 15 books on mountain topics, most recently 'Mountains; A very short introduction' (Oxford University Press, 2015). In 2012, the King Albert I Memorial Foundation awarded him the King Albert Mountain Award: the citation states that "Martin Price, with his exceptional knowledge and his editorial competence, has played a vital role for the mountains of the world". Further emphases of his work have been on: the human dimensions of global (environmental) change, including acting as Secretary of the International Social Science Council's Standing Committee on the Human Dimensions on Global Change (1989-90); and interdisciplinary research and practice, particularly in the context of UNESCO's Man and the Biosphere (MAB) programme, in which he has held a number of key positions, most recently Rapporteur of the International Coordinating Council (2014-16).

## **Abstracts**

## **Keynote addresses**

## **K1**

### **Mountains matter**

Martin Price

*Chairholder of the UNESCO Chair in Sustainable Mountain Development, University of the Highlands and Islands, Perth, UK*

This presentation discusses how and why mountains matter; to whom; how they have achieved recognition in global policy arenas; and the evidence for their importance. Mountains are clearly important for people who live in them; in addition, they historically gained global importance because they contain many sacred places, and are sources of many minerals and most of the world's major food crops. Following important scientific work, they gained global recognition at the UN Conference on Environment and Development in 1992. Subsequently, this recognition was underlined by inter-governmental and non-governmental processes, the designation of the year 2002 as the International Year of Mountains, and the establishment of the Mountain Partnership. The importance of mountains has also been recognised in major global processes including the Intergovernmental Panel on Climate Change, the Convention on Biological Diversity, the Millennium Ecosystem Assessment, and the development of the Sustainable Development Goals.

## K2

### **Mountain forests in a rapidly changing world - should we worry?**

Harald Bugmann

*Forest Ecology, ETH Zurich, Zurich, Switzerland*

Mountain forests cover a disproportionately large fraction of the mountain area and harbor above-average amounts of carbon. At the same time, they provide a large array of further goods and services to humanity, from timber across biodiversity conservation to medicinal plants, cultural heritage, and protection from hazards such as avalanches and rockfall. Forests develop slowly, and current stand structure typically has a long legacy effect. This contrasts with the increasing rate of change of climate and human demands for forest ecosystem goods and services. Is there reason to suspect that such disequilibrium will jeopardize ecosystem services from mountain forests? In my presentation, I will review this issue, with a focus on developed countries and on methodological aspects: it is intrinsically difficult to study and extrapolate ("predict") forest dynamics, which operate over long time scales and large spatial domains, and therefore quantitative, dynamic models have a particularly important role. Empirical evidence as well as modeling results suggest that forest expansion at upper treeline is occurring, albeit at widely different rates and often strongly retarded by domestic grazing. At the "trailing" edge of the forest, i.e. in dry areas, there is increasing evidence for accelerating loss of forest cover. Both trends have strong impacts on ecosystem services and human livelihoods. Within the forested area, climate-induced rates of change of forest properties are generally lower as long as large-scale disturbances (e.g., insect attacks, wildfires) are disregarded. Thus, the stand-scale perspective is not sufficient, but landscape-scale phenomena must be considered as well. Recent research has greatly expanded our ability to assess disturbance dynamics in a more and more mechanistic way. The presentation will end with reflections on the predictability of ecosystem dynamics from a more general point of view, including considerations of past dynamics in anthropogenic and natural systems. I propose that we should worry based on the model-based simulations of future trajectories of mountain forests, but we should take them seriously, not literally.

### **K3**

#### **Challenges and opportunities for understanding social-ecological dynamics, linking science with action, and moving towards sustainability in the world's mountains**

Julia Klein

*Colorado State University, Fort Collins, USA*

Mountains are iconic coupled social-ecological systems that are globally ubiquitous yet locally unique. As critical sentinels of climate change, mountains are far more than just lands at high elevation. Based on 59 mountain case studies worldwide, we have identified a suite of mountain-specific characteristics and persistent incongruities that require a new approach to understanding and addressing mountain social-ecological sustainability. We present a conceptual model of mountain social-ecological systems that highlights these mountain characteristics and incongruities, and identifies the prevailing press and pulse biophysical and socio-economic drivers, land uses and ecosystem services that characterize these mountain systems. We also examine which mountain regions share common features and drivers. A grand challenge for mountains is to understand mountain social-ecological dynamics across scales and to explore their future trajectories in the different contexts of mountain systems globally. We suggest that participatory social-ecological models are one important approach to addressing wicked problems in mountains, and the regions that rely on their services. While current modeling efforts in mountains have focused on understanding and decision-support, we suggest that participatory modeling can also be used for communication and learning, thus linking science with action, both within and beyond mountains. We also present an approach that has been successful for transdisciplinary approaches in mountain systems. We conclude by introducing the Mountain Sentinels Collaborative Network, an international network focused on transdisciplinary approaches to addressing global change challenges and to fostering sustainable futures in Earth's mountains.

#### **K4**

#### **Mountain Forests - traps or treasures?**

Georg Gratzner

*BOKU - University for Natural Resources and Life Sciences, Vienna, Austria*

Mountain forests are of global importance as centres of biodiversity and drivers of hydrology. These forests remained in inaccessible or infertile mountain areas not suitable for conversion into agricultural land. Such areas are characterised by poor infrastructure and a difficult market access, often a poor political participation and - very often - over proportional restrictions of land use through area protection for nature conservation. These characteristics make landscapes prone to act as poverty traps. Land users in such areas are generally poorer than lowland farmers and as poverty increases, their dependence upon ecosystem services provided by forests does as well. This dependence is not new: ever since mountains became home to people, nutrients stored in forest biomass were converted into edible products. While the dependency on these nutrients as a forest product is decreasing in industrialised countries, nutrient transfers in poor countries still play a crucial role for survival in mountains. In this context, we want to explore ways and possible extents of reconciling traditional forest use practices with contemporary forest production systems. Mountain forests provide a wide array of products adding to livelihoods of rural land users- an income source that is frequently neglected. Recent work suggests that the value share of these harvested products almost equals that of agricultural crops for developing countries. With the magnitude of these extractions, issues of their sustainability and conservation of mountain forests arise. While overoptimistic and sometimes idealistic claims of sustainability of local forest use seem unwarranted, examples underline that even in poor communities, resource extraction did not lead to a total loss of resources. Climate change and invasive species, however, pose new threats to mountain forests and call for research that goes beyond the "scientific management paradigm" which has been used to control forest use and access to resources.

## **Oral sessions**

## **S01O01**

### **Population dynamics of alpine herbivores in a warmer climate**

David Hik<sup>1</sup>, Isabel Barrio<sup>2</sup>, Scott Williamson<sup>1</sup>

<sup>1</sup>*University of Alberta, Edmonton, Alberta, Canada,* <sup>2</sup>*University of Iceland, Reykjavik, Iceland*

Accumulating evidence suggests that the extent and phenology of seasonal snowcover plays a critical role in determining the demography, behaviour and growth of mammalian herbivores in alpine environments. Stochastic, periodic and directional variation in seasonal temperature and precipitation may have very different effects on mammalian herbivores depending upon their life history strategies and capacity to adapt to variable and changing conditions. We will present an analysis of the responses of four herbivores living in alpine environments of the Yukon, (collared pikas, hoary marmots, Arctic ground squirrels and Dall sheep) to interannual and decadal patterns of temperature and precipitation. Each of these species appears to be sensitive to changes in winter snow cover and the timing of snowmelt in spring. In different ways, the timing of snowmelt appears to directly influence their overwinter survival, reproduction, and growth. At a larger scale, a good predictor of these responses may be the Pacific Decadal Oscillation index. We will also provide an overview of some recent efforts to improve our measurement of snowcover and to better integrate the role of snow on the dynamics of these alpine communities.

#### Acknowledgments

Natural Sciences and Engineering Research Council (Canada).

## **S01002**

### **Potential impact of climate changes on wetland vegetation of the Eastern Pamir (Tajikistan, Central Asia)**

Monika Metrak<sup>1</sup>, Lukasz Chachulski<sup>2</sup>, Pawel Pawlikowski<sup>1</sup>, Marcin Sulwinski<sup>1</sup>,  
Malgorzata Suska-Malawska<sup>1</sup>

<sup>1</sup>*University of Warsaw, Warsaw, Poland,* <sup>2</sup>*Warsaw University of Life Sciences, Warsaw, Poland*

As eastern part of the Pamir Mountains is characterized by great aridity and continentality, high-mountain wetlands develop there in the vicinity of lakes or in the river valleys. These communities are fed by surface and ground waters, mostly of glacial origin, hence they are vulnerable to increasing temperatures. Limitation of water supplies results in local differences in soil salinity and nutrient content, and influences biodiversity and productivity of vegetation. We performed a detailed vegetation survey and a wide range of soil analyses (including salinity and nutrients content) in the vicinity of three shallow lakes with adjacent wetlands: (1) Bulunkul (3740 m a.s.l.), (2) Rangkul (3790 m a.s.l.), (3) Sassykul (3830 m a.s.l.). We studied plant communities developed in a soil moisture gradient, in order to assess potential changes of vegetation and soils, to which wetland ecosystems may be subjected as a result of water shortage. Shores of lakes were densely covered with reeds, dominated by *Blysmus rufus*, with participation of aquatic species. This community developed mostly on alluvial peat soils, showing peat-forming properties. In periodically flooded areas formed either *Carex* reedbeds, characterized by high vegetation density (90% cover) and peat-forming properties (mostly alluvial peat soils); or *Kobresia* meadows developed mostly on alluvial meadow soils and characterized by the highest density (90% cover) and biodiversity. *Kobresia* meadows are semi-natural ecosystems, regularly grazed in winter and constituting one of the most important fodder sources for the livestock. Drier, rarely flooded areas were covered with loose, yet diversified, grassland communities with domination of *Puccinellia* and *Hordeum* species (including some species endemic for Pamir), developed on loamy alluvial soils. On the driest areas developed semi-desert communities dominated by *Eurotia ceratoides* and *Knorringia pamirica*, characterized by the lowest biodiversity and productivity.

#### Acknowledgments

This work was supported by the Polish National Science Centre (Grant No 2013/09/B/ST10/ 01662).

### **S01O03**

#### **Carbon fluxes and vegetal groups composition of an alpine grassland in relation to grazing and climate**

Francesca Ugolini, Silvia Baronti, Giuseppe Mario Lanini, Antonio Raschi  
*Institute of Biometeorology, Firenze, Italy*

Mountain prairies represent vulnerable ecosystems whose resilience is strictly connected to climate but also to management practices. During the years 2008 and 2009 in the alpine pasture (Festuco-Deschampsieto) of Malga Arpaco (Italy), monitoring actions of the grassland species compositions and greenhouse gases emissions were carried out through chamber-based measurements. About a hundred of cattle beef and dairy cows grazed in three summer months of both years. Summer 2008 recorded warmer June and July than the average and abundant rains whilst in summer 2009 mean temperature in July and August was much higher than the average. NEE per leaf area index (NEE/LAI), soil respiration (R<sub>soil</sub>) and night respiration per leaf area index (R<sub>patch</sub>) were measured fortnightly on patches of grassland in the grazed area. The results showed higher R<sub>soil</sub> in the grazed area compared to an ungrazed area as control, likely connected to higher soil fertility (richer in N and C). LAI of different patches of vegetation pattern was generally lower in 2009 and the best NEE/LAI was observed in patches of mixed vegetal groups than in patches of *D. cespitosa* which resulted little effective on carbon uptake. On the other side, grasses and forbs showed the highest values of R<sub>patch</sub>. Regarding the vegetation composition, a strong decrease of grasses in summer 2008 -likely connected to the higher presence of palatable grasses species and the cattle selectivity, and ontrast, an increase of invasive species cover (*D. cespitosa* and *C. eriophorum*) and less selectivity between grasses and forbs in 2009 were observed. The results lead to think about the role of management practices in connection to climate variables, in bounding the spread of invasive and little palatable species like *D. cespitosa* and *C. eriophorum*, also little influent on carbon sequestration.

#### Acknowledgments

This research was carried out within the frame of the European project CarboEurope and under the national project CarboItaly.

## **S01004**

### **Urban Climate in a small mountain city with a complex terrain - Bragança (Portugal)**

Artur Gonçalves, António C. Ribeiro, Filipe Maia, Manuel Feliciano  
*CIMO - Mountain Research Centre, Instituto Politécnico de Bragança, Bragança, Portugal*

Cities have singular climate as a consequence of the multiple interactions with buildings and other artificial structures, including such effects as the urban heat island (UHI) and changes ventilation patterns, with effects on urban air quality and energy use. Under such conditions, urban climate analysis is increasingly considered as a necessary activity that should be part of the urban planning practice, especially when addressing the effects of climate change. Although there has been a wide development of climate studies across different countries, further improvement is needed to address a wider diversity of geographic locations and conditions, including studies taking place in cities with complex terrain, such as mountain settlements. Following a trans-national project, BIOURB (POCTEP - INTERREG), a monitoring network was introduced in Bragança (Portugal), a small city located on a mountainous region. The methodology consisted on the cross-interpretation between data from a network of sensors and the analysis of the major factors influencing such climate conditions (topography, land use and artificial structures), allowing for the identification of major climate transformations represented as an Urban Climate Map, with the ultimate goal of providing useful indications for urban design. Urban climate monitoring was carried out with a combination of 24 temperature and relative humidity sensors, four wind anemometers and three weather stations. The location of the equipment took into consideration different Local Climate Zones (LCZs), topographic aspects and the potential rural to urban gradient. Results from recent years show that while addressing a small, though complex, urban reality and despite the proximity to rural surroundings, many meteorological data variations can be attributed to the presence of urban elements, including the UHI effect and changes on wind patterns. Additional variability can also be attributed to topographic effects, including cold air drainage and background wind exposure as a result of the local mountainous context.

## S01005

### **Aerobiological analysis of the grasslands of Sierra Nevada: effects of changes in land use and climatic conditions**

Paloma Cariñanos<sup>1</sup>, Jose A. Algarra-Ávila<sup>2</sup>, Manuel Delgado-Capel<sup>1</sup>, Javier Herrero<sup>3</sup>, David Santiago<sup>1</sup>, Consuelo Díaz de la Guardia<sup>1</sup>

<sup>1</sup>*Department of Botany. University of Granada., Granada, Spain,* <sup>2</sup>*Director of the Botanic Garden Detunda-Cueva de Nerja. Environmental and Water Agency. Consejería de Medio Ambiente, Rural y Marino. Junta de Andalucía, Andalusia, Spain,* <sup>3</sup>*Fluvial Dynamics and Hidrology Research Group. Andalusian Institute for Earth System research. University of Granada, Granada, Spain*

High mountain grasslands constitute one of the most vulnerable ecosystems to environmental changes due to its high dependence on weather conditions. In this paper the possible alterations occurred in the grasslands of Sierra Nevada (Granada, Spain), by analyzing the time series of grass pollen in the last 24 years are analyzed. Aerobiological records have been obtained from the sampling aerobiological station of the University of Granada, while environmental and weather information come from the Environmental Information Network of Andalusia, (REDIAM). The first results show that grass pollen year is detected in the atmosphere of the city an average of 166 days/year, corresponding to the flowering of the species of grassland of Sierra Nevada the period from mid-June to late August (September). During this period about 200 different species contribute their bloom, including some endemics high peaks are as *Agrostis nevadensis*, *Festuca clementei*, *F. frigida*, *F. indigesta*, *Holcus caespitosus*, *Koeleria dasyphylla* and *Trisetum glaciale*, which have been the subject of recovery plans in recent years due to their degree of threat. Throughout the series there has been a lack of trend in the case of Annual Pollen Index (PI), while the annual sum of daily values has experienced numerous oscillations. These changes may be related to anomalies in the distribution of seasonal rainfall and periods of snow cover. Changes in land use, with an important modification of the forest, has also had an effect on the area of the presence of different species of mountain setting. It can be concluded that the analysis of all these factors allows to know the response of these high mountain grasslands to the effects of climate change, knowing their evolutionary response and plan management actions so that appropriate conservation measures can be taken to those species at risk of threat.

#### Acknowledgments

National Program of Research, Development and Innovation, Spanish Ministry of the Economy and Competitiveness, for backing through Project CGL2014-54731-R FENOMED.

## **S01O06**

### **Effects of anthropogenic fragmentation on primary productivity and soil carbon storage in temperate mountain grasslands**

Emilia Ionela Cojoc, Carmen Postolache, Bogdan Olariu  
*University of Bucharest, Bucharest, Romania*

Habitat fragmentation is one of the most severe anthropogenic pressures exerted on ecosystem's biodiversity. Empirical studies to date focused with an overriding interest on the effects of habitat loss or habitat fragmentation per se on species richness patterns detrimental to biogeochemical processes. To account for changes in ecosystem fluxes we investigated how anthropogenic fragmentation affects primary productivity and carbon storage in mountain temperate grasslands. A field study was conducted to assess the influence of grassland isolation on soil carbon stocks, species biomass and functional groups distribution. We tested the hypothesis that increased isolation of grassland within the land cover decreases soil carbon stocks and N available nutrients as well as species above-ground biomass. Soil carbon concentration decreased with isolation but increased near the forest edge. We found significant differences in above-ground biomass distribution and relative contribution of species functional groups among isolation conditions. The magnitude of edge effect on carbon stocks, N availability and primary productivity intensified with increasing isolation as a consequence of the additive influence of edges. Our study reveals that the potential creation of artificial isolated patches diminished primary productivity, N availability and C stocks. However, in highly managed landscapes, grazing pressure is an additional factor that changes biomass and nutrients patterns. We emphasize that spatial configuration of the landscape has a major role in modulating ecological flows and ecosystem service supply, besides changes in species richness.

#### Acknowledgments

POSDRU/159/1.5/S/133391; German Academic Exchange Service (DAAD).

## **S02001**

### **Biomonitoring of the flora in the transboundary mountainous forest of the Central-West of Tunisia: the Case of Bouchebka's Mountains**

Saadaoui Islem<sup>1</sup>, Ilahi Hayet<sup>1</sup>, Bryant Christopher<sup>2,1</sup>, Rejeb Hichem<sup>1</sup>

<sup>1</sup>*Higher Agronomic Institute of Chott Mariem, Sousse, Tunisia,* <sup>2</sup>*Faculty of Art and Sciences, UdeM, Montreal, Canada*

This work is carried out in the region of Bouchebka, a transboundary mountainous area in the Central West of Tunisia. The series of the forest in Bouchebka is a part of the great mass of Aleppo pine. It covers 92 % of the forest area in the delegation of Feriana. The purpose of this research was to identify the floristic spectrum of the forest in this area. To achieve our goals, a Biomonitoring of the vegetation was conducted each spring and summer since 2013 over two plots with different human action, during three years while highlighting the human and natural factors that affect their distribution. Data processing is performed through the software XLStat 2013 and 2015. The results show that the fenced plot is dominated by perennials and forest species, mainly the Aleppo Pine, while the unfenced plot is distinguished by the presence of ruderals and cultivated species. The flora distribution is mainly influenced by the natural conditions of the area: the results show that 72% of species are drought tolerant for 2015 and 82 % for 2013 which shows the arid environment. Biodiversity indicators show the significant floristic richness: between the years 2013 and 2015, the species diversity of MARGALEF increased from a value of 3.3 to 8.1 and Shannon index has increased from a value of 2.8 to 5.5. The factorial analysis shows an anthropic activity that is revealed through the presence of the positive indices of cultivated species, weeds and ruderal species that are negatively interacted with forest species. The area is characterized by its rich flora that is positively changing gradually through natural and human conditions that promote the distribution and the maintenance of certain species.

#### **Acknowledgments**

Research Unit of Horticulture Landscape and Environment University of Sousse.

## **S02002**

### **Forests in mountain environments of Tierra del Fuego: Biodiversity and productive values**

Vanessa Lencinas, Rosina Soler, Alejandro Huertas Herrera, Guillermo Martínez Pastur  
*CADIC CONICET, Tierra del Fuego, Argentina*

Tierra del Fuego (Argentina) is an archipelago located in the southernmost South America region, where landscape is characterized by the last spurs of Los Andes Mountains. Here, lowlands (LL= 0-300 m.a.s.l.) were covered by grasslands, shrublands, peatlands, open and closed forests; mountain environments (ME= 300-600 m.a.s.l.) were dominated by closed forests; and alpine areas (AA= >600 m.a.s.l.) were usually covered by sparse forests and grasslands. Forests types were *Nothofagus antarctica* (NA), *N. pumilio* (NP) and mixed *N. pumilio* and *N. betuloides* (M). The objective was to analyse differences in productive values (cattle stocking rate and timber) and potential biodiversity (combination of habitat suitability maps of 20 most important understory plant species of each forest type) among altitudinal levels across forest landscapes. LL had most of forests (73%) of the three types, while ME (26%) and AA (1%) were dominated by NP and M. Cattle stocking rate in NA decreased with altitude. Timber forests are mainly in LL (73% in NP and 88% in M) where 91% of the harvested areas were located there. Potential biodiversity in NA was intermingled in LL (low, middle and high qualities), while potential increased with altitude in ME. NP presented the highest qualities in LL and decreased with altitude. Finally, M increased the qualities with altitude. Forests are the main ecosystems in mountains (ME and AA) but represent a small percentage of forestlands with low productive values (cattle stocking rate for NA, and timber for NP and M). Mountains presented lower potential biodiversity for NA and NP forests compared to LL, but the potential in M increased in these areas. Trade-offs between productive activities and biodiversity conservation can occur in LL for NA and NP, but these conflicts can be avoided for M (timber was greater in LL and biodiversity potential was greater in ME).

#### **Acknowledgments**

This research was supported by 'Operationalisation of ecosystem services and natural capital: From concepts to real-world applications' (OpenNESS) project financed under the European Commission's Seventh Framework.

## **S02003**

### **Biodiversity conservation value of mountain environments in Isla de los Estados**

Guillermo Martínez Pastur<sup>1</sup>, Alejandro Huertas Herrera<sup>1</sup>, Sarah Kather<sup>1</sup>, Boris Díaz<sup>2</sup>,  
Vanessa Lencinas<sup>1</sup>

<sup>1</sup>CADIC CONICET, Tierra del Fuego, Argentina, <sup>2</sup>INTA, Santa Cruz, Argentina

Isla de los Estados (Argentina) is located in the South Atlantic Ocean and formally is a natural reserve of Tierra del Fuego province due to its particular marine fauna. However the different terrestrial ecosystems, including mountain areas, suggest the potential of unique biodiversity assemblage without significant human impacts. The objective was to analyse the differences in plant and bird richness and abundance (cover/density) comparing lower and upper altitude environments in forests (mixed evergreen dominated by *Nothofagus betuloides*) and open-lands across the landscape (2 ecosystem types x 2 altitudes in 3 fjords along E-W gradient). A total of 35 plant species was detected, which decreased in closed forest and increased in open-lands with altitude (16 to 20 species, and 26 to 20 species, respectively), where differences in richness and cover were detected between environments and fjords. Beside this, a total of 33 bird species was detected, with a decreasing of richness in forests and open-lands with altitude (12 to 8 species and 13 to 11 species), where differences in richness and density were detected between environments and fjords. Plant species assemblage was influenced by environment type and altitude, where some species presented clear preferences for alpine environments (e.g. *Bolax gummifera*, *Escallonia serrata*, *Maytenus disticha*, *Azorella lycopodioides* and *Festuca contracta*). In the case of bird species, the assemblage was more influenced by environment type than altitude, however some species presented greater preference for alpine environments (e.g. *Vultur gryphus* and *Polyborus australis*). Results suggest that mountain environments present a similar conservation value than lower altitude environments, where open-lands maintained more species and abundance than forests.

#### **Acknowledgments**

Partially financed by Quixote Expeditions Guest Scientist program ([www.quixote-expeditions.com](http://www.quixote-expeditions.com)).

## **S02004**

### **Angolan mountains current research and conservation issues**

Francisco Gonçalves<sup>1,2</sup>, Nigel Barker<sup>3</sup>, David Goyder<sup>4</sup>

<sup>1</sup>*Herbarium of Lubango, ISCED-Huíla, Lubango, Angola,* <sup>2</sup>*University of Hamburg, Biocentre Klein Flottbek, Hamburg, Germany,* <sup>3</sup>*University of Rhodes, Great Escarpment Biodiversity Research Programme, Grahamstown, South Africa,* <sup>4</sup>*Kew Herbarium, Royal Botanic Gardens, London, UK*

Most of the Angolan mountainous parts are situated about 100-200 km from the coast, forming an extensive mountain chain known as "Marginal Mountain Chain", and most of them form part of the Great Escarpment of Southern Africa. Starting in Angola, the escarpment continues southwards for about 5000 km through Namibia, east and northwest of South Africa, Lesotho, Swaziland, Zimbabwe, Mozambique and includes also Mushinga escarpment in Zambia. The Angolan mountains, and in particular the escarpment have been reported to harbour a rich and unique biodiversity. However, with exception of birds, the entire biodiversity, including plants are poorly known and not documented. Due to the increasing pressure on the biodiversity, and therefore concerns have been voiced over the future conservation of unique ecosystems of the escarpment. Under the framework of the joint cooperation programme, between the Herbarium of Lubango (LUBA), ISCED-Huíla, Lubango, Angola and Great escarpment biodiversity research programme, University of Rhodes, South Africa, aiming to document the floristic diversity of the Angolan escarpment, we visited various areas from central to south limits of the Angolan escarpment. A general walk-over survey combined with plant specimen collection and sight observation to aid the characterization of the vegetation and compiling of an inventory of plant species present were done. From the areas visited hundreds of botanical specimens were collected and identified, the list includes species recorded for the first time in Angola, potential news species and additions to the recent published checklist of Angolan plants. However, there are many concerns regarding the conservation of the biodiversity in particular the flora, and unique ecosystems which remains an important issue to be faced.

#### **Acknowledgments**

Co-funded by: Angolan Ministry of Science and Technology and South African Department of Science and Technology.

## **S02005**

### **Conservation of native fish and mussel populations in mountainous streams of NE Portugal**

Amílcar Teixeira<sup>1</sup>, Ronaldo Sousa<sup>2</sup>, Simone Varandas<sup>3</sup>, Elsa Froufe<sup>4</sup>, Manuel Lopes-Lima<sup>4</sup>

<sup>1</sup>*CIMO-ESA/IPB, Bragança, Portugal*, <sup>2</sup>*CBMA- U. Minho, Braga, Portugal*, <sup>3</sup>*CITAB-UTAD, Vila-Real, Portugal*, <sup>4</sup>*CIIMAR-U. Porto, Porto, Portugal*

Freshwater ecosystems are threatened by a myriad of human activities and their biodiversity declines far greater than those on marine and terrestrial ecosystems. Several impacts such as habitat loss and fragmentation, pollution, river regulation, overexploitation, introduction of invasive species and climate change are responsible for increasing the extinction risk of native species and for the disruption of important ecosystem functions and services. Freshwater mussels (Bivalvia: Unionoida) are among the most threatened faunistic groups in these freshwater ecosystems. These mussels depend on fish to complete their life cycle, where mussel larvae use a specific range of fish hosts to metamorphose. Therefore, the persistence of freshwater mussel species will ultimately depend on the conservation of their fish hosts. The Iberian Peninsula holds a high level of spatially restricted species and endemisms. Nowadays, many native fish and mussel species of Iberia are listed as vulnerable, endangered or critically endangered and their populations are declining. In this study, we will use data collected in the last 5 years in mountainous streams of NE Portugal (Sabor, Tâmega and Tua basins) to assess the conservation status of native freshwater mussel and fish species. Despite the low human density in all the three basins, some river stretches have suffered a long history of habitat loss and degradation. Furthermore, the increase in intensity and magnitude of extreme climatic events are inducing higher mortality rates in fish and mussel populations. For instances, in Sabor, Tâmega and Tua rivers there are reports of massive die-offs of mussel populations due to a succession of irregular drought and flood events. For all these reasons, several in-situ and ex-situ conservation measures developed to protect endangered native species of NE Portugal will be presented. In addition, other actions were oriented to the training and public awareness for the conservation of threatened species and habitats.

#### Acknowledgments

CONBI: Biodiversidade e Conservação de Bivalves- informação ecogeográfica, genética e fisiológica (PTDC/AAC-AMB/117688/2010).

## **S02006**

### **Biodiversity conservation in Calabria region (southern Italy): perspectives of management in the sites of the "Natura 2000" network.**

Pasquale Marziliano, Fabio Lombardi, Giuliano Menguzzato, Angelo Scuderi, Valeria Altieri, Vittoria Coletta, Claudio Marcianò  
*Mediterranean University, Reggio Calabria, Italy*

Calabria region (Southern Italy) is one of the richest areas in biodiversity across the EU, due to its geographical position surrounded by two seas (Tyrrhenian and Ionian), and characterized by a higher altitudinal gradient interesting the Apennine chain. Calabria counts 69 habitats of community importance, sensu EU Natura 2000 Directive, 20 of which could be considered priority. Since 2005, 185 marine and terrestrial Nature 2000 sites have been established, covering the 19% of the whole regional landscape. Particularly, forest habitat types are 17, with an extension of about 45000 ha, representing the 10% of the regional forest cover. These ecosystems are characterized by high levels of biodiversity, with many endemisms. Some of them are, as example, *Pinus nigra* (subsp. *Calabrica*), *Soldanella calabrella* and, as insect species, *Cucujus tulliae*. However, these areas are often not adequately managed, increasing the risk of extinction for many endangered species. A new approach based on systemic and sustainable silviculture is then required. The management policies in mountainous ecosystems should be implemented in an overall concept of mountain development, where local communities are involved as key stakeholders. The management of Nature 2000 sites can represent a fundamental challenge to achieve sustainability, supporting a multi-functional approach for the forest management in the whole region. Here we describe the main traits of the PAN Life project - Nature 2000 Action Program - aimed to develop conservation measures to reduce the loss of biodiversity, supporting the provision of forest ecosystem services in a long-term perspective. Particularly, we focused on the peculiar habitats, but also on the flora and fauna species that urgently need to be protected. Moreover, we draw attention at conservation measures that should be applied, but also to the chances of a sustainable economic development directly linked to the enhancement of biodiversity conservation.

#### Acknowledgments

PAN Life Project – Natura 2000 Action Programme.

## **S02007**

### **Birds species richness in a calabrian pine stand on Etna volcano**

Angelo Scuderj, Pasquale A. Marziliano, Giuliano Menguzzato, Valeria Altieri, Vittoria Coletta, Fabio Lombardi

*Mediterranean University of Reggio Calabria, Reggio Calabria, Italy*

Since adequate information on the distribution of biodiversity is hardly achievable, biodiversity indicators are necessary to support the sustainable forest management. These surrogates assume that either some habitat features, or the biodiversity patterns observed in a well-known taxon, can be used as a proxy of the overall diversity. However, a large gap of knowledge on how forest management and biodiversity are related still exists. This is remarkably true for most taxa, especially at fine spatial scales. Forest birds play an essential functional role in forest ecosystems and they are considered as efficient biodiversity indicators. They regulate forest trophic chains at the predation level (e.g. insects and small mammals) and are useful for seeds dispersion of many plants in Mediterranean forests. Understanding the degree to which forest structure influences the bird species distribution is an essential step for developing appropriate forest management options useful to maintain adequate levels of forest naturalness. This study highlights the relationships between bird richness and distributional pattern with forest structure complexity. The investigated area is a Calabrian pine forest located on the north-eastern side of Etna volcano (Sicily). Structural forest features were correlated with birds presence data recorded through listening point location techniques. An analysis of variance (ANOVA) was carried out to highlight relations between the structural forest features and the associated bird species. Two structural forest types were analyzed: (1) a multilayered stand originated from selection cutting on small groups and (2) a simplified monoplan stand originated from clearcutting. The results revealed that bird species richness was significantly higher in multilayered canopies, and the species replacement was lower. In the more structurally complex stand, nesting species were the 63% higher than in monoplan stand. We deduced that selective cutting in Calabrian pine stands increased structural complexity, therefore enhancing birds diversity.

## **S03O01**

### **Changes in Moroccan Mountains Livestock farming systems**

Ahmed El Aich

*Department of Animal Productions, Agronomic and Veterinary Medicine Hassan II,  
Rabat, Morocco*

A set of pastoral mountains extend from the Middle Atlas to the High Atlas Central with the abundance of forests and rangelands as the main characteristics. In the Middle Atlas the traditional system was then based on travel in groups of farmers and their herds between highland grasslands ("jbel") in summer and low lands plains ("azarhar") in winter. With colonization, the balance was significantly altered by the introduction of some colonial farms in the most favorable locations on the foothills. More recently, we saw the restriction of grazing areas under the effect of clearing, the extension of agriculture, reforestation, and in some cases the installation of private "ranches" and regional Parcs. Settling on the lowlands and the foothills expanded illegality on the altitudes ("jbel"). Settlements of herders increased the duration of the grazing pressure and induce replacements of perennial species by annuals species and a decrease in the vigour degradation of low shrubs. A trend toward a diversification and intensification of livestock systems is taking place in conjunction a switch to agriculture with high added value crops. In the high valleys of the High Atlas, the agro-pastoral systems of traditional farmers are of two integrated compartments. An intensive one built in terraces in the bottom of valley with an elaborated system of irrigation in addition to the sylvo-pastoral component on the slopes of watersheds exploited by sheep and goats principal that transfer fertility (manure) to the intensive compartment. Over the past four decades, the acceleration of use of mineral fertilizers and supplements for livestock, the ability to bring out the local cows with improved breed and the introduction of horticulture resulted in a more intensive farming.

#### Acknowledgments

LEDDRA project (EC project).

## S03002

### **Application of near-infrared transmission (NIT) spectroscopy for estimation of quinoa (*Chenopodium quinoa* Willd) proximate composition**

Christian Encina-Zelada<sup>1,3</sup>, Jorge Pereda<sup>2</sup>, Luz Gómez-Pando<sup>4</sup>, Vasco Cadavez<sup>3</sup>, Ursula Gonzales-Barron<sup>3</sup>, Martha Ibañez<sup>4</sup>, José A. Teixeira<sup>1</sup>

<sup>1</sup>Department of Biological Engineering, School of Engineering, University of Minho, Braga, Portugal, <sup>2</sup>Faculty of Food Industries, National Agricultural University, Lima, Peru, <sup>3</sup>CIMO Mountain Research Centre, School of Agriculture, Polytechnic Institute of Braganza, Bragança, Portugal, <sup>4</sup>Faculty of Agronomy, National Agricultural University, Lima, Peru

Quinoa (*Chenopodium quinoa* Willd.) is a pseudo-cereal which originated around the Titicaca Lake and is cultivated in all the Andean countries. For the past 7000 years, indigenous people have maintained, controlled, protected and preserved different quinoa's varieties, in different ecological zones in natural germplasm banks. Quinoa can be cultivated up to 4 500 m.a.s.l., still producing seeds with higher nutritive value than traditional cereals. It has been widely reported that quinoa grains possess a high nutritional value due to its optimal amino acid profile, polyunsaturated fatty acids and good antioxidant capacity. Nonetheless, most varieties of quinoa differ in morphology, phenology and chemical composition of the tissues. Hence, the main objective of this research was to develop multivariate models to estimate the chemical composition (moisture, total protein, crude fat and ashes) of quinoa by applying near infrared transmission (NIT) spectroscopy. To this effect, NIT spectra from Peruvian quinoa accessions (n=72) were obtained and pre-processed to remove spectral noise and background effects of NIT, applying spectrum filters such as Savitzky-Golay first and second derivatives (SG1 and SG2 with different polynomial degrees), moving average (MA), gap-segment (GS), standard normal variate (SNV), detrend (DT), multiplicative scatter correction (MSC), and using pair-wise combinations of those filters. Partial Least Squares (PLS) analyses allowed the extraction of an optimal number of components that minimise the root mean standard error of prediction (RMSEP). It was found that using between 8 to 16 PLS components, multivariate models yielded acceptable estimations for crude fat (RMSEP=0.445; R<sup>2</sup>=77.21%), moisture (RMSEP=0.861; R<sup>2</sup>=84.36%), total protein (RMSEP=0.565; R<sup>2</sup>=80.25%) and ash (RMSEP=0.280, R<sup>2</sup>=75.19%) contents. The pre-processing filter that led to the best estimations was the Savitzky-Golay second derivative.

#### Acknowledgments

Eng. Encina-Zelada acknowledges the financial aid provided by the Peruvian National Programme of Scholarships and Student Loans (PRONABEC) in the mode of PhD grants (N<sup>o</sup>183308).

### S03003

#### **“Dark Needle Conifer” Mortality in Southern Siberia Mountains**

Viachaslav Kharuk<sup>1</sup>, Sergey Im<sup>1</sup>, Ilya Petrov<sup>1</sup>, Alexey Golukov<sup>1</sup>

<sup>1</sup>Sukachev Forest Institute, Krasnoyarsk, Russia, <sup>2</sup>Sukachev Forest Institute, Krasnoyarsk, Russia, <sup>3</sup>Sukachev Forest Institute, Krasnoyarsk, Russia, <sup>4</sup>Sukachev Forest Institute, Krasnoyarsk, Russia

The phenomenon of “dark needle conifer” (DNC: Siberian pine, *Pinus sibirica*, and fir, *Abies sibirica*) decline and mortality within South Siberian Mountains was analyzed based on remote sensing, forest pathology and dendrochronology data. The special emphasis was devoted to Baikal Lake Region Mountains. It was found that since 1980<sup>th</sup> tree radial growth index was decreasing ( $R^2 = 0.69$ ) on the background drought increase (drought index SPEI:  $R^2 = 0.7$ ). The turning point observed in the begin of 2000<sup>th</sup> when Siberian pine and fir population were divided on the “survivors” and “decliners” cohorts. Spatial distribution of these cohorts were different: dead trees were located mainly within relief features with increased water stress risk ( steep convex slope of south-west exposure). Tree growth index was correlated with air temperature ( $r^2=0.41$ ), drought index ( $r^2=0.6...0.8$ ), vapor pressure deficit ( $r^2= 0.34$ ), and root zone wetness ( $r^2= 0.39...0.53$ ). Along current year, correlations were significant also with previous year climate variables. Water –stressed trees were affected by bark-beetles (the secondary cause of DNC mortality); the synergy of these two impacts caused Siberian pine and fir mortality. The data obtained indicated that *Pinus sibirica* *Abies sibirica* will be eliminated from the part of its areal and substitute by drought-resistant species (e.g., larch and Scot pine).

#### Acknowledgments

RSF (grant #14-24-00112) supported this research.

**S03004**

**Who gains from so-called Scientific Management of Community Forests in Nepal? A Case study from the Western Hills**

Bijendra Basnyat<sup>1,2</sup>, Thorsten Treue<sup>1</sup>, Ridish K Pokharel<sup>1</sup>

<sup>1</sup>*Institute of Forestry, Pokhara, Nepal*, <sup>2</sup>*Copenhagen University, Copenhagen, Denmark*,

<sup>3</sup>*Tribhuvan University, Kathmandu, Nepal*

Based on intensive studies of two community forests in a western hill district of Nepal, this research explores the distributive effects of so-called scientific forest management. To establish the difference between the previous conservative and the recent so-called scientific management approach, both qualitative and quantitative data collection methods were applied, including management plan content analyses, stakeholder consultations, a survey involving 101 forest users, and financial cost-benefit analyses. Results show that all stakeholders use the scientific forestry narrative to promote their vested interests. Forest users, community leaders, and timber merchants pursue material or financial benefits while forest bureaucrats have both political and economic motives. Users have become very dependent on the forest bureaucracy the representatives of which have become much more involved in the details of community forest management, especially those related to management planning and timber harvesting. The users are yet to understand the complexities of scientific forest management, particularly the associated costs. Financial analyses reveal that the benefit cost ratio is significantly higher for the original conservative forest management than for scientific forestry. Accordingly, users can hardly maintain their current low prices on timber for internal consumption and a likely consequence would be that they are forced to increase internal timber prices and/or put more of their timber on the market. Thus, forest user groups seem to have lost out both politically and financially while the forest bureaucracy has reestablished its control over otherwise decentralized forest resources. In the process consultants enjoy substantial incomes, from producing scientific management plans and timber merchants stand to benefit from the need of forest user groups to generate substantial cash incomes to finance costs of scientific forest management that they have been lured into.

**Acknowledgments**

This research was carried out under Danida financed project "Science and Power in Community Forestry (SCIFOR), of Institute of Forestry, Pokhara, University of Copenhagen, Denmark and Sokoine University of Agriculture, Tanzania and Aarhus University, Denmark.

## **S03005**

### **From Vesuvius to Portugal, soil bioengineering techniques and species to mitigate erosion processes on bare slopes in mediterranean mountains**

Carlo Bifulco, Francisco Castro Rego

*CEABN InBio Instituto Superior de Agronomia Universidade de Lisboa, Lisboa, Portugal*

Soil bioengineering (SB) techniques, developed in Central Europe, were adapted to the Mediterranean climate during seven years of projects on the Vesuvius slopes (1998-2005). In these projects the techniques applied used rooted plants instead of plant cuttings, but were installed with buried stems as applied for cuttings. To implement SB projects in Portugal with native species, we had to restart the research because the species used in the Vesuvius projects do not occur in the Portuguese flora. In this communication we present recent SB studies in Portugal, using four native species, evaluating their ecological effectiveness to recreate the dynamics of vegetation succession. Ten-year-old SB projects, located on recent slopes of the Vesuvius, were monitored to assess their geotechnical features and their vegetation dynamics. Those dynamics were compared with that of not treated nearby areas and demonstrated the ecological effectiveness of SB projects. Different species of the Portuguese flora were investigated to select the best candidates and test their use in SB projects. As in the Vesuvius works, we searched for shrub or tree species able to produce adventitious roots on buried stems. The results for the four species tested, *Fraxinus angustifolia* Vahl, *Sambucus nigra* L., *Rosmarinus officinalis* L., and *Viburnum tinus* L., indicate that they can be used to implement SB projects in large areas of Portugal. The results of these studies were already applied in a SB project of the Infraestruturas de Portugal on the slopes of Malveira junction of A21 highway, near Lisbon (2014). This application confirmed the geotechnical and ecological efficiency of SB projects. Moreover, the species of the Portugal flora tested are also found in other areas of the Western Mediterranean region and beyond, and can therefore be useful to implement SB projects in larger areas, stabilizing slopes and preventing erosion in mountain slopes.

## **S03O06**

### **The JRC Soil Erosion Map of the European Union: a critical insight on the Portuguese mountain areas**

Lúcio Rosário<sup>1,2</sup>, Tomás Figueiredo<sup>3</sup>

<sup>1</sup>*Comissão Nacional de Coordenação do Combate à Desertificação, Lisboa, Portugal,*

<sup>2</sup>*Instituto da Conservação da Natureza e das Florestas/ISBOA, Lisboa, Portugal,*

<sup>3</sup>*CIMO/ESA/IPB, Bragança, Portugal*

The Joint Research Centre (JRC) recently made available the Soil Erosion Map of the European Union, developed on the base of extensive geo-referenced data sets gathered from all European countries concerning the pertinent erosion factors (climate, soil, topography, vegetation cover and land use practices), treated with a common methodology, and applied to well-known empirical erosion models. The results of this work, gathering contributions from a large team of European experts, is a set of high resolution maps, namely of the erosion factors and the outcomes of several erosion models, one of which is the Revised Universal Soil Loss Equation (RUSLE 2015). The Portuguese Commission for Combating Desertification (CNCCD), within its international commitments to ensure national implementation of resolutions issued from this UN Convention, is engaged on nation-wide assessments of the state and trends in natural resources degradation (soil, water, biodiversity), as an essential tool to policy measures design and implementation aimed at mitigating on-going threats in susceptible areas. Therefore, the JRC Soil Erosion Map comes timely in this process and is being under analysis. Portuguese mountain areas are included to a significant extent in the most susceptible belt identified along the territory, especially north of the Tagus River but also at the lower altitude southern uplands. Also under severe erosion risk, these areas endure biophysical threats and face, as well, demographic constraints, both adding to their actual fragile condition, which require special attention and urgent integrated policy measures. This paper aims at discussing the JRC Soil Erosion Map with special focus on the Portuguese mountain areas, in its assumptions, base information and outcomes. As so, the study addresses in detail the procedural framework for carrying out a critical insight on the document (towards future adoption as reference for the Portuguese territory), actually implemented by the CNCCD.

**S03007**

**Biofilm as nutrient removal from eutrophic waters: potential applications in a mountain urban river (Ferveça River, NE Portugal)**

Ana Maria Geraledes<sup>1</sup>, Cyntya Eustáquio de Sousa<sup>2</sup>, Maria Cristina Crispim<sup>2</sup>

<sup>1</sup>*CIMO, Escola Superior Agrária do Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal, Bragança, Portugal,* <sup>2</sup>*Universidade Federal da Paraíba, Paraíba, Brazil*

Algal blooms are, generally, controlled by chemical and/or physical methods. However, these methods can be toxic and/or deleterious to biota, laborious, expensive and short-lived. The most effective control measure is reducing the amount of available nutrients in water. Biofilm is amongst the most efficient organisms in removing dissolved nutrients in aquatic ecosystems. Micro and mesocosm experiments carried out by the team tested the magnitude of nutrient uptake by biofilm using water from a lake and of a sewage plant treatment. Artificial substrates (plastic bands) were used in order to stimulate biofilm colonization. Results, for both river and sewage treatment water, revealed that similar proportion of total inorganic nitrogen and total phosphorous, 58 and 57%, respectively, was captured during the 45 days of experimentation, confirmed by the significant decrease of chlorophyll a concentration and by the increasing of water transparency in the treatments with biofilm. The Ferveça River is a mountain river, flowing for about 25 km, and discharging into Sabor River (River Douro watershed). It is subjected to high levels of disturbance: the upper section receives diffuse nutrient inputs (namely nitrogen and phosphorous) mainly generate by agricultural activities; the middle section, which flows through Bragança city, has been regulated, several pools were created and riparian vegetation was fully removed from the left bank; the lower section receives the effluent from the sewage treatment plant, inputting an additional charge of nutrients. Therefore, due to eutrophication and reduced shade, blooms of filamentous algae occur frequently, both in the middle and in the lower sections, impacting water quality, recreational and aesthetic value of the fluvial landscape. In the present communication, the applicability and the potential use of this environmental-friendly methodology, directly "in-situ" and/or in sewage plant, as a means of preventing Ferveça River eutrophication and the excessive algal growth, will be discussed.

## **S04O01**

### **Promoting sustainable use of Medicinal and Aromatic Plants for livelihood improvement and biodiversity conservation through Capacity Building training program in Himalaya mountain Swat District, Pakistan**

Hassan Sher<sup>1</sup>, Rainer W Bussmann<sup>1</sup>, Robbie Hart<sup>1</sup>

<sup>1</sup>University of Swat, Mingora, Pakistan, <sup>2</sup>Missouri Botanical Garden, St. Louis, USA,

<sup>3</sup>Missouri Botanical Garden, St. Louis, USA

Rural communities in Swat District, particularly those living in the mountain regions, use MAPs locally for medicinal purposes and for domestic food consumption. In addition, MAPs are traded in the urban markets to generate income. This paper reports on a project aimed at capacity building through awareness raising, trainings, exposure, and developing market linkages to promote the sustainable use of MAPs. The methodology of the survey focused on a series of consultation and coordination meetings with Forest Department. Additionally, Focus Group Discussion were held in each village with MAPs traders, collectors, and people of different age groups. This was followed by field surveys guided by community members. The study reported top twenty MAPs species having high market value and used in indigenous system of medicine by all ethnic groups. These species were traded through formal and informal trade network including cross-border smuggling between Pakistan and Afghanistan. The project covered a range of interventions for its sustainable use and livelihood improvement such as local awareness campaigns, capacity-building training, and community mobilization for conservation of threatened species, formation of MAPs Producer Associations who are directly linked to big buyers for maximizing their net income. Capacity building of the target population was the main intervention undertaken to achieve the overall objectives of the project. Therefore, community participation at all levels of the project was ensured to enhance their knowledge and skills on sustainable harvesting and marketing of MAPs, which represent the prime 'engines of growth' for the local economy. The project has achieved all planned targets, and although it is too early to measure the impact of these activities, it is expected that the project will serve as a strategic investment for income generation through sustainable harvesting and marketing of MAPs for rural communities in remote northern parts of Swat District.

#### Acknowledgments

Higher Education Commission of Pakistan.

## S04O02

### Inner Areas in Italy - an innovative approach for detecting mountain areas?

Thomas Streifeneder, Andrea Omizzolo, Elisa Ravazzoli  
*European Academy (EURAC), Bolzano, Italy*

In 2012, the Italian Ministry for Territorial Cohesion presented the strategy for the Inner Areas 2014-2020 to improve the quality of life and economic wellbeing of inhabitants. Since that time, it experienced an increasing critical acclaim within the scientific community and on policy level. This proves the recent ESPON call for tender on "*Inner Peripheries: national territories facing challenges of access to basic services of general interest*". Based on a comprehensive set of socioeconomic indicators, the concept of inner areas defines municipalities with demographic problems, which are distant to centres of agglomerations and services with instable development paths but characterised by high attractiveness due to resources not available in urban areas. The concept defines a) poles based on the availability of essential services and b) distances from main poles in travel times. Then, Italian municipalities were classified into six categories: *poles* (urban, inter-municipality and belt areas) and *inner areas* (periphery, ultra-periphery, inter-mediate). In Italy, not all mountain municipalities are classified as inner areas but some are classified as poles. Hence: Does the concept of Inner Areas generally render superfluous the delimitation of mountains? Does it represent a viable way to detect the socioeconomic heterogeneity of mountains in the sense of diverse levels of disadvantage? If the future support for less favoured areas like mountains is based on this concept, what does it mean for excluded mountain areas? The paper will present the concept of Inner Areas in relationship with mountain delimitations in Italy. The authors provide statistical and cartographic results based on a comparison of inner and mountain areas. The objective is to illustrate and explain the impact of the Inner Areas concept on the understanding and representation of mountain areas providing recommendations on possible synergies, future mountain delimitations and possible applications on international level.

### **S04003**

#### **«There is something rotten in the state of Norway». A critique of post WWII exclusion of locals in mountain protection policy.**

Tor Arnesen

*Eastern Norway Research Institute, Lillehammer, Norway*

Enter Norway - 58o N to 72o N. 5 % of the 385 252 km<sup>2</sup> is developed land as urban&second homes (2 %) and agriculture (3 %). 5,2 million inhabitants; 81 % in urban settings; 80 % live within 10 kilometres along a 103000 kilometres coastline; rich in marine resources. 45 % of the interior land mass is classified as mountain area, inhabited by 4,5 % of the population; (1,4 inh./km<sup>2</sup>). If dropped at some random spot in Norway, you could to walk for days alone. Do a thought experiment: What would be a reasonable expectation to protection regimes given this spatial layout? Two approaches seems reasonable: (1) A high-strung zoning protection policy to shield areas from development along the coast, and (2) a low-key protection policy in the diluted population of the interior mountainous area geared at encouraging sustainable use. Converted to familiar concepts; (1) a national park approach along the coast as this most clearly define the national responsibility and machinery of power in regulating exploitation of abundant resources in the developed regions of the nation, and (2) a biosphere reserve approach to support and empower rather diluted mountain societies in exploiting sustainably extensive resources available to community. The exact opposite was the case in post WW2 and until the turn of the century. 1/3 of the mountain area is protected in what was a high-strung national park central authority domain takeover regime, and on the coast only small patches of land is protected. Why, where are we now, and again why? The paper will present reasons and recent developments in the regimes. One conclusion will be a critique of a policy rendering mountain communities powerless and disengaged in an unnecessary assumption of power by the state, but also recent regime evolution in a more reasonable direction.

## **S04004**

### **Terras de Coura Landscape Plan**

Isabel Matias<sup>1,2</sup>

<sup>1</sup>*Leiras do Carvalho, Lda, Paredes de Coura, Portugal,* <sup>2</sup>*Centro de Estudos Arnaldo Araújo/ESAP, Porto, Portugal,* <sup>3</sup>*Valminho Florestal, Valença, Portugal*

The time has now come to announce what's going on in Landscape intervention in Portugal and also, to present the development of the Pilot-Project in Terras de Coura in course at the moment. This Project aims to accomplish all the objectives mentioned in the European Landscape Convention. Portugal recently approved the National Policy on Architecture and Landscape, acknowledging thus its social, cultural, economic, environmental and ecological value and its impact on the quality of life of its population. The process of developing this Landscape Plan, follows various known methods such as those applied in France, Spain and Italy. The aim is not only to convey knowledge about local issues, but also to perform pedagogic activities with the population so as to provide a better understanding and implementation of the projects and actions in the future. In the Paredes de Coura mountain region, we identified 9 Landscape Sub-Units, some of them considered transitional. The process will lead to the development of a Programme of Actions for the implementation of corrective measures and/or guidelines for the intervention in the landscape. Since Landscape is a natural resource of natural and cultural values which expresses the population relations with the land, it is considered as a decisive factor for the localization of certain activities such as tourism and recreational activities. The project seeks also to involve the local municipalities and the active participation of the population. For this reason, the landscape quality is appreciated also as an economic resource very significant to the region, implying employment and thus competing for a locally integrated process of development. The uniqueness of Coura's Landscape and the need to maintain its identity as well as the collective memory of the community, stand as another reason which motivated us for this project.

#### Acknowledgments

Município de Paredes de Coura; Pascal de Moura Pereira, Leiras do Carvalho, Lda:  
Paula Pires Mendes, Leiras do Carvalho, Lda; Luís Alberto Brandão, Valminho Florestal

## **S04005**

### **Mountain Environment: policies for the protection on Brazil and Peru**

Luis Felipe Cesar

*Universidade Federal Rural do Rio de Janeiro, Rio de Janeiro, Brazil*

Generally speaking, mountains are defined as large natural ground elevations, with altitude of 300 meters, with steep slopes, deep successive valleys, peaks and high ridges. The world's total surface of mountains is approximately 40 millions square kilometers, which is equivalent to 27% of the surface of the Earth. Chapter 13 of the Global Agenda for Sustainable Development (Agenda 21) recognizes the importance of fragile mountain ecosystems as "essential for the survival of the global ecosystem", and acknowledges them as "source of water, energy, biodiversity, minerals, forest and agricultural products and recreation". Mountain ecosystems are peculiar in various aspects. This thesis highlights some of them, such as agriculture, tourism, biodiversity, protected areas, health and governance through a comparison of public policies, especially from Brazil and Peru. Despite the extent of its mountainous area, Brazil has not yet joined the global effort to protect mountains. Although the Brazilian State has undertaken conservative actions in mountain areas, particularly through the creation of protected zones such as the protected areas, it neither considers nor organizes these initiatives as a governmental policy for these ecosystems. In 2011, the National Commission for Biodiversity approved the National Program of Researches and Conservation in Mountain Ecosystems, an initiative that signaled the beginning of a national policy. However, the program was never published and carried out. By contrast, the Peruvian environmental legislation devotes Article 100 of Ley General del Ambiente, of 15 October 2005, to mountain ecosystems. A survey conducted in December 2013 obtained 96.7% of favorable responses to the development of a national policy for the protection of mountain ecosystems in Brazil. It also signal the need of a specific legislation in Brazil, and proposes a bill draft of a National Policy for Mountain Ecosystems.

**S04006**

**Culture heritage management and local development in a South Sámi and Norse mountain borderland**

Terje Skjeggedal<sup>1</sup>, Kjell Overvåg<sup>2</sup>

<sup>1</sup>*Norwegian University of Science and Technology, Trondheim, Norway,* <sup>2</sup>*Eastern Norway Research Institute, Lillehammer, Norway*

The presentation discusses how South Sámi and Norse culture history through municipal planning and management may contribute to local development in the very sparsely populated mountain communities in South Eastern Norway. The area represents the southern part of the South Sámi district in Mid Scandinavia. The planning and management activities performed by the municipalities are crucial for local development in these areas. These activities take place within a complex context of management regimes involving also regional and national levels. Our discussion require knowledge from three different fields; cultural heritage, municipal planning and management and local development. These fields have in common that they to a certain extent are social constructed. Thus, a discourse analytical approach gives an appropriate and common theoretical frame. We find that the organization of culture heritage management is extremely fragmented, both concerning responsibilities, activities and localization. Norse and Sámi culture heritage is separated between the County and the Sámi Parliament, and the municipalities have no formal responsibilities. This fragmentation crumbles and marginalizes the culture heritage management in general and especially the Sámi culture management. The authorized culture heritage discourse concentrated to objects and preservation dominates. The discourse of attractiveness by winning the competition for migrants has got a hegemonic position both in municipal and county planning. Further, none of the plans presents or discusses more fundamental conflicts. The discourse of consensus dominates. This contributes to neutralize the conflicts and make them invisible and not legitimate. We will argue that local economic development based on cultural heritage first of all can be a supplement to other basic industries. Then the focus in planning and management should change from the competitive attractiveness approach towards using cultural heritage to strengthen the inhabitant's knowledge, identity and "sense of place", in a local community development approach.

**Acknowledgments**

The Research Council of Norway.

**S04O07**

**Mountain cultural heritage in Montenegro: A Case study of *katuns* at the Kuči Mountain and Durmitor area**

Tatjana Koprivica<sup>1</sup>, Aleksandra Kapetanovic<sup>2</sup>, Ivan Lakovic<sup>1</sup>

<sup>1</sup>*University of Montenegro, Historical Institute, Podgorica, Montenegro,* <sup>2</sup>*NGO Expeditio, Kotor, Montenegro*

Montenegro has large hilly and mountainous areas with distinctive relief and only small areas of lowland. The country is intersected by deep and narrow river valleys and mountain chains. Such geography and climate conditions have created high diversity in landscape, in biodiversity, in agriculture, and in areas of high natural value farmlands. The study covers the *katuns* in the area of Kuči Mountains and Durmitor area (on the list of World Cultural and Natural Heritage). This areas preserves very rich and multi-layered historical-cultural heritage. It is visible in housing architecture, customs and customary law's code, traditional poetry, anecdotes, *katuns*' internal organization and many other aspects. The *katuns* are temporary settlements in mountainous regions where the agricultural households stay with livestock during the summer season, most frequently for 4 to 5 months (from the end of May until October). The main purpose is to use mountain pastures for rearing of farm animals for producing traditional milk and meat products, which is the main source of income for these households. In terms of buildings, the *katuns*' settlements include different types of wooden or stone structures - cottages for household members, mainly without electricity and water, where traditional production of cheese and other dairy products is still going on. In the period May-December 2015, all *katuns*, sites and objects of cultural-historical importance in research area were visited, photographed and mapped. There were taken the data on their condition, population number, purpose and current state of existing objects. Every *katuns* is geotagged and placed in QGIS database. The *katuns* are a unique social-cultural resource of Montenegro that should be preserved and revitalised via implementing new activities to enable them to become distinctive and attractive tourism destinations.

**Acknowledgments**

Project Valorising the Montenegrin Katuns through sustainable development of agriculture and tourism-KATUN (2015-2017) supported by HERIC program, World Bank.

## **Sy02001**

### **Valuing protected mountain landscape in the Sacred Himalayas: visitors perspective**

Kamal Thapa

*Environmental Friendly Local Governance Programme (EFLGP), Besishahar  
Municipality, Lamjung, Nepal*

Nepal is a mountainous (Himalayan) country with 83% of its territory in mountain region. Southern part flatland (also known as Terai) covered rest of the country. Some of the beautiful and spectacular iconic landscapes and biodiversity rich areas are protected by the establishment of different category of protected areas and governed by several acts, rules, regulations and guidelines. Protected areas in Nepal covers 23.23% of its total area that varies from Himalayas to the lowland Terai. While Terai protected areas shares 16.85% of total protected area coverage, mountain parks and protected areas share 83.15%. Some of these protected areas are the destination of nature based tourism. In order to explore the value of protected mountain landscape in Nepal, survey among (international) tourist visiting Langtang National Park, (Nepal) was carried out in 2013 and 2014. Contingent Valuation method was applied to explore the tourists' value for Langtang National Park in the form of Willingness to Pay (WTP) for park visit. Result revealed that 77.5% of the total respondents (N=476) replied WTP question. Average WTP for park visit is USD 57.50 which reflects the average value of protected mountain landscape among international tourist per visit.

#### Acknowledgments

WWF Russell E. Train Education for Nature Programme and The Rufford Foundation.

## **Sy02002**

### **Assessing social values for ecosystem services in two mountain landscapes in the Romanian Carpathians**

Sorina Mihaela Bogdan<sup>1</sup>, Irina Iulia Nastase<sup>1</sup>, Ileana Patru - Stupariu<sup>1,2</sup>, Andreea Andra - Toparceanu<sup>1</sup>

<sup>1</sup>*University of Bucharest, Faculty of Geography, Bucharest, Romania,* <sup>2</sup>*University of Bucharest Research Institute, Bucharest, Romania*

Mountain ecosystems provide a vast range of ecosystem services which have been increasingly studied and assessed mostly from a biophysical perspective. However, there is still little information about how stakeholders value non-material ecosystem services and benefits, information that can prove useful in decision-making and planning processes. Thus, our study aims to find out what is the spatial distribution of social values for ecosystem services perceived by stakeholders, and how do social values correlate with landscape characteristics. Our analysis focuses on two case studies representing highly forested mountain areas with very different touristic development and management backgrounds. For this purpose, we followed two main objectives: i) quantifying and mapping these perceived social values for ecosystem services; ii) analyzing the relationship between social values and landscape characteristics. In order to achieve these objectives we used both social data (perceived social values for ecosystem services) and landscape data (land use/cover, distance to roads/trails, distance to water bodies, topography). To gather the social data we applied an in-situ questionnaire that also included a participatory mapping exercise. For the analysis of this data we used the SolVES 3.0 tool, developed by the USGS, to obtain both spatial results (Value Index maps for each social value) as well as numerical results (average nearest neighbor statistics to determine the clustering of points for each social value) and graphic results (graphs that show how landscape characteristics relate to social values). Our results show the presence of hotspots where multiple social values are clustered, for both case studies. We also found some correlation between perceived social values and landscape features, especially the ones providing accessibility such as roads and trails. These results can be useful for the planning of new touristic investments and also for the protection of highly valued areas that overlap with fragile ecological systems.

### **Sy02003**

#### **Mountain landscape adding value to mountain products: a case study of Guaramiranga coffee - Brazil**

Mônica Amorim<sup>1</sup>, Renato Linhares de Assis<sup>2</sup>, Adriana Maria de Aquino<sup>2</sup>

<sup>1</sup>*Universidade Federal do Ceará, Fortaleza (CE), Brazil,* <sup>2</sup>*Embrapa Agrobiologia - Núcleo de Pesquisa e Treinamento para Agricultores (NPTA), Nova Friburgo (RJ), Brazil*

Mountain landscape has always inspired humanity. Overtime, different civilizations have considered mountain a unique site from which they could get inspiration, strength and superior status. In modern times, mountains are celebrated indistinctively by countries, regardless of their level of development. Mountain regions are a source of life: they concentrate water resources, fertile soils, rich vegetation and other elements of biodiversity. Their natural condition, such as altitude and humidity creates a especial climate and environment that stimulate a number of activities, such as tourism, sports, art creation and leisure, among others. Appreciation of mountain landscape may be extended to mountain products, especially those following sustainable production processes, preserving local culture, knowledge and identity. The notion of landscape is not restricted to aesthetic aspects or scenic views, but rather it involves a human perception of the site, including its smell, sounds, touch and imagination. Landscape, thus, is also influenced by culture and by the way humans interact with the place, for example, what they produce and which process they use. This research focuses on Guaramiranga mountain region, located in the state of Ceará, Northeast Brazil. Methodology applied followed qualitative approach, including landscape observation and interpretation, interviews with local stakeholders, review of historical documents, and development policies/ initiatives. The conclusion points out that mountain products emerge as a distinct category of products, apart from the standard ones lacking a well-defined geographical base. This product differentiation enhances value added of mountain products, a character that may be the basis for an innovative development strategy in mountain regions. In Guaramiranga, local coffee grown at high altitude and under the forest shadows enables unique smell and flavor to the beverage, all of these favoring higher value added. Drinking Guaramiranga coffee is more than a tasting experience, as it resembles the mountain landscape and culture.

## Sy02004

### Landscape dynamics in the eastern mountains of Galicia: anthropic intervention

Ignacio J. Diaz-Maroto<sup>1</sup>, Olga Vizoso-Arribe<sup>2</sup>, Maria C. Diaz-Maroto<sup>3</sup>

<sup>1</sup>University of Santiago de Compostela, Lugo, Spain, <sup>2</sup>University of Santiago de Compostela, Lugo, Spain, <sup>3</sup>University of Castilla-La Mancha, Ciudad Real, Spain

The landscape dynamics of the eastern Galician mountains (Lugo and Ourense provinces, northwest of the Iberian Peninsula) is mainly the result of the human intervention during several centuries. In this paper we have studied the evolution and changes - environmental, socioeconomic and historical changes - in this area. The aim of our work is the proposing of a set of actuaciones for conservation and recovery landscape of these territories. The study focused on the progression of the natural hardwood forests, generally *Quercus* forests, intensively exploited since ancestral times. These forests were converted to agricultural land, felled for the naval, metallurgical and railway industries, joined with Church belongings, suffered forest fires, and were replaced by fast growing species, mainly coniferous and, today *Eucalyptus nitens* Shining Gum. All of these activities have led to a reduction in the occupied area by them. Nowadays, broadleaved forests cover small and generally rugged sites, remaining where the characteristics often avoid other land use type. These forests can be found in flat areas close to villages, but the natural regeneration is limited by human activities. Results indicate that these steep sites have a highly modified landscape, with a slow transformation where the biodiversity conservation, the hunting phenomenon and the cultural or environmental tourism have a high importance. Therefore, their current situation raises the problem of their socioeconomic transformation. On a positive view, the studied area covered by forests has increased recently, and presents a better awareness about their conservation and to the recognition of interest habitats by the European Union, as part of the Nature 2000 Network.

## **Sy02005**

### **Mapping Land Cover from spaceborne imagery in mountain environment: the impact of image spatial resolution and classification algorithms**

Sami Ullah<sup>1,4</sup>, Muhammad Shafique<sup>2</sup>, Muhammad Farooq<sup>3</sup>, Matthias Dees<sup>1</sup>

<sup>1</sup>*Chair of Remote Sensing and Landscape Information System, University of Freiburg, Freiburg, Baden Württemberg, Germany,* <sup>2</sup>*National Center of Excellence in Geology, University of Peshawar, Peshawar, KPK, Pakistan,* <sup>3</sup>*Pakistan Space and Upper atmospheric Research Commission (SUPARCO), Peshawar, KPK, Pakistan,* <sup>4</sup>*Department of Forestry, Shaheed Benazir Bhutto University, Sheringal, Dir Upper, Pakistan*

Satellite images of various resolutions and different image classification techniques are utilized to map Land Cover (LC). Mapping capabilities and achievable accuracies of LC classification in mountain environment are, however, influenced by image spatial resolution and classification techniques. Hence, developing and characterizing regionally optimized methods are essential for the planning and monitoring of natural resources. In this study, we evaluated and compared the potential of four image classification techniques i.e. k-nearest neighbor (kNN), support vector machine (SVM), random forest (RF) and neural network (NN) on the accuracy of LC classification in the Hindu Kush mountains ranges of Northern Pakistan. Moreover, we also tested the potential of SPOT-5 (2.5 m) versus Landsat-8 (30 m) in order to assess the impact of image spatial resolution on the achievable accuracy of LC classification. For the classification of LC based on SPOT-5 multispectral data, we achieved highest overall accuracy (OCA) = 89 % with kappa coefficient (KC = 0.86) using SVM followed by KNN, RF and NN. However, for LC classification derived from Landsat-8 multispectral data, we achieved highest OCA = 0.71 with KC = 0.59 using RF and SVM followed by KNN and NN. The OCA = 0.71 and KC = 0.59 derived from SPOT-5 versus OCA = 0.71 and KC = 0.59 achieved from Landsat-8 indicated that the results of LC classification based on SPOT-5 are more accurate and reliable than Landsat-8. The findings of the present study will be useful for the classification and mapping of LC in mountain environment based on SPOT-5 and Landsat-8 at local and regional scale studies.

#### **Acknowledgments**

University of Freiburg, University of Peshawar, Pakistan Space and Upper atmospheric Research Commission (SUPARCO) and Shaheed Benazir Bhutto University, Sheringal Dir Upper.

## **Sy02006**

### **Forest certification with broadleaved timber in NW of Spain: is it possible?**

Pablo Vila-Lameiro, Adriana Conde-Fernandez  
*University of Santiago de Compostela, Lugo, Spain*

Local governments and public institutions around the world realize that sustainability in procurement is a key responsibility and an important element in forward-looking policies and activities. It's an integral part of the role of the public sector to contribute to the aspirations of their constituency and to meet their needs within the limits of our planet. Aware of the importance of promoting sustainable forest management, national and local governments around the world have made sustainable timber procurement a key requirement of public purchasing. Many have put in place regulatory frameworks and legislation to this effect. Additionally, many have legislation in place to tackle illegal logging and help prevent illegally harvested wood or timber from unsustainable sources entering the market. The different certification systems are accepted by public procurement policies globally as providing evidence for sustainability and legality. Either managed system for forest certification includes common requirements. In this work it's analyzed the problems and current solutions to allow timber certification with autoctonous species with several administrative difficulties to be cut.

#### Acknowledgments

University of Santiago de Compostela; Irish Distillers Ltd - Pernod Ricard Co.

## **Sy02007**

### **Spatial dynamics and land use changes in Serra da Estrela Natural Park: management impacts**

Catarina Fonseca<sup>1,2</sup>, Teresa Santos<sup>1</sup>, Margarida Pereira<sup>1</sup>, Helena Calado<sup>2</sup>

<sup>1</sup>*CICS.NOVA, Interdisciplinary Center of Social Sciences, Faculty of Social Sciences and Humanities, University Nova de Lisboa, Lisbon, Portugal,* <sup>2</sup>*CIBIO - Research Center in Biodiversity and Genetic Resources /InBIO - Associate Laboratory, University of Porto, Ponta Delgada, Portugal*

The intrinsic dynamic of ecosystems and increasingly biophysical, social and economic changes pose tremendous challenges to the management of protected areas. Adaptive management is advocated as the most suited process to deal with the complexity and uncertainty of social-ecological systems. This is an iterative process of decision-making, adjustable as changes occur and their effects are felt and understood. One of the key elements of such process is the detection of significant changes in the territory. The analysis of land use changes is assumed as a good starting point to identify and understand relevant spatial dynamics. Mountain areas have specific characteristics and pressures, entailing particular challenges. Their unique nature makes them prime targets for the classification of protected areas. Serra da Estrela Natural Park (part of the mountain massif) was created in 1976 and is the largest (89 thousand hectares) protected area in Portugal, encompassing a relevant natural, geological and cultural heritage. Human occupation is significant and activities such as farming, grazing and agroforestry have contributed to shape the landscape. In fact, rural development is an important dimension for the management of the Natural Park, which should enhance traditional economic activities compatible with the safeguard of natural values. The analysis of land use change for the period 1990-2007 (using official land use land cover maps) shows the loss of 35% of the agricultural area and almost 50% of the forest area, and the increase of herbaceous/shrub cover and bare land. This may be explained by agricultural abandonment and repeated fires, well-known phenomena in mountain areas. Such alterations are also examined taking into account the protected area's spatial plan and its zoning, allowing the identification of measures to improve the management of the area.

#### Acknowledgments

FCT - Fundação para a Ciência e Tecnologia through: PhD grant no. SFRH/BD/104387/2014 for the first author; Project UID/SOC/04647/2013; Project PEst-C/BIA/UI0609/2013.

## **Sy04001**

### **The World Heritage: nature conservation and the safeguarding of intangible culture**

Amélia Frazão-Moreira<sup>1,2</sup>

<sup>1</sup>*Faculdade Ciências Sociais e Humanas, Universidade Nova de Lisboa, Lisboa, Portugal,*

<sup>2</sup>*Centro em Rede de Investigação em Antropologia (CRIA), Lisboa, Portugal*

The "world heritage": monuments, objects, natural sites, knowledge ... local legacies that the humanity must safeguard? The UNESCO Conventions (Convention of the Cultural and Natural World Heritage - 1972; Convention for the Safeguarding of the Intangible Cultural Heritage - 2003) lead to the debate of key subjects as the tenuous distinction between natural and cultural heritage and the transformation of local heritage in universal and commodified values. Focusing on the conceptual and historical configurations of endanger and safeguard, this presentation discusses the political appropriations of traditional ecological knowledge concept and the interconnections between preservation of biological and cultural diversity.

## **Sy04002**

### **Dynamic ecological knowledge systems amid changing place and climate: Mt. Yulong rhododendrons**

Robbie Hart, Jan Salick

*Missouri Botanical Garden, St. Louis, MO, USA*

In an era of rapid environmental change, how can the generative and conservative processes of Traditional Ecological Knowledge (TEK) allow adaptation and biocultural conservation? We address these questions with an in-depth study on Mt. Yulong, NW Yunnan, China, focusing on TEK of the biologically and culturally salient mountain genus *Rhododendron* among the indigenous Naxi and immigrant Nuosu Yi ethnicities. In both cultures, we found *Rhododendron* TEK to be rich and intimately connected to the progression of *Rhododendron* flowering over seasonal and elevational gradients. Naxi and Yi knowledges of both trends and drivers of change in this biological system were parallel to insights from ecological studies. Knowledge richness was connected with place (urban vs. rural dwelling and elevation of village), and the immigrant Yi had a knowledge base as rich as that of the indigenous Naxi. Both Yi and Naxi interviewees credited this knowledge equality to a combination of generative processes (Yi villages were higher in elevation and Yi livelihoods made more use of mountain resources, which enabled them to acquire knowledge of plants quickly), and conservative processes (Yi migrated from an equally diverse mountain region in which *Rhododendron* is also salient; its position was retained their system of TEK though its elements were adapted). Among rural Naxi, cultural systems (seasonal festivals and ethnotaxonomy) conserved knowledge, even while their direct use of rhododendrons decreased with changing livelihoods.

#### Acknowledgments

This research was supported by the “Biodiversity Conservation and Sustainable Development in Southwest China” NSF IGERT grant #0549369, the Whitney R. Harris World Ecology Center, the Explorers Club, and the Anne S. Chatham Fellowship in Medicinal Botany of the Garden Club of America. The research would not be possible without the tireless effort of Naxi and Yi field assistants and the patient and generous contributions of time and knowledge from interviewees.

## Sy04003

### **Traditional knowledge in the Caucasus - changing knowledge patterns in Georgia after the end of soviet occupation.**

Rainer W Bussmann<sup>1,2</sup>, Narel Y Paniagua Zambrana<sup>1,2</sup>, Shalva Sikharulidze<sup>3</sup>, Ketevan Batsatsashvili<sup>3</sup>, Zaal Kikvidze<sup>3</sup>, David Kikodze<sup>3</sup>, Dato Chelidze<sup>3</sup>, Robert Hart<sup>1</sup>  
<sup>1</sup>Missouri Botanical Garden, Saint Louis, MO, USA, <sup>2</sup>Herbario Nacional de Bolivia, La Paz, Bolivia, <sup>3</sup>Ilia State University, Tbilisi, Georgia

The territory of modern-day Georgia has been continuously inhabited since the early Stone Age, and agriculture was developed during the early Neolithic era. In Georgian the name of the country is "Sakartvelo", and "Georgia" is semantically linked to Greek (γεωργία) meaning "agriculture". Due to its long tradition, agriculture in Georgia is characterized by a great diversity of landraces, and endemic species of crops. These show a high level of adaptation to local climatic conditions and often-high disease resistance. Fieldwork was conducted in Khevsureti, Khevi, Samtskhe-Javakheti, Tusheti, Svaneti, and Racha in July-August 2013, July-August 2014, and September-October 2015. Interviews using semi-structured questionnaires were conducted with over 175 participants after obtaining their oral prior informed consent. Our research indicates that while traditional crops like wheat, barley and rye have almost disappeared, a large number of species is traditionally also grown in home gardens, and a large part of the wild flora is used for food, medicine and cultural purposes. However, the related traditional knowledge is mainly held in the generation above 50, while younger people have started to lose traditional knowledge. No gender differences in knowledge could be observed. Overall, home gardens serve mostly as source for food, while wild plants are especially important for medicine, and traditional pickles and jams. The main reason for genetic erosion of ancient crop varieties is the demographic decline in mountain regions due to harsh economic conditions and lack of modern infrastructure. The shift from ancient cultivars to modern high-yielding crops such as maize and potato, began in mountain villages after the end of Soviet occupation, when local inhabitants who had been forced to the lowlands, returned to their original villages.

#### Acknowledgments

William L. Brown Center endowment.

## **Sy04004**

### **Square Peg in Round Hole: Agriculture Development Strategy in Nepal**

Krishna Prasad Paudel<sup>1</sup>, Teeka Bhattarai<sup>2</sup>, Sujata Tamang<sup>3</sup>

<sup>1</sup>*ForestAction, Nepal, Kathmandu, Nepal*, <sup>2</sup>*Fastenofper, Kathmandu, Nepal*, <sup>3</sup>*University of New South Wales, Sydney, Australia*

The mountains harbor highly fragmented and topographically diverse landscape, making it difficult to adopt high input, mechanized, large scale agriculture. Increasingly the agriculture in mountains is witnessing it's downfall across the globe. Local food system, farmers' income and stability of ecosystems are threatened. Farmers are under pressure to adapt their system of cultivation faster to cope with changing climate. Finely tuned to micro-climates, Nepal's mountain agro-systems have thrived for thousands of years sustaining bio-diversity and recycling of resources to an optimum. Augmented with the changes in lifestyle and driven by quick-return high external input, policies that are generally devised at state level without adequate consideration to specific agro-ecological conditions is the crux of the problem. Arid Karnali region is one of the victims of such a drive. This paper illustrates how such regions have been ignored in the process of policy formulation taking the country's latest Agriculture Development Strategy (2015-2035) in reference. It is observed that largely the Strategy is not informed by evidences from the ground. Though the Strategy sought for a radical change in agricultural sector recognizing multiplicity of complex institutions, substantial infrastructure, mechanization, flow of external resource for productivity, the Strategy paid little attention to livelihood strategies and food security in the mountains. the proposed high external-input agriculture approach does offer neither dietary needs of local the population nor it promotes crops that have relative advantage over 'main stream crops'. The Adaptive Agro-ecological Approach that fits best to social, cultural and ecological systems of farming populations could be the viable and sustainable solutions in addressing the changing climate and food insecurity in future for both - the region and the country at large. It recommends the formulation of policies in such a manner that allows and encourages different agro-ecological regions to formulate strategies of their own.

**Sy04005**

**Territory, Identity and Belonging: the process of pomeranian repossession in environments mountain in Santa Maria de Jetibá - Brazil**

Ricardo Linhares de Assis<sup>1</sup>, Renato Linhares de Assis<sup>2</sup>

<sup>1</sup>*Secretaria de Fazenda do Estado do Espírito Santo, Vitória, ES, Brazil,* <sup>2</sup>*Embrapa Agrobiologia - Núcleo de Pesquisa e Treinamento para Agricultores (NPTA), Nova Friburgo, RJ, Brazil*

This work aims to expose some analysis about the relationship between identity, territory and belonging in the repossession process of Pomeranians immigrants and their descendants who settled in mountain environments of Santa Maria de Jetibá region, on the state of Espírito Santo - Brazil, in the mid-nineteenth century. The search for a new territorial space, which often can be accompanied by trauma and suffering, also allows a reunion of identity roots, with a geographical relocation defined by an identity-territory relationship as individual belonging or collective. Marked by a memory built from the oral and symbolic tradition, the complexity of this process of uprooting and restructuring in new places and cultures led to the emergence of new relations between themselves and other groups, encouraging the re-creation of a pomeranian ethos supported in a process of repossession in the mountains of the state of Espírito Santo. In which method is feasible based on the initial isolation in the mountainous area in question, associated with the peasant universe sustained from the collective memory inherited through several generations

## **Sy04006**

### **Dynamics of indigenous medicinal plants and medicines in Farwestern Nepal**

Ripu Mardhan Kunwar<sup>1,5</sup>, Sudan Uprety<sup>1</sup>, Aron Evans<sup>1</sup>, Abdul Sahim Ansari<sup>5</sup>, Ashok Ram<sup>2,5</sup>, Janardan Mainali<sup>3</sup>, Bhagwat Rimal<sup>5</sup>, Rainer W Bussmann<sup>4</sup>

<sup>1</sup>Florida Atlantic University, Boca Raton, FL, USA, <sup>2</sup>Api Nampa Conservation Area, Kathmandu, Nepal, <sup>3</sup>University of North Carolina Wilmington, US, Wilmington, NC, USA, <sup>4</sup>William L Brown Center, Missouri Botanical Garden, St Louis, USA, <sup>5</sup>GPO Box 19225, Kathmandu, Nepal

By 2100, the impacts of land use change on biodiversity at global scale are likely to be more significant than climate change and invasive species introductions. All these changes along with socio-economic and cultural transformations shaped the indigenous systems to adjust the new circumstances. The interest of this study was to assess the relative effects of changes on climate and land use on dynamics of medicinal plants utilization and indigenous medicines. We used Remote Sensing data to assess land use change, Normalized Difference Vegetation Index (NDVI) and Leaf Area Index (LAI) to estimate the condition of the districts' forests and vegetation, and interviews and discussion with local people to evaluate the forces affecting the condition of medicinal plants and indigenous medicines in three districts of Farwestern Nepal. We found that the LAI and NDVI are insignificantly reduced in the last decade, and it could partly be due to the less influence of climate variables and more influence of vegetation and socio-cultural variables. The reduction of LAI and NDVI and change in land use were more intense in high altitude area forests. However, the forests are valued as socio-culturally integral as collection grounds for medicinal plants, as grazing lands for cattle and as sacred sites for ritual and cultural persistence.

#### Acknowledgments

Rufford Foundation UK; Graduate Research Inquiry Program (GRIP), FAU, USA; WLBC, MBG, USA; Practical Solution Consultancy, Nepal.

## **Sy04007**

### **Traditional ecological knowledge and conservation of biocultural heritage: facing the challenge**

Ana Maria Carvalho

*Mountain Research Centre, Scholl of Agriculture, Polytechnic Institute of Braganca, Braganca, Portugal*

Mountains areas have particular physiography and a long history of human occupation enabling certain species and habitats to remain relatively unchanging and providing unique landscapes. Safeguarding natural features has been a key reason for creating protected areas such as some of the most important Portuguese natural parks. It's been more than thirty years since the creation of these parks and there are some visible positive effects on nature conservation. However, population ageing and the abandonment of many activities, particularly those related with agriculture and traditional farming systems, are facts influencing local knowledge transmission and the systems of plant-use, having some adverse impact on agro ecosystems biodiversity and cultural landscapes, for whose conservation the parks were created. IUCN (2008) considers that protected areas should support biodiversity conservation, while also contributing to people's livelihood and providing the long term conservation of nature with associated ecosystem services and cultural values. Biocultural heritage sustains landscapes, wild gene pools, wild foods and medicines, and essential ecosystem services (e.g. soil, water, carbon sequestration) that support people and agriculture. It includes biological resources, as well as, long standing traditions, practices and knowledge. Understanding complex knowledge systems and their ongoing interaction is crucial for improving useful knowledge, skills and innovations for resilient farming, for food and health security and for adapting to drivers of change. Biocultural approaches to conservation can achieve effective outcomes, recognizing, respecting and combining multiple knowledge systems into conservation planning. Using examples from the Montesinho Natural Park (PNM) and the Douro International Natural Park (PNDI), this presentation discusses that addressing erosion of both cultural and biological diversity requires the development of a conceptual framework for assessing trends affecting traditional knowledge and responses to several issues, e.g. promoting communication between stakeholders, designing tools, providing adequate policies.

#### Acknowledgments

Cultivos yerbas i saberes: Biodiversidade, sustentabilidade e dinâmicas em Terras de Miranda (2009-2013). ON2-QREN-FEDER, NORTE-09-0230-FEDER-000064 e Fundo EDP Biodiversidade; Etnobotânica do Nordeste Português: saberes, plantas e usos (2004-2009). POCI/ANT/59395/2004//PPCDT/ANT/59395/2004.

## **Sy05001**

### **A task force on forest adaptation and restoration – concept and pathways**

Andreas Bolte

*Thünen Institut of Forest Ecosystems, Eberswalde, Germany*

In the face of climate and global change forest adaptation and restoration is a key issue for securing forest integrity, vitality and productivity. A new task force within the framework of the International Union of Forest Research Organisations (IUFRO) is dedicated to globally compile and improve knowledge of how to achieve an optimal adaptation status of forest and forests landscapes. We are introducing the Adaptive Measure (AM) approach by (1) considering all actions that increase adaptive capacity of forests and forest land, (2) combining Adaptive Forest Management (AFM) concepts on stand-scale with Forest Landscape Restoration (FLR) concepts on landscape scale, (3) linking national and trans-national policies, as well as trans-disciplinary expertise in various fields, and (4) integrating experts and working activities among various IUFRO sections. The TF conceptual pathway is following three aims: identifying knowledge gaps, comparing existing activities and techniques, and elaborating best practice approaches. Our approach includes four main elements: (1) retrospective knowledge (gap) analyses, (2) collaborative compilation and analyses using existing data and research infrastructures, (3) conception and implementation of collaborative monitoring and research activities, and (4) summarizing best practice approaches for different environments and socio-economic requirements. In a first step, we synthesize knowledge and identify information gaps on biophysical and genetic adaptive traits of forest trees on species and sub-species level as well as on adaptive measures (AM) . This shall include regions that are rarely found high up on the international forest research agenda (for example, Central Asia and South America). Secondly, we will perform a meta-analyses on continental AM concepts under global change using existing and evolving knowledge. A special emphasis will be put on mountain forests due to their important role for forest adaptation and forest landscape restoration on the global scale.

#### Acknowledgments

International Union of Forest Research Organisations (IUFRO).

**Sy05002**

**Governance and restoration**

Stephanie Mansourian<sup>1,2</sup>

<sup>1</sup>*mansourian.org, Gingins, Switzerland*, <sup>2</sup>*University of Geneva, Geneva, Switzerland*,

<sup>3</sup>*IUFRO, Vienna, Austria*

Governance has an impact on the outcomes of restoration as it determines the interactions among actors and ultimately the efficiency with which any restoration actions will be performed. It considers power relations among stakeholders and decision-making processes. Furthermore, in the context of mountains, the linkages between upstream and downstream users and institutions are also particularly interesting to consider when seeking to restore parts of the landscape. The aim of this paper is to introduce the importance of governance in restoration, particularly in large scales.

## Sy05003

### **Impacts of forest governance regimes on Afromontane forest conditions and resilience to climate change on Mt. Elgon, East Africa**

Aaron Russell<sup>1,2</sup>, Daniel Waiswa<sup>3</sup>, Benjamin Owuor<sup>4</sup>, Paul Ongugo<sup>4</sup>, Allan Bomuhangi<sup>3</sup>, Abwoli Banana<sup>3</sup>, James Kimondo<sup>4</sup>

<sup>1</sup>*Independent, Leuven, Belgium,* <sup>2</sup>*Center for International Forestry Research, Bogor, Indonesia,* <sup>3</sup>*Makerere University, Kampala, Uganda,* <sup>4</sup>*Kenya Forestry Research Institute, Nairobi, Kenya*

Mount Elgon is a trans-boundary East African ecosystem that harbors unique biological diversity and provides critical services to surrounding communities. As a key water tower, the effectiveness of forest and land-management policies directly impacts on agriculture, hydro-power, fisheries and other sectors across large watersheds in Uganda and Kenya. Hosting some of the highest human population densities in the region, Ugandan and Kenyan authorities have developed different exclusionary and participatory forest governance approaches to enforce respective conservation mandates. The future resilience of forest assemblages will be challenged as climate change interacts with societal interventions to challenge trophic phonological linkages, enable introductions exotic species, expansion of diseases and increase exposure to extreme climate events. This study assesses the impact of forest governance regimes on forest structure and composition over time (1997-2014) in two study sites in Uganda (Kapkwai and Bufuma) and Kenya (Chorlem and Kimothon). Each forest unit was monitored 3-4 times during 1997-2013 using the International Forestry Resources and Institutions (IFRI) methodology at 30 randomly established sample plots. Data was collected on seedlings (counts), saplings and shrubs (diameter at breast height (DBH) and height), and trees (DBH and height), and forest uses/disturbances to calculate trends forest structure (density, basal area) and composition (dominant species, species richness, Shannon-Wiener species diversity). In comparing outcomes between participatory forest management and centralized forest management areas in Uganda vs Kenya, results defy dogmatic generalizations as outcomes in the two countries differed. This study highlights the fragility of some improvements in forest resilience as recent declines in forest cover highlight the need for continued improvements in community engagement to address both internal socio-economic and urban/private sector driven deterioration of Mt.Elgon's forests. This study also highlights the need for greater integration of rural development (climate change adaptation) and conservation (climate change mitigation) policies.

#### Acknowledgments

International Forest Resources and Institutions Network (IFRI), Makerere University and the Kenya Forestry Research Institute (KEFRI); AdaptEA project team and supporting staff at the Center for International Forestry Research (CIFOR), Makerere University, Kenya Forestry Research Institute (KEFRI), and WorldAgroforestry Center (ICRAF); Rockefeller Foundation for funding the AdaptEA project (Grant: 2011 CRD 306); Complementary funding was received from AusAID (63560) and UNITAR (G.EGP.2011.03), CIFOR, and the CGIAR Collaborative Research Program on Forests, Trees and Agroforestry.

## **Sy05004**

### **Adaptive management of a forest close to the alpine timberline**

Nathalia Jandl<sup>1</sup>, Robert Jandl<sup>2</sup>, Andreas Schindlbacher<sup>2</sup>

<sup>1</sup>University Vienna, Vienna, Austria, <sup>2</sup>Austrian Forest Research Center, Vienna, Austria

Climate change will increase the productivity of mountain forests in the Alps. We took a high-elevation protection forest dominated by Cembran pine (*Pinus cembra*) in Obergurgl, Austria, as test case in order to evaluate the economical options for forest management. Our scenarios included climate change, different intensities of timber extraction, the timber market, and the availability of government subsidies for harvesting operations. We simulated the standing timber stock and the soil carbon pool. The growth rate of forests will increase by approximately 15%. Biotic and abiotic disturbances are expected to play a minor role at the chosen site. Under a zero-management scenario the forest accrues carbon dioxide both in the aboveground biomass and in the soil. Even under an extensive management strategy with moderate timber extractions every 50 years the carbon stocks are declining. A more intensive management scenario with timber extractions every 30 years leads to substantial losses of the soil carbon pool and changes the stand structure, so that the protective function of the forest is not ensured. Under the consideration of high timber prices, as presently recorded, and the availability of governmental subsidies the production of stone pine can be economically successful, whereas European larch (*Larix decidua*) contributes only marginally. A practical constraint is the delivery of timber to the road. Best-practice for the management of protection forest allows the extraction of only small timber volumes in order to maintain a desired stand structure. For economic reasons, long-distance cableway logging systems require a minimum quantity of extracted timber per installation that exceeds the recommended harvesting intensity. Therefore, the intensification of forest management cannot be recommended from the perspective of sustainability and protection against natural hazards. Leaving the forest unmanaged does not impose a particular threat to stand stability and is under the encountered situation a reasonable strategy.

## **Sy05005**

### **Parallel disasters: wars and biodiversity loss in mountain areas**

Bartolomeo Schirone<sup>1</sup>, Iman Al-Hirsh<sup>1</sup>, Nisreen Al-Qaddi<sup>1</sup>, Corrado Battisti<sup>2</sup>, Federico Vessella<sup>1</sup>, Tatiana Marras<sup>1</sup>, Maria Raffaella Ortolani<sup>1</sup>

<sup>1</sup>*Dipartimento di Scienze Agrarie e Forestali (DAFNE), Università della Tuscia, Viterbo, Italy,* <sup>2</sup>*'Torre Flavia' LTER (Long Term Ecological Research), Roma, Italy*

It is widely accepted that the Mediterranean Basin is a prominent hotspot of biodiversity hosting a significant richness of plant lineages and fauna. Projected trends in the context of global change suggest this area will cope with strong increases in temperature and decreases in precipitation with consequent effects on forests and ecosystem services. Upward shifts of species range and/or mass extinction are expected to occur at broad scale, especially in the Mediterranean. Here, mountain ecosystems would undergo the most severe reduction and fragmentation events. Further human based impacts aggravate the effects of the global warming. Among them, wars and civil disorders seriously affect mountain landscapes, marking them across time. Presently, many theaters of war occur in the Mediterranean and they mainly interest mountain areas at high level of biodiversity. Those scenarios are furtherly overlapped to the global warming, thus exposing many species to a concrete risk of extinction. Here we summarize the most important disorders mangling the southern Mediterranean countries and the Middle East. One study case would be the Palestine and the negative feedbacks from local conflicts on the natural heritage, firstly the floristic one. Coupling the most advance forecasting methods about climate change and the actual vegetation cover or land use, coexisting factors, pressures and threaten species are investigated. Proposals and management plans to conserve biodiversity are therefore exposed. It is undoubted that every scientific recommendation will be inefficient and unreliable if no political solution will be taken to stabilize and pacify that area.

**Sy05006**

**Mountain forest management under global change: insights from model-based studies for Switzerland**

Harald Bugmann, Nicolas Bircher, Maxime Cailleret  
*Forest Ecology ETHZ, Zurich, Switzerland*

There are controversial views whether (1) current management for "multi-functional" forests in the Swiss Alps is climate-adaptive already, and (2) whether any (further) adaptation of forest management is needed to warrant the provision of the wide range of ecosystem services that are demanded by human societies from mountain forests. To disentangle the various aspects that are buried in this controversy, we are using the dynamic forest model ForClim to assess the likely impacts of climate change on forest dynamics in the absence of management (as a baseline), under an assumed continuation of current "best-practice" management (which does not necessarily coincide with the actual management taking place on the ground), and under a management regime that was developed jointly with stakeholders (i.e., what they perceive to be feasible adaptation measures). Simulation results provide a range of key insights. First, the impacts of climate change vary regionally (e.g., within a mountain region) quite considerably because of the vastly different current climatic conditions, inducing different sensitivity to climate change. Second, some areas will profit from a changing climate (particularly high elevations), whereas others will suffer (mostly at low elevations because of higher drought occurrence). Current management practices do not normally lead to disastrous deterioration of ecosystem service provision, but adaptations of management practices often are beneficial and should be considered in detail.

**Sy05007**

**Management and restoration of Italian afforestations under global change**

Orazio la Marca<sup>1</sup>, Roberto Mercurio<sup>2</sup>, Leonardo Nocentini<sup>2</sup>

<sup>1</sup>*Scuola di Agraria Università, Firenze, Italy,* <sup>2</sup>*SIRF, Viterbo, Italy*

In Italy, as a consequence of the past deforestations, degraded areas were reforested mainly with conifers (*Pinus nigra* s.l. and with *Pinus pinaster*, *Pinus halepensis*, *Pinus pinea*) since the beginning of the XXI century for soil protection and floods prevention. In the same time some forest exotic species, as Douglas fir, after ninety years of experimentation, showed very good results in terms of ecological adaptability and high growth rate in the selected sites of the Apennine. Nowadays, lack of silvicultural treatments, ageing processes, insects and fungi outbreaks lead to an unsteady biological equilibrium in many of pines afforestations. Add to this the effects of climate change as wind storms and dryness. The restoration of pines afforestations into more resilient stands is one of the main aims of the Italian forest policy and the priority of the researches was addressed to the more fragile stands. Three options are highlighted: 1) changing the conifers (rehabilitation with native broadleaves) in the case of very degraded stands and with the need to start up local wood energy chains, 2) conserving the conifer stands, where are prevailing cultural, esthetic and recreational functions, 3) fostering the mixed stands, with the conifers of the old cycle and native broadleaves, more resilient to the extreme events. As regards Douglas fir stands new silvicultural models has been developed to combine high growth rate with mechanical stability.

Acknowledgments

University of Firenze.

## **Sy05008**

### **Response of rare and endangered species *Picea omorika* to climate change - the need for speed**

Vladan Ivetic

*University of Belgrade - Faculty of Forestry, Belgrade, Serbia*

Serbian spruce (*Picea omorika* (Pančić) Purk.) is a rare and endangered tertiary relict and endemic species, with restrictive natural range in Serbia and Bosnia and Herzegovina. Natural distribution is fragmented and limited to four locations, mainly around the mid-course of the river Drina. The natural range constantly decline since the middle of the 19th century, followed by decline of extent of occurrence and number of mature individuals. Decline is slow and attributed to poor regeneration and lack of competitive ability. However, facing climate change this decline will accelerate. In recent years dieback related to drought stress is observed as response to extreme weather events. Due to reproduction characteristics and limited natural range with small and fragmented populations (total of app. 10,000 individuals), Serbian spruce will face difficulties to keep the pace with climate change. In addition to genetic researches, successful use of Serbian spruce in Central and Northern Europe indicate the broad adaptation potential and wide genetic variation, despite narrow morphological variation, self-fertilization, and limited range - but also indicate possible directions of migration. In this paper, possible scenarios are discussed and a number of strategies are offered as response to climate change challenge. Natural migration and adaptation are the least likely scenarios, indicating assisted migration in species rescue form as appropriate strategy for Serbian spruce. Current conservation programs, limited to in-situ actions, need to be supplemented with ex-situ actions and strategies. At the worst case scenario, the most appropriate sites should be found and colonized in order to prevent Serbian spruce expiration in the following decades.

**Sy05009**

**Response of beech and oak forests to global change related stresses in Alps and Appennines**

Donato Chiatante<sup>1</sup>, Antonio Montagnoli<sup>1</sup>, Mattia Terzaghi<sup>1</sup>, Gabriella Stefania Scippa<sup>2</sup>  
<sup>1</sup>University of Insubria, Varese, Italy, <sup>2</sup>University of Molise, Pesche (IS), Italy

In mountainous forestlands, the shallow soil represents a not renewable resource and that explains why erosion is of special concern. Rainfall intensity increase due to global change increments soil erosion particularly on mountainous sites. It is known that vegetation cover plays an essential role in limiting soil particles movements. This study focuses on a beech and oak forest situated in the Alps and Appennines. In recent years this forest has been interested by management operations which aim to convert this forest from coppice to high stand structure. The purpose of this study is to understand if the conversion operations affect soil erosion. Our results show that these operations modify considerably the stand structure by changing quantitatively and qualitatively tree traits such as stems and branches with the consequence of altering also the canopy architecture of the stand. Furthermore, also the root component in below-ground compartment results to be affected with a modification of fine root turnover. These modifications are responsible for an increase in the amount of soil erosion observed in stands immediately after the end of these management operations but a mitigation of this event is observable with the time while the high stand structure is under formation. The amount of soil eroded seems to be independent from the run-off rate. The overall message emerging from these data indicates that when programming any type of forest operations in stands characterized by erosion prone conditions their effect upon the soil stability should be taken in close consideration. Furthermore, despite the present study refers to coppice forests the indication emerges that similar events could take place in mountainous areas independently from the type of forest considered. Therefore any restoration and/or adaptation measures should be evaluated for effect upon erosion.

**Acknowledgments**

This work was supported in part by grants from the MIUR (PRIN 2008 n. 223), the University of Insubria (FAR) and the EC FP7 Project ZEPHYR-308313.

## **Sy06001**

### **Soil organic carbon stocks under banana plantation and forest in mountain areas, southeastern Brazil**

Joyce Monteiro, [Aline Oliveira](#), Mauricio Coelho, Wenceslau Teixeira, Rachel Prado  
*Embrapa Solos, Rio de Janeiro, Brazil*

Banana (*Musa* spp.) plantation in the mountain areas is an important economic activity in the municipality of Cachoeiras de Macacu, Rio de Janeiro state, Brazil. This study reports the initial results of monitoring of the soil organic carbon stocks (SOCS), as a soil quality indicator of an area at the Faraó Community under banana plantation in agroforestry system (AFS) and a neighboring area of remaining forest (reference). The monitoring was held on a family-based farm that receives support from a government program called Rio-rural. This program aims contribute to sustainable development in rural areas. In a slope dominated by Dystric Cambisols in each of the areas, nine small pits were sampled - three in each third of the slope (hillslope, middleslope, and footslope), at five depths (up to one meter deep). The SOCS were 40.5 Mg ha<sup>-1</sup> at 0-30 cm and 79.3 Mg ha<sup>-1</sup> at 0-100 cm deep in the AFS area and 45.5 Mg ha<sup>-1</sup> at 0-30 cm and 104.2 Mg ha<sup>-1</sup> at 0-100 cm deep in the forest area. The SOCS do not differ significantly between the AFS and the forest up to 30 cm, indicating that the AFS has good maintenance of the SOCS potential, probably due to the following integrated factors: (1) the characteristics inherited from the organic matter in the surface horizon of the native vegetation that concentrates stable organic compounds; and (2) agricultural practices of banana plantation, which causes little soil disturbance and leaves the crop remains in the field. On the other hand, the SOCS of the different uses up to 100 cm is significantly different ( $p = 0.05$ ), indicating that in depths between 30 cm and 100 cm, the forest stocks more organic carbon in relation to agroforestry, probably due to the greater efficiency of the forest's root system to accumulate carbon.

#### Acknowledgments

Programa Rio-rural - SEAPEC/ Governo do estado do Rio de Janeiro.

## Sy06002

### **Farmers' perceptions – Influence on sustainable regional development approaches in Alpine biosphere reserves**

Adelheid Humer-Gruber<sup>1,2</sup>

<sup>1</sup>*Interdisciplinary Mountain Research, Innsbruck, Austria,* <sup>2</sup>*University of Innsbruck, Innsbruck, Austria*

Structural changes in agriculture are beginning to be felt even in remote mountain regions. The specific cultural landscapes, with their mosaic of various uses, remain in relatively good ecological condition. Generally agriculture fulfils a high variety of essential functions in rural areas. As managers of the land, Alpine farmers play an important role in the maintenance of the Alpine landscape, nature conservation, high quality food production and sustainable rural development. Biosphere reserves serve as model regions for sustainable regional development. In the selected Alpine biosphere reserves the conservation of cultural landscapes plays a major role, therefore farmers feature in many essential functions the biosphere reserves. Integrating local traditional knowledge on ecosystem management and mitigating natural hazards are of highest interest. What affects the farmers' willingness to participate in the development of biosphere reserves and how does it change over time? How can their point of view improve sustainable development approaches? The farmers' point of view on issues of agriculture, cultural landscape, nature conservation, biosphere reserves and knowledge transfer is explored. Qualitative interviews with forty farmers in the Biosphere Reserve *Salzburger Lungau und Kärntner Nockberge (AT)*, *Biosfera Val Müstair (CH)* and *Biosphäre Entlebuch (CH)* have been conducted. Adapted snowball sampling has been applied to record the diversity of farmers in this area, working intensive or extensive with conventional, integrated or organic farming systems on their property. The interviews are evaluated along a coding system, which evolved according to the *grounded theory approach*, and typologies are extracted. The identified typologies are compared in different biosphere reserves in Austria and Switzerland, considering the periods of existence. This research should help to identify, strengthen or complete approaches for sustainable regional development in conservation sites in the Alps.

#### Acknowledgments

University of Innsbruck - Scholarship for PhD students; Previous project funded by MaB-Austria and MaB-Switzerland (Man and Biosphere).

### **Sy06003**

#### **Raising the local cattle breed Mirandesa in Trás-os-Montes mountain areas: traditional versus new production management systems**

Sílvia Nobre

*CIMO/IPB, Bragança, Portugal*

The cattle breed Mirandesa has its origin from the region of Trás-os-Montes more specifically, in the Cold Mountain lands and in the Mirandês Plateau. These two geographical areas have conditioned two agricultural systems which integrate the Mirandesa breed bovines, mainly due to weather conditions. The first is characterised by heavier rainfall (over 800/1000 mm), where permanent irrigated pastures predominate. In the Mirandês Plateau, where the rainfall is lower (under 600/800mm), non-irrigated meadows are more frequent. In previous studies two cattle management systems in these mountain areas were identified. One, the traditional, is associated mainly to older farmers, with small herds, on which the cows feed mainly on natural pastures. Cows are conducted daily to the pastures and spend the night in traditional cowsheds located around the farmers' houses. Calves remain all day in the calf sheds until weaning. The other management system of the Mirandesa cows is extensive management. This is used by younger farmers who raise bovine herds of greater size and chose to use extensive management, maintaining the animals always on the field. In any of the mentioned management systems the objective of the farmers is the sale of calves at weaning, at the approximate age of 7 months, when the meat can be marketed as PDO (Protected Designation of Origin). The animal feeding comprises natural pastures which are complemented with various forage crops. This communication intends to highlight and discuss the major constraints of these two systems from a technical, social and economic point of view. Will also be shown the solutions found in order to overcome these constraints that have permitted the maintenance of this production clearly typical of these mountain areas.

## Sy06004

### **Production of winter green manure in mountain region in the state of Rio de Janeiro, Brazil.**

Tayana Scheiffer, Adriana de Aquino, Renato Linhares, José Guilherme Guerra, David Castor  
*EMBRAPA, SEROPÉDICA, Brazil*

The state of Rio de Janeiro is a major producer of vegetables in Brazil, especially in the mountainous region. The productive areas are mostly small family production units using technologies such as synthetic fertilizers and pesticides. Heavy rains in January 2011 resulted in losses in agricultural areas due to floods, landslides, lixiviation of fertilizers and soil erosion. To reverse or prevent frames degradation, unsustainable production and economic uncertainty, agroecological practices can be adopted. An example is to use green manures as cover, resulting in protection, reducing erosion and gradual building of soil quality, increasing organic matter and biological activity. This study aimed to evaluate the productivity of Gramineae and leguminoseae, mixed and single, used as winter's green manure, in the mountainous region of Rio de Janeiro. The experiment was established in the city of Nova Friburgo, with delineation of four randomized blocks. The treatments were compost of Black oats, *Lupinus albus*, Consortium (70% B, 30% L) and weeds. The plants were planted in plots of 33,6m<sup>2</sup>. At 120 days after planting, the dry mass and nutrient content of shoots and roots were evaluated. The shoot Productivity of *Lupinus albus*, consortium and weeds was similar (5t/ha), and similar to those seen in other studies for Lupine white. On the other hand the Oat-black was smaller than the other treatments (2,1t/ha) and other studies. For roots, there were no differences between treatments (0,6t/ha). Despite the low productivity observed for oat in this experiment, other studies have found that this plant has increased productivity and potential for the region. Here, good performance can be observed and confirm the potential of the *Lupinus albus* for the region, and especially the consortium performance that combines different features and benefits from two groups of plants traditionally used as green manure, grasses and legumes.

## **Sy06005**

### **Growing stevia in Northeastern of Portugal: effect of N rate and cutting regime**

Sandra Afonso, Margarida Arrobas, Isabel Q. Ferreira, Manuel Ângelo Rodrigues  
*Polytechnic Institute of Bragança, Bragança, Portugal*

*Stevia rebaudiana* (Bertoni) is a perennial herb native from South America. It is characterized by a high content of steviol glycosides in its leaves representing an interesting no-calorie sweetener. Since December 2011 has increased interest in this species in Europe after steviol glycosides have been authorized as food additives. In this work, the adaptation of stevia to the growing conditions of NE Portugal was assessed, as well as the potential to produce biomass when grown as an annual crop and subjected to various N rates (0 to 150 kg N ha<sup>-1</sup>) and two cutting regimes (single and double cut). Most plants died during the winter (minimum temperatures peaked at -8.0 °C at 10 cm aboveground), being necessary to replant the crop next spring. In the double cut regime and the higher N rate 1514.4 and 2390.0 kg/ha of dry leaves and 4748.5 and 5215 kg ha<sup>-1</sup> of total dry matter were respectively produced in 2014 and 2015. Based on the leaf N concentrations recorded from these experiments, preliminary sufficiency ranges of 25 to 35 g kg<sup>-1</sup> for mid-summer and 15 to 25 g kg<sup>-1</sup> for early autumn are proposed.

**Sy06006**

**Building and institutionalizing Participatory Guarantee Systems (PGS) in Rio de Janeiro State, Brazil: beyond the organic guarantee**

Ana Paula Siqueira<sup>1</sup>, Maria Fernanda Fonseca<sup>2</sup>, Eiser Felipe<sup>3</sup>

<sup>1</sup>UFRRJ/PPGCTIA, Seropédica/RJ, Brazil, <sup>2</sup>PESAGRO, Nova Friburgo/RJ, Brazil,

<sup>3</sup>UFRRJ/PPGAO, Seropédica/RJ, Brazil

The principles of agroecology and organic agriculture provide adequate food production and population nutrition, as well as the management of natural hazards and the empowerment of mountain communities. The institutionalization of organic agriculture in Brazil has been built since the 70s, gaining strength from the 90s of last century, through social and political networking techniques, incorporating technological innovation with social focus. In the twenty-first century (2003-2009) the regulation of organic production considered the various forms of evaluation of organic conformity assessment existing in the country, not just third-party system (certification). Participatory Guarantee Systems (PGS) and Social Control Organizations (SCO) are the assurance mechanisms of most of the organic farmers, family farming or not, in Rio de Janeiro (Brazil). They consider social criteria (information sharing, collaborative participation, producers/consumers articulation, short circuits and marketing - street market and public procurements) as important or more than the industrial-commercial conventions (laboratory analyzes, focus on records, long marketing channels) institutionalized in regulations of organic agriculture in the world. PGS offer a locally-based system of organic quality assurance, with emphasis on social control and knowledge building. This work presents the scenario of social technology construction and application in the PGS groups of ABIO (Biological Farmers Association of Rio de Janeiro State), focusing in mountains region of the state, strategies (social movement, agroecological theories and practices), perspectives and challenges. The results show the growth in the number of organic producers (around 200% since 2010), participatory research methodologies, technical assistance and training in agroecology, strengthening actor networks. The construction of adequate policies to the different realities, although time-consuming, contributes to sustainable development and mitigation of natural hazards. The challenges are: incorporate innovations to assist in the records and traceability of organic products; bring producers and consumers, scientists and technical workers together, in favor of organic quality assurance.

**Acknowledgments**

Programa Rio Rural, ABIO, Pesagro-Rio, CAPES.

**Sy06007**

**Assessing the soil fertility and the tree nutritional status of chestnut groves grown in the region of Bragança, Northeastern of Portugal**

Margarida Arrobas<sup>1</sup>, Sandra Afonso<sup>1</sup>, Isabel Q. Ferreira<sup>1</sup>, Eje Röndahl<sup>2</sup>, Manuel Ângelo Rodrigues<sup>1</sup>

<sup>1</sup>*Polytechnic Institute of Bragança, Bragança, Portugal,* <sup>2</sup>*Lillebaelt Academy of Professional Higher Education, Lillebaelt, Denmark*

In the NE of Portugal there is a growing interest in the chestnut tree crop which has led the producers to intensify the cropping system, namely by increasing the use of fertilizers. However, few studies exist on the adaptation of the chestnut trees to soil conditions as well as their response to fertilizer application. The soil testing and plant analysis laboratory of the Polytechnic Institute of Bragança initiated a project aimed to assess the soil fertility of the chestnut groves and the tree nutritional status in order to be able to better advise the producers in their annual fertilization programs. Soil (217) and leaf (84) samples were collected in three counties of NE Portugal (Bragança, Vinhais and Macedo de Cavaleiros). The results show high acidity in soils [pH<4.5 (4%), 4.51< pH<5.5 (68%), 5.51< pH< 6.5 (27%)]. The organic matter content was lower than 3% in 79% of soil samples. More than 50% of soil samples presented P contents classified as very low (25%) or low (32%). Most of the samples revealed K contents classified as high (58%) or very high (29%). Leaf nutrient concentrations varied in the ranges of 14.8-27.8 (N), 0.8-3.1 (P), 2.6-15.9 (K), 2.4-17.0 (Ca), 0.8-4.4 (Mg) g kg<sup>-1</sup> and 10-215 (B) mg kg<sup>-1</sup>. However, in spite of the great variability in leaf concentration of each one of the nutrients analyzed, no significant relationships were found between soil properties and the concentration of the nutrients in the leaves. The organic matter content was not correlated with leaf N concentration. The same occurred between extractable soil P and K and the concentration of these nutrients in the leaves. The best linear relationship was found between soil pH and leaf Mg concentration. The results also stressed that little information on tree nutritional status can be drawn from soil testing.

**Sy06008**

**Alternative models of territorial occupation and its contribution to endogenous development in Mountain systems**

Nádia Aun, Renato Assis  
*UFRRJ, Seropédica, Rio de Janeiro, Brazil*

This paper aims to comprehend how alternative models of territorial occupation concerning the agriculture production can contribute to endogenous development in mountain systems. In Brazil, this kind of alternative occupation is mainly sited in mountain systems. We believe there are two reasons for that. Firstly, the landscapes consist of an intangible value that lead to the aforementioned occupations, whether for agriculture production or for the 'new rural population' movement between rural/urban areas. Secondly, we can also consider as facts the climate change and the advance of conventional and commodity agriculture production towards flat and mechanized lands. This research was undertaken in association with agricultures from the Associação Agroecológica de Teresópolis - AAT, which are located at Teresópolis, a municipality in the highland area of Rio de Janeiro state. For our methodological approach, we used the concept of 'Rural Web', as a way to integrate theories that enfold the study of 'webs'. Such approach helped us understand the interconnections between each member of the group, as well as between aspects of the endogenous development. It was also possible to perceive the significant diversity amongst the actors and how important this characteristic is to the success of the Association. This heterogeneity ensures the possibility of building an articulated group in permanent interaction with the dimensions proposed by the 'Rural Web' methodology. Although the differences of 'types' and abilities, there is one concern, a common strength, that has brought them together as a group: the preoccupation with the landscape and the necessity to ensure the sustainability of their production systems, which, according to some of the interviewed agricultures, means guaranteeing the livelihood for themselves and their environment by producing their own food (or most of it) and trading the surplus within fair prices, fulfilling their social role in society.

Acknowledgments

Capex and Embrapa.

**Sy06009**

**Cover crops for the Mediterranean rainfed fruticulture**

Manuel Ângelo Rodrigues<sup>1</sup>, Sandra Afonso<sup>1</sup>, Isabel Q. Ferreira<sup>1</sup>, Eje Röndahl<sup>2</sup>,  
Margarida Arrobas<sup>1</sup>

<sup>1</sup>*Polytechnic Institute of Bragança, B, Portugal,* <sup>2</sup>*Lillebaelt Academy of Professional  
Higher Education, Lillebaelt, Denmark*

Cover cropping is the most desirable method of ground management in fruticulture. However, in drought prone regions, such as in the Mediterranean basin, the introduction of cover crops in the orchards should be done with caution due to competition for water. The olive orchards are a paradoxical example. In spite of the increase in the irrigated areas, most of the olive orchards are rainfed managed, particularly in slopping lands with less access to water and irrigation infrastructures. In this work, a summary of four year of research on cover cropping with self-reseeding annual legumes is presented. The groundcover percentage and the persistence of the seeded species, their ability to produce biomass and to fix nitrogen from the atmosphere and the effect of the covers on the tree nitrogen nutritional status and olive yields were assessed. The results showed good soil coverage with living vegetation during the winter and a mulch of dead material during the summer. The seeded species dominated the cover during the four years of experience. The dry matter yield (average of four growing seasons) ranged between 3 and 6 t/ha/year and the nitrogen fixed in the above-ground biomass between 50 and 115 kg/ha/year depending on the length of the growing cycle. The lowest and highest values were respectively recorded for *Trifolium subterraneum* cv. Nungarin and *Trifolium incarnatum* cv. Contea. The early-maturing cultivars produced less biomass and fixed less nitrogen than midseason cultivars. A cover consisting of a mixture of early and midseason species and cultivars of annual legumes produced an effect on the nitrogen nutritional status and olive yield higher than the application of 60 kg N/ha/year.

## **Sy08001**

### **Polyphenols: old products for new ingredients**

Celestino Santos-Buelga

*University of Salamanca, Salamanca, Spain*

Polyphenols are one of the largest group of plant secondary metabolites that are also widely present in plant-derived foods, i.e., vegetables, cereals, fruits and derived products like wine, juices, chocolate or tea, in which they contribute to sensory, technological and health-promoting properties. A variety of biological activities have been ascribed to plant polyphenols, including antioxidant, anti-inflammatory, estrogenic, antimicrobial, antiproliferative or antitumor abilities, and their consumption through diet has been related with a lower risk of some chronic diseases, such as cardiovascular disease, type II diabetes, different types of cancers or neurodegenerative disorders like Alzheimer's and Parkinson's. Furthermore, when added to foods, polyphenols may help to maintain nutritional quality and extend the shelf-life of products, owing to their antioxidant and antimicrobial properties. Processing of plant foods give rise to substantial amounts of residues, such as pulps, peels, seeds or leaves that can still be exploited for the extraction of bioactive polyphenols, in view to their use for the production of food additives or nutraceuticals. In this presentation, particular focus will be put in two types of by-products characteristic of the Iberian Peninsula, namely grape pomaces resulting from the winemaking process and wastes generated during olive oil production. These by-products are quite good sources of different classes of polyphenols, such as flavonoids (flavanols, flavonols or anthocyanins), phenolic acids and simple phenolics derivatives or secoiridoids, with potential interest in food, pharmaceutical and cosmetic industries.

#### Acknowledgments

Financial support is received from the Spanish MINECO through the project AGL2015-64522-C2-2-R.

## Sy08002

### **ValorNatural®: a Project and a Platform**

Isabel C.F.R. Ferreira<sup>1</sup>, Maria Filomena Barreiro<sup>2</sup>, Luís S. Pais<sup>2</sup>

<sup>1</sup>*Mountain Research Centre (CIMO), Polytechnic Institute of Bragança, Bragança, Portugal,* <sup>2</sup>*Laboratory of Separation and Reaction Engineering (LSRE), Associate Laboratory LSRE/LCM, Polytechnic Institute of Bragança, Bragança, Portugal*

The use of synthetic additives (preservatives and colourants), in the food and cosmetic industries, is a current major concern, from both the human health and environmental points of view. Although considered a promising safer alternative, the use of natural additives still faces some drawbacks and limitations. A specific problem is the difficulty to find abundant natural sources, preferably based on sustainable cultivation, and adequate green and environmental friendly extraction technologies. Additionally, huge volumes of residues from the forestry and food industries, currently considered as low-value by-products, are underexploited in applications such as energy production and/or as compost. This context is emphasized also by an increasing consumer' awareness and interest in "chemopreventive nutrition", being highly receptive to functional foods with specific health-promoting components (nutraceuticals). The challenge to full exploit the potential of these high added value ingredients derived from natural sources, including mountain matrices, requires the development of integrated multidisciplinary solutions that will consider issues from cultivation to extraction, separation and stabilization processes. All the implemented strategies must be supported by reliable and expedite chemical and biological analysis and methodologies for final products validation. Furthermore, the economy of mountain regions, typically with high levels of diversity in natural matrices (e.g., mushrooms and plants), will strongly benefit from the development of new products based on natural ingredients. Herein, it will be presented ValorNatural®, which is a project aiming at developing and demonstrating extraction and separation methodologies, suitable to be scalable for industrial use, for the production of functional ingredients (preserving, flavouring, colouring and bio-active agents) for the food and cosmetic industries, from sustainable natural sources. Case studies developed by the research group will be discussed. Furthermore, a platform to support companies working in this field, under development in the Brigantia EcoPark (The Science and Technology Park of Bragança), will be also presented.

## Sy08003

### **Microencapsulation of bioactives: from nature to products**

Maria-Filomena Barreiro<sup>1</sup>, Isabel C.F.R. Ferreira<sup>2</sup>

<sup>1</sup>*Laboratory of Separation and Reaction Engineering - Laboratory of Catalysis and Materials (LSRE-LCM), Bragança, Portugal,* <sup>2</sup>*Mountain Research Centre (CIMO), Bragança, Portugal*

In a general way, to potentiate marketable products based on natural bioactives, research should be oriented towards product development with possibilities for industrial applications by choosing appropriate technologies, processing conditions, materials and strategies. As so, to go from “nature to products” several steps need to be followed: (i) selection of viable plant sources; (ii) selection and application of appropriate extraction techniques; (iii) application of stabilization/encapsulation techniques; and (iv) proof of concept, preferably with real matrices. Even though the existing knowledge concerning the identification and characterization of natural sources of bioactives, application of these compounds into food/cosmetic matrices still present important challenges that urge to be solved. In fact, bioactive compounds are generally recognized as presenting problems of instability, either during storage and processing stages or upon application, which weakens their bioavailability and potential benefits. Moreover, they can present unpleasant taste and odor. Microencapsulation is a technique that allows bioactive compounds/extracts to be incorporated into a matrix or coating shell in the form of particles with diameters ranging from 1 to 1000 micrometers. These microparticles can release their contents along with time by means of different release mechanisms, which are dependent from the used encapsulation materials, productive process, final morphology and application. Microencapsulation can thus provide a tool to protect natural bioactives against the action of atmospheric agents such as light, moisture and heat, ensuring stability increase and bioavailability control. Moreover it can be used to provide a controlled and target release. This work intends to give an overview of the cooperative and interdisciplinary work developed between BioChemCore (<http://esa.ipb.pt/biochemcore/>) and LSRE/IPB (<http://lsre.fe.up.pt/>) research groups, in the field of bioactives microencapsulation. Thus, microencapsulation techniques will be discussed by presenting a set of case studies focusing process development and product validation though incorporation of microencapsulated bioactives into food/cosmetic matrices.

#### Acknowledgments

FCT (Portugal) for financial support to CIMO (PEst-OE/AGUI0690/2014); FCT/MEC and FEDER under Programme PT2020 for financial support to LSRE (Project UID/EQU/50020/2013).

## **Sy08004**

### **Development of a natural colouring agent based on betacyanins from plant origin**

Custódio Lobo Roriz<sup>1,2</sup>, Lillian Barros<sup>1,3</sup>, Miguel A. Prieto Lage<sup>1,4</sup>, Ana Maria Carvalho<sup>1</sup>, Patricia Morales<sup>2</sup>, Maria Filomena Barreiro<sup>3</sup>, Isabel C.F.R. Ferreira<sup>1</sup>

<sup>1</sup>*Mountain Research Centre (CIMO), ESA, Polytechnic Institute of Bragança, Bragança, Portugal,* <sup>2</sup>*Dpto. Nutrición y Bromatología II. Facultad de Farmacia. Universidad Complutense de Madrid (UCM), Madrid, Spain,* <sup>3</sup>*Laboratory of Separation and Reaction Engineering - Laboratory of Catalysis and Materials (LSRE-LCM), Polytechnic Institute of Bragança, Bragança, Portugal,* <sup>4</sup>*Nutrition and Bromatology Group, Faculty of Food Science and Technology, University of Vigo, Ourense, Spain*

A current worldwide trend of research is the search for alternative natural sources of colorants to avoid the unsafe effects caused by the synthetic counterparts. Betacyanins, which are betalain pigments displaying a red-violet colour, have been reported to be three fold stronger than the yellow-orange dye produced by anthocyanins. Although being less commonly used than anthocyanins and carotenoids, betacyanin applications cover a wide range of matrices, where they are mainly used as additives or supplements in the food, cosmetics, pharmaceuticals and livestock feed industries. Betacyanins are obtained mainly from the red beet, *Beta vulgaris* L. (between 10 to 20 mg per 100 g of fresh pulp), but alternative primary sources are needed. The floral parts of *Gomphrena globosa* L. represent a potential source of betacyanins. In this context, the present study aims to evaluate: 1) a process for the selection and separation of pigmented floral bracts and bracteoles (~4 % of the dried plant material); 2) the identification of the major betacyanin compounds (gomphrenin II and III, and isogomphrenin II and III); 3) the most appropriate extraction procedures (from maceration, microwave and ultrasound assisted techniques) together with the optimal conditions that maximize betacyanin extraction (time, temperature, solid-liquid ratio and ethanol-water ratio); and 4) shelf life and colour stability of the obtained natural agent. The responses were assessed by the quantification of betacyanins by high-performance liquid chromatography coupled with a photodiode array detector and mass spectrometry with electron spray ionization. In addition, results clarified some contradictory trends described in the literature concerning the time and temperature variables, finding a considerable improvement on the betacyanins yield (higher than that typically found for *Beta vulgaris*), without displaying any type of degradation patterns.

#### Acknowledgments

FCT for financial support to CIMO, LSRE and L. Barros (BPD/107855/2015); Xunta de Galicia for financial support to M.A. Prieto.

## Sy08005

### **Development of a natural preservative based on catechin and derivatives from plant origin.**

Bianca Albuquerque<sup>1,2</sup>, Miguel Angel Prieto<sup>3</sup>, Celeide Pereira<sup>2</sup>, Lillian Barros<sup>1,4</sup>, Isabel C.F.R. Ferreira<sup>5</sup>

<sup>1</sup>*Centro de Investigação de Montanha (CIMO), ESA, Instituto Politécnico de Bragança, Bragança, Portugal,* <sup>2</sup>*Universidade Tecnológica Federal do Paraná, Campus de Medianeira, Medianeira, Brazil,* <sup>3</sup>*Nutrition and Bromatology Group, Faculty of Food Science and Technology, University of Vigo, Ourense, Spain,* <sup>4</sup>*Laboratory of Separation and Reaction Engineering (LSRE), Associate Laboratory (LSRE/LCM), Polytechnic Institute of Bragança, Bragança, Portugal,* <sup>5</sup>*Centro de Investigação de Montanha (CIMO), ESA, Instituto Politécnico de Bragança, Bragança, Portugal*

The controversy and ambiguity related with chemical additives, allied to the sporadic scares, have paved the way for natural additives to gain interest and funding. Today, most consumers prefer foods added with natural additives, which is seen by the food industry as an opportunity to find new and more efficient natural-based solutions. Polyphenols constitute some of the most interesting groups of natural compounds in the vegetable kingdom and due to their antioxidant capacity, they have been used to develop natural additives in the class of preservatives. They can be added as plant extracts, taking advantage of the synergistic effects between compounds, or as individual molecules. Catechin, a widely known flavon-3-ol, is also known for its antioxidant activity. The discovery of new alternative sources of natural additives is also a very important topic, therefore the aim of this study was to obtain an extract enriched in catechins (natural preservative), from fruits of *Arbutus unedo* L., as an alternative source to the already well studied *Camellia sinensis* (L.) Kuntze. However, the catechin stability during the extraction and storage processes requires essential conditions that need to be examined cautiously. Therefore, a stability study of the enriched catechin extract powder was performed, evaluating the main affecting conditions involved in the obtaining and storage of the extract and its stability in mimitized food matrices. To determine these effects three main variables (time, temperature and pH) affecting catechin function were considered, being the catechin content monitored by HPLC-DAD. Mechanistic and phenomenological equations were used to describe the responses and optimal conditions for catechin stability. Overall, with this study the best stability conditions for catechin enriched extracts were established (information protected by a submitted patent) in order to allow its use as a natural preserver by the food industry.

### Acknowledgments

The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support to CIMO and L. Barros (SFRH/BPD/107855/2015).

## Sy08006

### **Bioactive properties of dairy beverages functionalized with pure ergosterol and mycosterol extracts: a comparative study with phytosterol counterparts**

Sandrina A. Heleno<sup>1,2</sup>, Adenilson Rudke<sup>1,2</sup>, Ricardo C. Calheta<sup>1</sup>, Lillian Barros<sup>1,2</sup>, Odinei H. Gonçalves<sup>3</sup>, Alírio Rodrigues<sup>4</sup>, Maria Filomena Barreiro<sup>2</sup>, Isabel C.F.R. Ferreira<sup>1</sup>

<sup>1</sup>Mountain Research Centre (CIMO), ESA, Polytechnic Institute of Bragança, Bragança, Portugal, <sup>2</sup>Laboratory of Separation and Reaction Engineering - Laboratory of Catalysis and Materials (LSRE-LCM), Polytechnic Institute of Bragança, Bragança, Portugal,

<sup>3</sup>Universidade Tecnológica Federal do Paraná – UTFPR Campus Campo Mourão, Paraná, Brazil, <sup>4</sup>Laboratory of Separation and Reaction Engineering (LSRE) – Associate Laboratory LSRE/LCM, Faculty of Engineering, University of Porto, Porto, Portugal

*Agaricus bisporus* L. is the most consumed mushroom worldwide exhibiting a high content of ergosterol in its sterol's fraction (~90%). Some studies have demonstrated the health benefits of this molecule related to its antioxidant, antitumor and also hypocholesterolemic effects, similar to the ones exhibited by phytosterols. Functional foods containing phytosterols, or their derivatives, can be found at commercial level bearing the European Food Safety Authority approved health claim "able to lower cholesterol levels in serum". Therefore, this work aims to present the use of mycosterols as an innovative alternative to phytosterols. *A. bisporus* bioresidues obtained from mushroom's industry were used to obtain mycosterols by ultrasound assisted extraction. Pure ergosterol and the obtained mycosterol extracts were added to dairy beverages, in a similar amount to the one used in the commercial ones incorporated with phytosterols. All the beverages were analysed immediately (T0) and after seven days of storage at 4°C (T1) regarding nutritional parameters, antioxidant activity and cytotoxic properties against human tumor cell lines and a non-tumor porcine liver primary culture. The beverages functionalized with the mycosterols extract revealed an antioxidant activity similar to the commercial beverages with phytosterols. However, beverages with pure ergosterol revealed twice this antioxidant activity. Moreover, only the samples functionalized with pure ergosterol or the mycosterols extract have shown an increase in the antioxidant activity from T0 to T1, meaning that the compound/extracts were able to protect the dairy drink from oxidation, increasing the product shelf life. Samples with pure ergosterol also revealed the highest cytotoxicity for tumor cell lines, while the beverages with phytosterols showed the lowest activity with no significant differences between T0 and T1. All the samples revealed a similar nutritional composition, and none of them revealed toxicity for normal cells. Studies on the hypocholesterolemic effects of the developed beverages are being carried out.

## **Sy09001**

### **The missing link: the role of social workers in the enhancement of agro-environmental payments in protected mountain settings**

Pedro Gabriel Silva<sup>1,2</sup>, Livia Madureira<sup>1,2</sup>

<sup>1</sup>*University of Trás-os-Montes e Alto Douro, Vila Real, Portugal,* <sup>2</sup>*Centro de Estudos Transdisciplinares para o Desenvolvimento, Vila Real, Portugal*

This paper results from the project SAVE-Valorization of Environmental Services of Agro-Ecosystems in Protected Areas, a research sponsored by the Ministry of Agriculture through the Rede Rural (Rural Network) program. The project, developed by researchers from UTAD and Quercus was focused in the study and valuation of Ecosystem Services in the Serra da Estrela Natural Park (SENP), in Portugal. One of the key features of the research was the assessment of an agri-environmental program, the Iniciativas Territoriais Integradas (ITI-Integrated Territorial Initiatives), and its impact on the provision of Ecosystem Services, conservation and environmental sustainability. Among the research findings, we have discovered a wide potential of the ITI program for welfare provision and to bolster the economy of local communities in the SENP. Nonetheless, we have also perceived that, unlike what happened in other Portuguese protected areas, in the SENP, the results achieved by the ITI program were meagre, due to, among other reasons, a faulty governance architecture that was systematically parted from local stakeholders' involvement. A circumstance that might have been mitigated if, from the start, the local ITI program had integrated social workers, whether working in the municipalities or based in local 3rd sector organizations. If, on the one hand, the ITI governance design overlooked the possibilities that social workers could offer to a better implementation of the program, on the other hand, social workers seemed to disregard or relinquish the program. Hence, drawing from the outcomes of SAVE project, we propose discussing the potential of agri-environmental policies to act in support of social intervention and poverty alleviation in rural settings and the role that social workers can assume in its implementation and in rendering environmental measures more effective when it comes to fighting demographic decline, human desertification and economic impairment in rural mountain contexts.

#### Acknowledgments

Portuguese Ministry of Agriculture - Rede Rural (Rural Network).

**Sy09002**

**The eco-social model and a the multifocal vision applied to sustainable social intervention with vulnerable populations**

Helena Belchior Rocha  
*ISCTE-IUL, Lisboa, Portugal*

This presentation is part of a research process in Social Work in which the main objective was to analyze the concept of eco-villas and the intervention of Social Work through a multifocal vision with empowerment approach, where communities and its partners are co-authors in a participatory process for the collective construction of an integrated and sustainable development. We tried to identify the basic skills needed for an environmental practice in the Social Work domain and to understand how the practice of social workers excels in networking, and in the involvement of various sectors of vulnerable communities and its importance to sustainable development. The methodology chosen was the interpretative paradigm and a study of explanatory and mixed nature of field research, using quantitative and qualitative methods, such as non-participant observation, questionnaire survey and semi-structured interviews. The results highlight that social work establishes a strong link with the environment and sustainable development, as a profession and as an academic discipline. Its focus on human rights, social justice and community development creates a solid foundation for sustained participatory interventions and international processes for environmental practice. We also propose an eco-social model for social work that values in a special way the interrelationship of social and environmental dimensions is an asset to the profession given its interventionist character and its social significance. Therefore, the practice of intervention, along with research, gives professionals the opportunity to reflect and innovate in their professional practice and positioning them to pursue the issues of environmental justice and to promote sustainable development, which is a complex challenge due to the social structures that separate people from the physical environment.

**Sy09003**

**Eco-systemic social work and sustainable social development**

Jorge Ferreira

*ISCTE-IUL, Lisboa, Portugal*

With this presentation we intend to contribute to an analytical-critical reflection of the social protection model in rural areas enhancing the synergies and local capabilities through the upgrading of the productive social tissue in interaction with natural resources as a source of income for families / household budget. Therefore we developed an analysis based on Social Work epistemology as a basis for an intervention focused on the person as a human capital for a sustainable social, political, economic and cultural development of rural communities in contemporaneity. In the framework of the paradigm change of the society and the State, a redefinition of the role and assignment of the individuals in society (autonomy and participation), we witness the revival of social work in rural development. Social work intervenes in a complex social field with a continuous social transformation, reproducing new social problems, maintaining traditional problems and complexifying them, particularly in the field of social and human relations. The ecological model, sustained in the perspective of an interaction between individuals and social environment, defining a continuous adaptive exchange of the life cycle, characterized mainly with environmental problems, developing in people and communities co-responsibility in improving the social environment in the everyday life. Networking represents a possibility of the reconstruction of social ties solidarity, guided by the model of social networks, enhancing new ways to understand and read society. Intervention network gains relevance in contemporary society as an alternative model in the practice of the social worker in order to respond to the problems and the needs of the individuals in a globalized world.

**Sy09004**

**Sustainable development, centered on people and territories: Reconfiguration of social work practices**

Hermínia Gonçalves<sup>1</sup>

<sup>1</sup>*Department of Economics, Sociology and Management (DESG), UTAD, Vila Real, Portugal, <sup>2</sup>Transdisciplinary Studies Center for the Development of the same University /CETRAD-UTAD), Vila Real, Portugal, <sup>3</sup>Centre for Research and Studies in Sociology (CIES-IUL), Lisboa, Portugal*

The concept of eco-development centered on people and territories, in addition to economic dimensions, incorporates dimensions of environmental sustainability and intervention on social inequalities and it's supported in principles local governance, integral endogenous social intervention, and processes of research-action. Indeed, the assumptions that underpin contemporaneity of the social intervention are: 1) integrated and reflexive solidarity; 2) individualized training and socialization that can produce autonomy; and 3) attention to the deviations from the ability to participate (Henry Soulet, Marc, in Amaro, Agnes, 2012). This is an intervention paradigm that involves the social work in the combination of individual and community approach. In this communication the author discusses the place of Social Work in the Community eco-development, a theoretical and practical interconnection. There are a number of fundamental questions. How to incorporate in the practices of the social work the individual and community focus? What specific functions of social work are part of the community approach? Are the professional practices of social workers to significantly incorporate the community approach? What components of the classic method, of the Community Social Work, can be used to fulfill its ethical-political project in the context of social networks? How to ensure the harmonization of scientific-humanistic vision of the profession? In methodological terms was chosen a strategy of multiple cases study, to Local Councils for Social Action (Partnership structures created under the national Social Network Programme). The research, is supported, at the same time, in the qualitative and ethnographic methods and typical analytical theoretical reasoning of Grounded Theory, interprets the perceptions and identities of social workers that works on these local structures and the perceptions of the social work practices assigned by the Local Councils Coordinators for Social Action to social workers.

**Acknowledgments**

This communication is part of a doctoral research in Social Work on "Reshaping the Contemporary Social Services in the context of neoliberal thinking" supervised by Prof. Dr. Jorge Ferreira do ISCTE\_IUL. This work is funded by: Structural European Funds and Investment in its ERDF component, through the Operational Programme Competitiveness and Internationalization (COMPETE 2020) [Project No. 006971 (UID / SOC / 04011)]; and National Funds through FCT - Foundation for Science and Technology under the project UID / SOC / 04011/2013.

**Sy09005**

**Poverty neighborhoods: territorial intervention and strategies for human and social development**

Isabel Santana

*Isabel Santana - CIES -ISCTE, Lisbon, Portugal*

In this communication the author intends to contribute to the reflection on how some management strategies and territorial intervention, developed at the local level, can help to promote sustainable and autonomous changes in priority intervention areas (urban areas 'at risk'), promoting human and social development. The empirical component of the study focuses on the analysis of urban regeneration initiatives in two neighborhoods of priority intervention of Lisbon. The empirical research aims to characterize and identify how the public policies implemented in poor areas, where they develop urban regeneration initiatives, affecting exclusion / socio-spatial segregation reinforce social and territorial cohesion of individuals and communities. The aim is also to systematize community intervention models developed by social services in urban areas 'at risk' in the context of ecosystem theory which contribute to social and sustainable change.

## **Sy10001**

### **Using sustainable development actions to promote relevance of mountain wines in export markets**

Antonio Graça, Luis Simões, Miguel Pessanha, Rui Freitas, George Sandeman  
*SOGRAPE VINHOS SA, Avintes, Vila Nova de Gaia, Portugal*

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own. For the business community, sustainability is more than mere window-dressing. By adopting sustainable practices, companies can gain competitive edge, increase market share, and boost value (IISD, 2013). In mountainous regions, sustainability acquires a more important aspect as these are regions generally with reduced profitability and competitiveness due to inherent difficulties such as accessibility, remoteness, sparseness, topography and pedoclimatology. Therefore, any improvement on sustainability will be important for survival and growth of mountain wine businesses. In mountainous Douro Wine Region (DWR), home of Port and Douro appellations, for long this has been recognized as a critical aspect of business competitiveness. Already in 1982, a group of wine companies have invested there in the creation of an association with the scope of increasing knowledge for a more sustainable business from growing grapes and making wine (ADVID). This association has been a major driving force for the adoption of integrated pest management (IPM), integrated production (IP) and biological production strategies in mountain viticulture. Sogrape Vinhos farms 480 ha in DWR securing quality grapes for SANDEMAN Port and CASA FERREIRINHA Douro wines. Adopting IP practices for its entire vineyard area, the company continuously increases adoption of sustainable practices across the whole value chain, from grape to glass, considering a triple bottom line approach: economics, people and environment. In this endeavor, partnering with other companies through common development brokered by institutions such as ADVID has been key in addressing critical sustainability issues like climate change, biodiversity assessment and conservation of genetic resources. In 2015, these efforts were recognized by a major sustainability award in the United States raising awareness towards wines the company produces from mountain vineyards in DWR.

#### Acknowledgments

Botanical Research Institute of Texas.

## **Sy10002**

### **Mountain viticulture, climate change mitigation and adaptation in Douro Wine Region**

José Manso

*ADVID, Vila Real, Portugal*

Future climate changes in the Mediterranean viticulture mountain like Douro Wine Region will be characterized by severe summer conditions with the increase of the average temperature, with lower water availability, greater range and frequency of monthly temperature anomalies, greater frequency of days with extreme maximum temperatures. The mitigation and adaptation in Douro Wine Region needs to be proactive by the developments of the potential of the rich micro climate situation typical of a tridimensional mountain landscape, adaptation strategies and development of the new cultivation techniques and vineyards, developing the genetics heritage and mitigate wine quality differences by developing new technologies.

## Sy10003

### **Assessment of irrigation management in *Vitis vinifera* L., cv. Mencía: physiological and quality parameters - DO Ribeira Sacra – Spain**

Javier J Cancela<sup>1</sup>, María Fandiño<sup>1</sup>, Esperanza Valdés<sup>2</sup>, Benjamin J Rey<sup>1</sup>, Xesús P González<sup>1</sup>, Mar Vilanova<sup>3</sup>

<sup>1</sup>GI-1716. Project and Planning. Dep. Agroforestry Engineering University of Santiago de Compostela, Lugo, Spain, <sup>2</sup>CICYTEX-Technological Institute of Food and Agriculture-INTAEX (Junta de Extremadura), Badajoz, Spain, <sup>3</sup>Misión Biológica de Galicia (CSIC), Pontevedra, Spain

Heroic viticulture need test new tools, as irrigation, which permits a sustainable production with positives interactions with ambient and social aspects in Mountain regions. DO Ribeira Sacra is the most important viticulture area with high slope in Galicia (Spain), where Mencía is the priority red cultivar with an 85 % of grape production. To evaluate the irrigation effects, a field experiment was implemented in vineyards property of 'Ponte da Boga' winery (Castro Caldelas - Ourense), with two treatments: rain-fed (R) and drip irrigation (DI). During the season, measurements of stem-leaf water potential and soil water content were achieved, at harvest in the grapes probable alcoholic degree, titratable acidity, pH, macro and micro elements, nitrogen composition (TAC, TAN, YAN and TAS) and volatile compounds (alcohols, C6 compounds, ethyl esters, terpenes, aldehydes, acids, lactones, volatile phenols and carbonyl compounds) were evaluated. Main results showed that no differences between treatments was obtained to physiological measures, with stem-leaf water potential higher than -0.6 MPa, which showed a non-plant stress during the season. However, R treatment achieves a probable alcoholic degree of 14.2 %, higher than DI vineyards (11.9 %); that was opposite to titratable acidity tendency (R: 3.5 and DI: 5.3 g tartaric acid L<sup>-1</sup>). Statistical significant difference was obtained to K concentration values (mg L<sup>-1</sup>) in must, (1,995 and 1,222 mg L<sup>-1</sup>), in R and DI treatments, respectively. Values found in Nitrogen and volatiles compound were similar to values showed by Vilanova et al., (2015), with K concentration similar to R treatment. During the years of study, Mencía cultivar showed a critical problem with the titratable acidity values, in R treatment, to achieve stable wines. DI treatment displayed higher production than R treatment, with higher titratable acidity. Therefore an adequate irrigation management could provide more equilibrated grapes to attain a sustainable production over the years.

## **Sy10004**

### **Vine response to deficit irrigation in NE Portugal: water productivity, yield and berry composition.**

António Ribeiro<sup>1</sup>, João Andrade<sup>1</sup>, Diogo Ferrão<sup>2</sup>, David Barreales<sup>2</sup>, Joana Sobrinho<sup>3</sup>  
<sup>1</sup>*CIMO-Polytechnic Institute of Bragança, Bragança, Portugal*, <sup>2</sup>*ESA-Polytechnic Institute of Bragança, Bragança, Portugal*, <sup>3</sup>*Soc. Clemente Menéres Lda. Quinta do Romeu, Mirandela, Portugal*

Vine response to water deficit depends on the pattern and severity of the imposed water stress, and this information has been used to develop deficit irrigation strategies. However, successful strategies may vary among regions with different climates and can even be site specific, depending on the interactions within the grapevine variety, soil type and vineyard management practices. Regulated Deficit Irrigation is one of the most frequently used irrigation strategies in vineyards with the aim to balance grapevine vegetative and reproductive growth by applying less than the full vineyard water requirements, at specific periods of the growing season. The effect of several deficit irrigation regimes on vine water status, grape yield and quality parameters were studied in the Portuguese cultivar Touriga Nacional (*Vitis vinifera* L.) grown in organic production. Field studies were conducted during two seasons (2014-2015) in a commercial organic vineyard, located in the NE Portugal (lat. 41°31'N; long. 7° 5'W; 326 m asl). Treatments consisted of non-irrigated vines (NI) and three deficit irrigation regimes: 20%, 40% and 60% of reference evapotranspiration (ET<sub>o</sub>). Water was applied three times a week, from pre-veraison until one week before harvest. The results showed that moderate irrigation improved significantly the grapevine water status during berry ripening. Yield components and pruning weights had a significant increase in irrigated treatments. Water productivity increased each year as the supply of water decreased from 60% ET<sub>o</sub> to NI vines due to a greater reduction in pruning weight relative to yield. The differences among treatments were not statistical significance in the most of fruit quality parameters. However, the total phenols and the colour intensity showed a significant decrease in 60% ET<sub>o</sub> irrigated treatment.

#### **Acknowledgments**

Authors are grateful to POCTEP - Programa de Cooperação Transfronteiriça Espanha - Portugal for financial support (Project "RED/AGROTEC – Experimentation network and transfer for development of agricultural and agro industrial sectors between Spain and Portugal) as well as to the European Union (FEDER funds through COMPETE) and Soc. Clemente Menéres Lda. (Menéres Family Estate).

## Sy10005

### **Distribution patterns of vineyards on volcanic soils from the Macaronesian Islands: altitudinal and soil drivers**

Zulimar Hernandez<sup>1</sup>, Juan Pedro Pérez Trujillo<sup>2</sup>, Tomás de Figueiredo<sup>3</sup>, María José Marques<sup>1</sup>

<sup>1</sup>*Autonomous University of Madrid, Madrid, Spain,* <sup>2</sup>*University of La Laguna, Tenerife, Spain,* <sup>3</sup>*CIMO-IPB, Braganza, Portugal*

The main limitation of the tropical viticulture is the lack of cold hours during the crop cycle. This limits the dormancy period in growth meristems, with the subsequent reduction in grape production. In addition, the water stress during the grape ripening is necessary to obtain quality wines. An alternative to develop viticulture in tropical areas consists its location to higher altitudinal levels, where the minimum temperatures are lower. This is the case of vineyards from part of the Macaronesian Islands, which include Azores, Madeira, Canary and Cape Verde. In this paper, the relationship between abiotic factors, such as altitude and soil, and the crop is analyzed. Among climatic factors, geographic location, slope, monthly temperature (min, max, average), annual number of frost, and annual distribution of rainfall, are described. Soil physical and chemical variables, such as pH, electric conductivity, effective cation exchange capacity, organic matter, amorphous oxides, nutrients, metals ions or texture are analyzed using innovative spectroscopic techniques, previously calibrated with analytic data. Finally, some field data, such as grape production and quality (sugar, color, acidity, tartaric acid) are included in the statistical treatments. Results show that the current distribution of winegrowing areas is driven by noticeable thermic or water stress. In Azores, where the major limitation is to obtain wines of high alcoholic content, the vines are grown near the sea where marine salts compensated the high soil acidity. In Canary Islands, where the high temperatures quickly degrade the tartaric acid of grapes, viticulture is developed in agricultural terraces, at medium altitudes, where deeper soils are located, which favors the crop water availability in the summer months. Finally, in Cape Verde, mountain viticulture is possible due to higher daily temperature range differences, and the presence of buried soils under volcanic ashes, which allows the presence of water in aridic environments.

#### Acknowledgments

Funded projects: SEMACA, Interreg Project (MAC 2007/2014), University of La Laguna, Tenerife.

## Sy10006

### **Soil electrical resistivity profiles in terraced areas: methodological approaches and application to the Douro vineyards, Portugal**

Jorge Dafonte<sup>1</sup>, Aitor García-Tomillo<sup>1,3</sup>, Tomás de Figueiredo<sup>2</sup>, Antonio Paz González<sup>3</sup>, Felícia Fonseca<sup>2</sup>

<sup>1</sup>*Universidad de Santiago de Compostela, Lugo, Spain*, <sup>2</sup>*Instituto Politécnico de Bragança, Bragança, Portugal*, <sup>3</sup>*Universidad de A Coruña, A Coruña, Spain*

Terracing is an important method of soil erosion control and water conservation. Terraced vineyards are very common in the Douro region. The modern terraces are cutted into the mountainsides using earth moving equipment; they are separated by tall earth banks. Electrical resistivity tomography (ERT) is widely used in vineyard surveys; however most of the ERT surveys are conducted on uneven terrain where topography effects may produce misleading anomalies. Therefore, it is very important to understand the topography effects to remove them during interpretation of the model. In summary, there are two ways to remove the topography effect: the modelling approach, and the resistivity incorporating topography. The results presented in this study are derived from data collected in a vineyard located in Peso da Régua-Portugal (N - 41° 09' 587 W - 7° 45'989). The 2D resistivity tomography was obtained using ABEM Lund Imaging system and a multielectrode wenner array with 21 electrodes and 0.5 m interelectrodes separation. The wenner array is commonly used in profiling methods because it is more sensitive to vertical changes than to horizontal changes in subsurface resistivity and it is better adapted to subhorizontal geological structures. The inversion software Res2Dinv was used to calculate resistivity sections, the apparent resistivity data from the 2D survey were inverted using a least-square method to obtain a pseudo-resistivity 2D- including topographic variations, with finite-element method that incorporates the topography into the modelling mesh used. The used type of topography modelling was distorted finite-elements grid with damped distortion. The soil resistivity profile which is expected in this type of terraces, with low resistivity values in the toe of the slope corresponding to higher soil water content. So it is remarkable the incorporation of topographic data for the correct interpretation of the resistivity measurements obtained with the ERT.

#### Acknowledgments

This work was supported by Spanish Ministry of Economy and Competitiveness (project CGL2013-47814-C2).

## **Sy11001**

### **Pacific SST variations and decadal glacier evolution in the eastern cordilleras of Peru and Bolivia**

Bijesh Kozhikkodan Veetil<sup>1</sup>, Shanshan Wang<sup>2</sup>, Ulisses Bremer<sup>1</sup>, Sergio Florencio de Souza<sup>1</sup>, Jefferson Simoes<sup>1</sup>

<sup>1</sup>*Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil,* <sup>2</sup>*Key Laboratory of Arid Climate Change and Reducing Disaster of Gansu Province and Key Open Laboratory of Arid Climate Change and Disaster Reduction of CMA, Institute of Arid Meteorology CMA, Lanzhou, China*

We conducted the first decadal quantification of glaciers in the cordilleras Carabaya and Apolobamba in Peru and Bolivia and calculated the changes in glacier areas during the last four decades between 1975 and 2015 and glacial lakes between 1985 and 2015. Landsat MSS, TM and OLI images were used to measure glacier area changes. In order to understand the elevation gradient in glacier retreat in this region, we calculated the areal changes of glaciers at different altitudes. Glacier retreat in our study region is found to have created numerous glacial lakes in the recent decades. In contrast to the observed fluctuations in the glaciated areas in the western cordilleras of the tropical Andes, a continuous glacier recession is observed in the eastern cordilleras of Peru and Bolivia. It is estimated that the glacier area loss in the Cordillera Apolobamba and the Cordillera Carabaya was about 53% and 78% respectively between 1975 and 2015. It is also observed that the glaciers situated below 5000 m a.s.l. were nearly disappeared during this period and those glaciers situated above 5500 m a.s.l. were relatively stable. We propose that glaciers in the inner tropics and the southern wet outer tropics are retreating faster than those glaciers in the rest of the tropical Andes and the glaciers in the eastern cordilleras are least influenced by the SST variations in the Pacific.

#### Acknowledgments

Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul (FAPERGS), Brazil.

## **Sy11002**

### **Adaptive agriculture strategies to enhance ecosystem services provision in tropical mountain area in Brazil**

Ana Paula Turetta, Fabiano Carvalho Balieiro, Aluisio Carvalho de Andrade, Rachel Bardy Prado, Aline Oliveira, Guilherme Donagemma, Luciano Mansor de Mattos  
*Brazilian Agricultural Research Corporation - Embrapa, Rio de Janeiro, Brazil*

The agroecosystem concept provides an approach which analyze food systems as wholes, including their complex sets of inputs and outputs and the interconnections of their components that results in benefits for the whole system. The multifunctional capacity of agroecosystems is directed linked with ecosystem services provision. However, to define in a reliable manner, the connections between agricultural practices and ES provision, is still a challenge, since it is influenced by many factors, specific for each case. The aim of this study is to present some adaptative agriculture strategies to enhance ecosystem services provision in tropical mountains. The case study is the Pito Aceso watershed, located in the mountainous region of Rio de Janeiro State - Brazil. This area is a typical landscape of this region, with a mosaic of land use types and steep relief. Some results concerning that ES types more affected by deployment and management of agroecosystems are supporting and provisioning services, what demonstrated the potential of agriculture management provide multiple services besides food, fiber and energy. "No fire use" and "agricultural consortium" were the criteria for deployment and management of agroecosystems with higher potential for increasing ES provision and biomass stock in soil and litter was the soil parameter more appropriate to be used as indicator to monitor the impact of agroecosystem in ES provision.

#### Acknowledgments

Brazilian Agricultural Research Corporation – Embrapa.

### **Sy11003**

#### **Agricultural development, traditional water harvesting and the link to water scarcity in the foothills of the Western Ghats**

Darren Crook<sup>1</sup>, Sudhir Tripathi<sup>1</sup>, Richard Jones<sup>2</sup>

<sup>1</sup>*University of Hertfordshire, Hatfield, UK,* <sup>2</sup>*University of Exeter, Exeter, UK*

The foothills of the Western Ghats of India in the states of southern Karnataka and northern Kerala are home to a relatively recent innovation to harvest water from horizontal gallery filtration tunnel systems known as Suranga. A seasonal monsoon pattern results in increased demand for water during regular dry summers, but an increasingly variable pattern of monsoon activity is stressing water resources in the region. This water stress is accentuated in ground water sources that are being critically over exploited through the often unregulated use of borewells. Suranga systems are constructed mainly in laterite substrates tapping into perched water tables and aquifers that offer an alternative to borewell technologies. Their importance for irrigation within a largely agro-forestry agricultural system is explained alongside their importance for providing potable drinking water to poor and vulnerable tribal and lower caste communities. Community vulnerability is also explored in relation to market led changes that are occurring in agro-forestry that are leading to regional land use changes. The presentation concludes with an assessment of the impacts these changes may have on existing upland farming communities and their water supplies.

## Sy11004

### **Physical properties of Santiago Island soils, Cape Verde: challenges for water conservation in semiarid mountains**

Ângela Moreno<sup>1</sup>, Tiago Ramos<sup>2</sup>, M: Conceição Gonçalves<sup>2</sup>, Tomás Figueiredo<sup>3</sup>, Luís Santos Pereira<sup>4</sup>

<sup>1</sup>*Instituto Nacional de Investigação e Desenvolvimento Agrário, Cidade da Praia, Cape Verde,* <sup>2</sup>*Instituto Nacional de Investigação Agrária e Veterinária, Oeiras, Portugal,*

<sup>3</sup>*CIMO/ESA/IPB, Bragança, Portugal,* <sup>4</sup>*Instituto Superior de Agronomia, Lisboa, Portugal*

Cape Verde faces natural vulnerabilities related to its volcanic origin, insularity and location in the Sahel region and lacks mineral resources. The reduction and the irregularity of rainfall motivate droughts that are the main cause of desertification, with devastating effects on the fragile ecosystems of these semiarid mountains, affecting biodiversity, vegetation, land quality and agricultural production. Soils degrade with the loss of organic matter and lower water-retention capacity. In Cape Verde, the lands in semiarid mountains are under a high human pressure due to reduced territorial dimension, the scarcity of deep soils, water reserves and biodiversity. The limited knowledge on the hydraulic properties of semiarid Cape Verde soils makes the use of water balance models difficult. In this paper water retention characteristics of agricultural soils in mountains of Santiago Island and the development of point pedotransfer functions (PTFs) to improve irrigation management are investigated. Soil water retention curves were studied in 72 horizons of 31 soil profiles located in mountains. Soil textures varied from coarse to medium classes. PTFs were, at the same time, developed by regression analysis to predict total porosity ( $\phi$ ) and water retention at -0.25, -1, -3, -10, -33, -100, and -1500 kPa. Due to the lack of available data from Cape Verde, PTFs were developed from 85 soil horizons specifically selected from a Portuguese database. PTFs were then validated with the data determined in the 72 soil horizons studied in Santiago Island. Statistics showed a relatively good performance of Cape Verde PTFs, with RMSE varying between 0.038 and 0.065 cm<sup>3</sup> cm<sup>-3</sup>. However, Cape Verde PTFs always underestimated the measured values by -0.014 to -0.075 cm<sup>3</sup> cm<sup>-3</sup>. When compared with three other published PTFs, the new Cape Verde PTFs provided more acceptable results for use in modelling aimed at improving irrigation water management practices.

## **Sy11005**

### **Effects of climate change on the Ecuadorian moors ecosystem and the implications for the sustainable management of key ecosystem services**

Karla Beltran, Piran White  
*University of York, York, UK*

The Andean Moors is a natural ecosystem that functions as a giant sponge, storing and releasing water during the year, thereby ensuring the provision of water for dry periods in Andean regions. This natural ecosystem also provides other important ecosystem services including livestock production and carbon storage. In Ecuador, the Moors have suffered significant deforestation due to land use change, which has had a major impact on the capability of the ecosystem to resist or adapt to external pressures such as climate change. The aims of this project are to: 1) Establish a baseline situation regarding the provision of key ecosystem services by the Moors including biodiversity, water availability, carbon storage, and food security; 2) Analyse the potential impact of climate change on the delivery of these ecosystem services; and 3) Develop effective strategies for future management of the Moors to reduce or prevent potential catastrophic consequences for the Andean people who depend directly on the ecosystem services provided by the Moors. The research is applying niche-based modelling, computed in Maxent, based on ecosystem occurrences and climatic and ecological variables in order to represent an approximation of the Moors ecological niche under past, current and future environmental conditions. Alternative scenarios will be also developed through the open source tool INVEST to explore how current patterns of ecosystem service provision are likely to change under extreme climatic conditions. The results will be complemented by stakeholder interviews to evaluate the effectiveness of current policies related to the conservation of ecosystem services in Ecuador.

#### Acknowledgments

National Secretariat of Higher Education, Science, Technology and Innovation (SENESCYT – Ecuador).

## **Sy13001**

### **On the reconstruction of pre-landslide topography in mountain areas**

Mario Parise

*CNR IRPI, Bari, Italy*

Slope movements are dangerous threats in mountain areas, claiming casualties, and producing significant damage to inhabited areas and communication routes. Triggered by earthquakes, rainfall, or snow melting, they typically affect large volumes of rock, up to several millions of m<sup>3</sup>, potentially resulting in phenomena with high destructive energy and very long runout. Studying past slope movements provides useful insights to better understand the conditions predisposing to landslides in mountain areas, controlling their evolution, and the likely destructiveness. A good comprehension of their kinematics may result of extreme significance in depicting possible worst-case scenario, and planning actions for mitigating the risk. In all of this, reconstructing the topography before the occurrence of a landslide is an essential element for the complete understanding of the phenomenon. For recent slope movements, this is done by comparing pre- and post-landslide topography, and computing the differences. The situation is more complex for historic slope movements, for which no pre-landslide map is available. In this case, other approaches need to be followed. Availability of computer-assisted programs and GIS tools allows nowadays to reconstruct the pre-landslide topography, and to compare the rock mass volume before and after the landslide. However, notwithstanding the technological progress in the last decades, there are several constraints to be satisfied to properly reconstruct the most likely pre-landslide situation. First of all, the geomorphological conditions around the landslide site should be carefully analyzed. Depending upon the geomorphic control, different situations can be observed: from narrow valleys, where the direct impact against the opposite slope may result in dissipation of the energy, to channelization in the main valleys with very high destructive energy. This paper presents some considerations about the main constraints to be taken into account when performing reconstruction of pre-landslide topography for large slope movements in mountain areas.

## **Sy13001**

### **Linear erosion in mountain scrublands of North and Centre Portugal: the case studies of Seirós and Corgo gullies**

Bruno Martins<sup>1</sup>, Luciano Lourenço<sup>1</sup>, Felícia Fonseca<sup>2</sup>, Tomás Figueiredo<sup>2</sup>, Cármen Ferreira<sup>3</sup>

<sup>1</sup>*Universidade de Coimbra, Coimbra, Portugal,* <sup>2</sup>*Instituto Politécnico de Bragança, Bragança, Portugal,* <sup>3</sup>*Universidade do Porto, Porto, Portugal*

Gully occurrence is particularly common in the mountain areas of North and Central Portugal, dominantly covered by forests and scrublands. In many of these regions, linear erosion is a very important process, contributing to significant soil loss and land degradation. In rural areas, land degradation may be responsible for limiting the options for territory occupation and development, reducing farmland quality and suitable area. Driven by climatic conditions as long and intense rainfalls, gully formation is related to topographical factors such as hill-slope gradient, length and shape, to physical, chemical and mineralogical properties of the soils. The variety of physical factors associated with gully formation hinders straightforward interpretations and requires well grounded analysis based on local observation. Also, anthropogenic factors significantly contribute to gully formation and development and for the associated soil loss rates. Deforestation, forest fires, overgrazing, vegetation removal, as well as road building, are the most important ones. In most cases, they reduce infiltration and promote runoff water concentration. Two case studies are presented in this paper, aiming at discussing interpretations on gully formation factors and their contribution to soil loss. Both correspond to scrubland over colluvial hill-slope deposits, located in Seirós (Ribeira de Pena, Northern Portugal) and Corgo (Oliveira do Hospital, Central Portugal). Field surveys were performed to assess gully volume and the corresponding soil loss by linear erosion, consisting in measurements of cross-sectional area at regular intervals along the gully, and their integration up to gully cross-sections with less than 900 cm<sup>2</sup> area. Samples were taken on gully walls for bulk density (100 cm<sup>3</sup> cylinders). Field surveys also allow the collection of samples for granulometric analysis in the tentative to assert relationship to the gullies geometry and understanding the most significant driven factors in gullies formation.

## **Sy13002**

### **Effect of prescribed fire on soil erosion and soil chemical properties in a mountain area, Northeast Portugal**

Felícia Fonseca, Tomás Figueiredo, Anabela Quierós, Clotilde Nogueira  
*Instituto Politécnico de Bragança, Bragança, Portugal*

Prescribed fires are a common management practice in the temperate forests and can be an alternative to reduce the quantity of fuel and hence decrease the wildfire risk. However, fire can affect soil properties (physical, chemical, mineralogical, and biological), depending on a number of factors including fire severity and soil type. A direct effect of fire on soil surface is the creation a continuous film water-repellent which reduces permeability and increase the soil susceptibility to water erosion processes. Prior to prescribed fire, the study area was covered by shrub species typical of NE Portugal uplands as *Erica australis* (44% of the surface), *Chaemespartium tridentatum* (30%), *Cystus ladanifer* (26%). The fire affected differently individuals of the 3 species, the former showing a high resistance to fire. The research focused on changes in soil chemical properties and on soil erosion processes. Runoff and soil loss were monitored in a set of 4 m<sup>2</sup> paired plots installed in the study area, during the first year after the fire and summed losses equivalent to 13 mm runoff and 1.5 Mg ha<sup>-1</sup> soil loss. Chemical soil properties were assessed before, immediately after, and two, six and thirty six months (three years) after the fire. Despite low fire intensity, soil chemical changes were observed. Three years after the fire it turned out that the soil pH values were similar to those seen before the fire. However, the same was not verified with the values of the exchangeable bases, extractable potassium and electric capacity that differ from the observed ones before the fire. Although corresponding to a short monitoring period, these results may add to a better knowledge of the potential susceptibility of burnt scrublands to soil degradation and their natural recovery rates.

### **Sy13003**

#### **Increase of social-ecological vulnerability to natural disasters in the mediterranean mountains: what changed? The example of Piódão and Pomares basins, Portugal**

Adélia Nunes<sup>1,2</sup>, Luciano Lourenço<sup>1,2</sup>

<sup>1</sup>*Department of Geography and Tourism, Coimbra, Portugal,* <sup>2</sup>*CEGOT, Univ. Coimbra, Portugal*

Mountain areas are vital and complex system for biodiversity, water towers, valuable habitats, energy and fresh-air supply, recreational sites, and also for cultural heritage. Nevertheless, mountain areas have become increasingly disaster-prone in the 20th century and a disproportionately high number of disasters occur there, as compared with other environments. In mountainous regions of the Mediterranean basin, where forest fires have been increasing, floods and intensive erosion seems to be more regular elements of the landscape, once the climate is characterized by intense precipitation as a consequence of strong cyclogenesis. Although, mountain regions are relatively active geophysically and hydrologically, the understanding of hazards and the consequent disasters is based on knowledge of the bio-geophysical and in the human dimensions. During recent decades, a continuous population migration process has been taking place, worsening demographic structure problems and farmland abandonment. These changes are frequently followed by a significant loss of natural and cultural landscapes, decay of biodiversity, increase of natural hazards, forest degradation, forest fires, soil deterioration, water pollution. Various authors reported alterations in the fire regime, both in terms of higher fire recurrence and incidence of large events, which can generate significant consequences for Mediterranean ecosystems. Forest fires can greatly change hydrological processes and the landscape's susceptibility to major flooding and erosion events. The main goals of this work are to understand the incidence and recurrence of forest fires and the pos-wildfire off-site hydrological response and erosional processes, from a social and ecological perspective, in two basins located in the most important mountainous area of Portugal, the central cordillera. Mostly important is to understand the conditions that contribute to the increase of social-ecological vulnerability of systems in the face of hazards and emphasize the importance of learning from disaster, particularly if the goal is to enhance resilience and sustainability of social-ecological systems.

#### Acknowledgments

This work was funded by the CEGOT (Centre for Studies in Geography and Spatial Planning), which is financed by national funds via the FCT - Foundation for Science and Technology -under the COMPETE project, reference POCI-01-0145-FEDER-006891 (FCT project: UID/GEO/04084/2013).

**Sy13004**

**On the impact of global change on landslide disasters in Latin America**

Irasema Alcántara-Ayala, Ricardo Garnica-Peña

*Institute of Geography, National Autonomous University of Mexico (UNAM), Mexico City, Mexico*

Landsliding used to be a natural process in mountain areas. However, due to the influence of human activities, landslide disasters have mounted up dramatically in the last decades. Land use changes, urbanization processes, lack of planning, environmental degradation, poverty, inequality and inefficient disaster risk governance, are among the main drivers for disaster risk. In this paper, an analysis of the spatial-temporal impact of landslide disasters in Latin America is presented, along with the identification of the associated key risk drivers derived from global change. Future challenges linked to disaster risk reduction to enhance sustainability of mountains are additionally discussed.

Acknowledgments

Consejo Nacional de Ciencia y Tecnología (CONACyT).

## **Sy13005**

### **Risk assessment of tropospheric ozone and atmospheric nitrogen deposition effects on terrestrial ecosystems in Spanish mountain areas**

Rocío Alonso, Héctor García-Gómez, Susana Elvira, Ignacio González-Fernández, Isaura Rábago, Fernando Valiño, Javier Sanz, Héctor Calvete, Victoria Bermejo  
*CIEMAT, Madrid, Spain*

The Mediterranean Basin is one of the Biodiversity Hotspots for conservation priorities. Particularly, the Mediterranean mountains concentrate some of the most valuable areas, due to the extremely high biodiversity and to the provision of many environmental, cultural and economic services. Many of these areas have been recognized and protected under different conservation strategies. While conservation plans can implement management changes to reduce the impact of human activities, those ecosystems can still be affected by air quality and climate change. Tropospheric ozone (O<sub>3</sub>) and atmospheric nitrogen (N) deposition are two of the main air pollutants affecting natural and semi-natural ecosystems of the Mediterranean Basin. The meteorological conditions of this area with high solar radiation, temperature and prevailing stable atmospheric conditions favor photochemical O<sub>3</sub> formation, resulting in the highest O<sub>3</sub> concentrations in Europe. On the other hand, atmospheric N deposition in the Mediterranean Basin remains lower than in central Europe due to its distance from the intensive industrial and agricultural areas. Very little information is available on the threat that N and O<sub>3</sub> can pose to biodiversity and ecosystem functioning in mountain areas. Moreover, most of the air quality networks do not include monitoring stations at high elevation. A first risk assessment has been developed showing that atmospheric N deposition exceeds empirical N critical loads (CL) in some protected areas of the Spanish Natura 2000 network. Most of the empirical CL exceedances have been detected in mountain areas located in the north (Pyrenees, Cantabrian Range) and other mountain areas close to high emission sources, such as forests and scrublands close to Barcelona and Madrid cities, in the Eastern Coast, and near the Strait of Gibraltar. On the other hand, increases of O<sub>3</sub> with elevation have been reported in some mountain ranges in Spain exceeding O<sub>3</sub> critical levels for the protection of vegetation.

#### Acknowledgments

AGRISOST (Comunidad de Madrid project, S2013/ABI-2717); Spanish Ministry of Agriculture, Food and Environment through an agreement with CIEMAT on Critical loads and levels; CEDEX through an agreement with CIEMAT on Nutrients in Sanabria.

## Sy13006

### **Tailored programme for biological control by hypovirulence of Chestnut Blight in Portugal. Rules, regulation and practical application**

Eugénia Gouveia

*Instituto Politecnico de Bragança, Bragança, Portugal*

*Cryphonectria parasitica* (Murrill) Barr. is a fungus of the natural mycoflora of Asian chestnuts that becomes a notorious alien invasive species (AIS) when accidentally introduced in the beginning of the century on American chestnut (*Castanea dentata*) and Chestnut Blight becomes a devastated epidemic disease. Further, in 1938, the parasite was detected in Italy and rapidly cause epidemic with tree death and degradation of the chestnut ecosystem. Only in 1989 the disease was identified in Portugal and epidemics and negative effects occurred similarly as before in Europe. Initial management of the disease was attempted by the eradication measures but this approach didn't control the disease. Biological control by hypovirulence, a dsRNA virus mediated mechanism of parasitic reducing virulence, is a specific, selective and efficient mean, in Europe, to control the disease and improve host plant recovery. We will present our approach and steps for implementation of biological control by hypovirulence of Chestnut Blight in order to minimise its spread and harms fostering knowledge transfer and innovation in plant disease control to restoring and enhancing the multipurpose chestnut ecosystems in the north mountains regions of Portugal.

## **Sy15001**

### **Eco-Eco: Ecological - Economical Assessment of Grazing Services Using a Target Based Model**

Tzach Aharon Glasser<sup>1</sup>, Alberd Kaminer<sup>1</sup>, Ella Segal<sup>2</sup>

<sup>1</sup>Ramat-Hanadiv Nature Park, Zichron Ya'akov, Israel, <sup>2</sup>Technion-Israel Institute of Technology, Haifa, Israel

Mountainous areas in Mediterranean regions have gone through a long term process of abandonment and are not suitable for intensive agricultural practices. Livestock farming which is based on pasture as a main source of forage is considered a sustainable and preferable practice in these areas, firstly as a source of income for farmers and secondly for the enhancement of ecological values and sustainable landscape management. Livestock grazing is implemented for conservation of local ecosystem functions, preventing shrub encroachment, invasive species distribution and maintenance of fuel-brake zones mitigating wildfire risk. However, in many cases, the economic value of this type of farming system is fairly low. The low profitability leads to further abandonment of land and the cessation of extensive farming systems in mountainous areas. Herd owners struggle to evaluate and price grazing services, while land managers are seldom prepared to pay for what it is worth. In the following paper we propose a conceptual model which aims to bridge the gap between livestock farmers and landscape managers. This target based models' main goal is to "put a price" on grazing services supplied by local herds, using ecological and economic traits, considering herd management objectives as well as landscape and ecological objectives. The model presented accounts for different grazing regimes particularly, addressing sheep and goat herds in mountainous areas. The major parameters proposed in this model are: terrain, vegetation type, management objectives and herd characteristics. A practical equation constructed by the parameters and the hypothesis behind each one is presented. Evaluation of the model was demonstrated on a case study in the Judean Mountains.

#### Acknowledgments

Ramat-Hanadiv Nature Park, Zichron Ya'akov, Israel.

## Sy15002

### **Distinct types of LU-trajectories reveal cascading effects on the multi-functionality of mountain landscapes**

Lukas Egarter Vigl<sup>1</sup>, Erich Tasser<sup>1</sup>, Uta Schirpke<sup>1,2</sup>, Ulrike Tappeiner<sup>1,2</sup>

<sup>1</sup>EURAC research, Bolzano, Italy, <sup>2</sup>University of Innsbruck, Innsbruck, Austria

Managing multiple ecosystem services (ES) in agricultural landscapes is a challenging task, especially in regions with complex topographical and agro-ecological conditions. This challenges require ES assessments approaches that go beyond the case study level and provide information on a transnational level that are not limited to a single point in time. We used a spatiotemporal explicit approach to examine the provision of eight ES from 1955 to 2005 across 32 municipalities in the European Alps. We show how an ES upscaling procedure, from case study to an Alpine-wide level, based on topographical, agro-ecological and socio-economical parameters can improve our understanding of ES dynamics and pathways. Our results show that ES supply shifted between 1955 and 2005, from a predominance of provisioning ES in a mainly agricultural landscape in 1955 to a landscape characterized by regulating ES. We found that major changes in ES supply occurred between the 1955-1985: Provisioning services were found to be either directly influenced by changes in farm management activities or by market developments, whereas regulating ES mostly responded to alterations in biophysical factors (forest densification) and to land abandonment. Cultural services were found to be highly correlated to topography and changes in landscape composition. By mapping groups of ES through time for the entire Alpine arc we were able to highlight ES hot and cold spots that are most likely to either enhance or diminish the provision of distinct groups of services. By introducing a spatiotemporal perspective in ES assessment we provide clear evidences of the dynamic nature of ES provision and contribute in identifying processes and drivers behind these pattern. Our results emphasize that mountain ES supply is particularly sensitive to long-term LULC change, to topography and to regional socio-economic conditions and can contribute to guide evidence-based environmental measures at national and transnational level.

### **Sy15003**

#### **Current and future role of forest composition as a fire-mitigation ecosystem service**

Paulo M. Fernandes, Rui Lourenço, Helder Fraga, João A. Santos  
*Centro de Investigação e de Tecnologias Agro-Ambientais e Biológicas, UTAD, Vila Real, Portugal*

Fire behaviour characteristics vary with forest type, producing a range of environmental impacts and affecting fire growth and size, hence area burned. Natural or man-made changes in forest composition can thus potentially translate into a fire-mitigation ecosystem service. Projections of changes in fire weather through fire danger indices as a result of climate change are now common in the literature. However, only the quantification of changes in fire behaviour is fully interpretable from the fire ecology and fire management viewpoints, and yet has seldom been addressed by previous research. We based fire behaviour predictions on current (1980-2010) and future (2020-2100) bias-corrected climate conditions, assuming the RCP 8.5 scenario of comparatively high greenhouse gas emissions. Daily estimates of fire spread rate, fireline intensity and crown fire activity were produced for one location in NW Portugal for the peak burning period, i.e. corresponding to minimum relative humidity, maximum air temperature, and afternoon wind speed; dead fuel moisture content was based on the Fine Fuel Moisture Code of the Canadian FWI System. Fire behaviour estimates were obtained with the BehavePlus Fire Modelling System using custom fuel models for maritime pine and blue-gum eucalypt, with or without understory vegetation, evergreen hardwoods, and deciduous hardwoods. A larger presence in the landscape of the less flammable forest types would substantially moderate fire activity, and more so under future conditions.

## **Sy15004**

### **Declining of natural and social capital in the Portuguese mountain protected areas, how to invert the trends?**

Lívia Madureira<sup>1,2</sup>, Pedro Gabriel Silva<sup>1,2</sup>

<sup>1</sup>*Universidade de Trás-os-Montes e Alto Douro, Vila Real, Portugal,* <sup>2</sup>*CETRAD - Centre for Transdisciplinary Development Studies, Vila Real, Portugal*

Portuguese mountainous areas experienced a long term decline in both their natural and social capital. Within the later 30 years the mountainous agroforestry and pastoral agro-ecosystems which shaped the current landscape of these areas have been progressively abandoned in association with major sociodemographic and economical changes, which have led to depopulation, population ageing, farmland abandonment and grazing decline. These changes have facilitated the expansion of wild fires through these areas that impoverished their natural capital stocks and flows of regulating ecosystem services. Tourism and the demand for cultural services in these areas have exhibited an opposite trend, what has led to the expansion of the tourism supply, including accommodation and the offer of recreation services. The traditional natural protected areas policies had contradictory impacts and show somehow exhausted. This paper bases on empirical evidence collected to the Natural Park (NP) of Serra da Estrela (NPSE) to illustrate the decline on both the social and natural capital, and on the respective flow of services (social and natural capital based), along with the increase on the demand of cultural services. Ecosystem mapping and economic valuation methods have been employed, along with the regional data available to estimate some indicators for green accountability. The main goal of the paper is to use the evidence abovementioned to anchor a discussion on innovative solutions for the value capture of the services of natural capital at the local level. These build largely on the acknowledgement of the local population, the tourists and visitors, the general public, along with the economic and political actors, of the scarcity and the cost (and value) of the provisioning, regulating and cultural services supplied by the mountainous areas.

## Sy15005

### **Assessment of fire hazard regulation ecosystem service in a mountain area in northeastern Portugal**

Ângelo Sil<sup>1</sup>, Paulo M Fernandes<sup>2</sup>, Cristina Marta-Pedroso<sup>1</sup>, Joaquim Alonso<sup>3</sup>, Ana Paula Rodrigues<sup>1</sup>, João C. Honrado<sup>4</sup>, Ajith Perera<sup>5</sup>, João Azevedo<sup>1</sup>

<sup>1</sup>*CIMO - Polytechnic Institute of Bragança, Bragança, Portugal*, <sup>2</sup>*CITAB - University of Trás-os-Montes and Alto Douro, Vila Real, Portugal*, <sup>3</sup>*Polytechnic Institute of Viana do Castelo, Viana do Castelo, Portugal*, <sup>4</sup>*InBIO – University of Porto, Porto, Portugal*,

<sup>5</sup>*Ontario Forest Research Institute, Ontario, Canada*

The fire hazard regulation ecosystem service (ES) is the capacity of ecosystems and landscapes to maintain the frequency and intensity of fire events. Assessing how ecosystems and landscapes regulate fire hazard is of utmost importance to avoid or mitigate negative environmental and socioeconomic impacts as well as to understand the benefits that human societies can obtain and their value. This study aimed to understand how landscape change affects fire behavior at the landscape level and to understand how these changes in fire impact human communities, i.e., what is the role of the landscape structure in the provision of the fire hazard regulation ES and what is the value of this service. This allows the identification of trends in present landscapes that can be used in future planning and management. The study was conducted in the Sabor River's upper basin in northeastern Portugal. The assessment was based on fire behavior modeling in the study area under five landscape scenarios (1990, 2006 and three future alternative landscapes). Modeling was conducted with BFOLDS (Fire Regime Model, v2.0). Simulations ran under extreme weather conditions, from thirty ignition points randomly located. The valuation assessment was based in the potential effects of fire on timber, firewood and mushrooms production, based on the relationship between average burned area and the economic value of ES. Between 1990 and 2006 the simulated average burned area increased while the average fire intensity decreased over time. Regarding the three alternative scenarios, the forest expansion scenario showed, on average, larger and more intense fires when compared with the rural abandonment and the shrubland expansion scenarios, as well as with previous dates. The potential losses in ES in monetary units followed the trends observed for fire behavior. In spite of this, the forest expansion scenario shows the highest supply and value of ES.

#### Acknowledgments

This work is funded by FEDER funds through the Operational Programme for Competitiveness Factors - COMPETE and by National Funds through FCT - Foundation for Science and Technology under the project PTDC/AAG-MAA/4539/2012 / FCOMP-01-0124-FEDER-027863 (IND\_CHANGE).

**Sy15006**

**No man's land. A tail on mountain areas socio-economic and environmental degradation at the Portuguese Centro Region**

António Dinis Ferreira

*CERNAS - ESAC - IPC, Coimbra, Portugal*

We present the evolution of landscape, population, economic activities, environmental degradation and the impact on the livelihood, environmental services and natural risks associated with changes suffered by various types of Mountain areas in the Portuguese Centro Region. The mountain areas are presented in their diversity and attractiveness, to explain the different rates of depopulation and environmental degradation. The mountains in the region had different levels of attractiveness, some granite mountains showing signs of pre-historical times, while in other a more permanent settlement was only possible after maize introduction. One century ago, despite all differences, mountain areas had a diversified landscape as a result of the typical multi-activity resultant of the need to make a living in a harsh and fragile environment. This included forestry, a low productivity agriculture, grazing and charcoal production. With demographic growth these ecosystems were under pressure. The way of life was particularly rough, reason why, following forestation policies of communal land used for grazing, depopulation started, in most cases during the 1930-1950 period. This decreased the capacity to manage the landscape, and resulted from the middle of the 1970s in the appearance of frequent and severe forest fires that became recurrent and deleterious events. The depopulation process depends on the relative weight of the other activities and their capacity to provide a decent living from nowadays standards, had a overwhelming impact on schist villages, while many granite mountains still keep some population, although decreasing. The limestone mountains, located in more populated littoral areas, have the least decreases in population. The burning of large areas, lead private owners to replaced Pinus by Eucalyptus, that is becoming dominant, especially in schist mountains. In addition to the analysis of landscape evolution during the last century, we discuss the different political, legal and governance contexts, and the potential to reverse the dereliction and degradation processes.

## **Sy16001**

### **Grassland vegetation influenced by farming systems in Romanian Carpathian Mountains (case studies)**

Veronica Sarateanu

*Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, Timisoara, Romania*

Romanian Carpathian Mountains represents 53 % from the entire Carpathians, respectively 66,300 square kilometers (27.8 % from the territory of Romania). The Carpathians' length is about 1500 km, Romania having 910 km on its territory. The average altitude of the Romanian Carpathians is 840 m, only the southern sector reaches heights over 2500 m (2544 m Moldoveanu peak). One of the great natural resource of the Romanian Carpathian is represented by pastures and hay meadows with high biodiversity. This fact is due to the wide inter-mountain depressions, and the plateau like heights covered with grasslands and forests. The alpine grasslands represent a very small part of the total grassland surface, most of it consisting in secondary grasslands found in the deciduous and coniferous forests level created by centuries by humans for livestock. The secondary grasslands from Romanian Carpathians are highly rich in species. Farming activities from the past have created and maintained most of the herbaceous vegetation swards that have developed specific vegetation communities and habitats. The dominant farming system in the Romanian mountain area is still extensive, that is proper for the maintenance of the great biodiversity. The purpose of the paper is to present several case studies of grasslands and farming systems from different sectors of the Romanian Carpathians. The main constraints in the mountain area are depopulation and population ageing; one of the immediate effects is secondary grassland abandonment followed by shrub encroachment and other vegetation succession phases.

#### Acknowledgments

UEFISCU, Ministry of Education and Research.

## **Sy16002**

### **Sustainable grazing in tundra? Assessing the ecological impacts of sheep grazing in Iceland**

Bryndís Marteinsdóttir<sup>1</sup>, Isabel C Barrio<sup>1</sup>, Ingibjörg Svala Jónsdóttir<sup>1,2</sup>

<sup>1</sup>University of Iceland, Reykjavik, Iceland, <sup>2</sup>University Centre in Svalbard, Longyearbyen, Norway

Sheep grazing is a main component of agricultural systems in the North. Over the centuries grazing by sheep has not only shaped landscapes and biodiversity, but also rural economies and culture. The sustainability of these systems has been questioned as stocking rates often exceed the carrying capacity of the land, leading to irreversible ecosystem degradation. In Iceland, sheep grazing has been associated with extensive soil erosion, particularly in the summer rangelands within the volcanic active zone. The ecological impacts of sheep grazing have been well documented in ecosystems outside Iceland, but to what extent these results apply to the particular conditions in Iceland remains poorly evaluated. While studies on the effect of sheep grazing have been carried out in Iceland, most have only been published in Icelandic, as internal reports, in local journals or as abstracts of conferences and meetings, or remain unpublished, and are thus not accessible to a wider, international research community. We synthesized all available information, with special focus on the gray literature, on the ecological impacts of sheep grazing on tundra rangelands in Iceland. We searched local databases and used expert knowledge to identify relevant studies; we compiled over 300 documents, but only a few contained extractable information that we could use in our data synthesis. General trends suggest that sheep grazing in Iceland, together with harsh climatic conditions and soil characteristics, retards succession in sparsely vegetated lands and hampers land restoration efforts. Sheep grazing has long-lasting effects that do not easily revert even after decades of grazing cessation and soil erosion remains one of the main environmental problems associated to sheep grazing in Iceland. A better understanding of the ecological impacts of sheep grazing is required to inform sustainable grazing practices adapted to the local conditions of this region.

#### **Acknowledgments**

ICB was supported by a postdoctoral fellowship funded by the Icelandic Research Fund (Rannsóknasjóður, grant nr 152468-051).

### **Sy16003**

#### **Agroforestry systems in North-Eastern mountains of Portugal: a portrait in the transition for the XXIst century**

Filipa Torres-Manso<sup>1</sup>, Ana Marta-Costa<sup>1</sup>, Marina Castro<sup>2</sup>, Manuel Tibério<sup>1</sup>

<sup>1</sup>UTAD, Vila Real, Portugal, <sup>2</sup>IPB, Bragança, Portugal

**Abstract:** The gathered results from population and agricultural census of the past decades have demonstrated a significant decrease of the inhabitants of the North-Eastern mountain regions of Portugal. This depopulation has been reflected in rural activity and particularly in extensive grazing systems. As a result of the rural areas abandonment, the previously compartmentalized landscape by mosaic agroforestry, where agricultural fields were alternated with forest, shrublands and pastures, currently appears dominated by tall shrubs or burned areas with representative dimensions. This situation leads us to ask about the current context of the agrosilvopastoral activity and what are their prospects for the future. The demand for such responses have originated a series of studies focused on those territories, to assess the constraints and motivations of shepherds who have remained here and those who have emigrated and have already come back. These approaches include interviews with shepherds and the survey/registration of traditional grazing paths, namely, in the Natura 2000 Network Sites of Alvão/Marão Mountains, Montemuro Mountain, Morais/Azibo, Montesinho/Coroa /Nogueira and Douro International. From the socioeconomic point of view, the low yields from agriculture, given the poor valorisation of its products; the low productivity of the systems; the great demand for hand labour; and the aging population, were identified as some of the factors that have contributed to that decline. However, many of the shepherds, who have come back, highlight advantages of the used traditional pastoralism, when compared with other labour activities practiced as migrants. Others, having taken advantage of new learning, have tried to implement new agrosilvopastoral models. Nowadays, the mountain grazing systems, despite its regression, seem to be renewing. They do not have a single standard, but include a diversity of situations. However, besides they are still insufficient for an adequate landscape management, it is important to know about their sustainability.

#### **Acknowledgments**

This work is supported by: European Structural and Investment Funds in the FEDER component, through the Operational Competitiveness and Internationalization Programme (COMPETE 2020) [Project No. 006971 (UID/SOC/04011)]; and national funds, through the FCT – Portuguese Foundation for Science and Technology under the project UID/SOC/04011/2013.

## **Sy16004**

### **Management of range resources in mountain areas of Middle Atlas - Morocco and in North Portugal**

Ahmed El Aich<sup>1</sup>, Marina Castro<sup>2</sup>

<sup>1</sup>*Institut Agronomique et Vétérinaire Hassan II, Rabat, Morocco,* <sup>2</sup>*IPB-CIMO, Bragança, Portugal*

Rangelands cover 69% of the world's agricultural land (FAO Stats 2009) and around 40% of all global land surface. They occupy 32% of the land surface in Portugal (ICNF 2013) and 42% in Morocco. Most of these rangelands are managed by nomads and transhumant pastoralists in Morocco, and by semi-sedentary in the North of Portugal. Pastoral systems have undergone profound changes. Among the trends and perturbations faced by pastoralists across the world, we can enumerate demography changes and breakdown of the traditional local institutions and systems for managing natural resources. Recently, since ecological integrity of pastoral systems that sustained natural resources for a long time depended on the mobility of people and herds, the United Nations Environment Programme (UNEP) considered transhumant feeding systems for livestock as one of the most sustainable. As consequence, productivity of rangelands became highly variable and hardly sustain livestock requirements, especially, in mountain regions where the winter cold is an additional limiting factor for vegetal production. Therefore, livestock producers developed specific strategies to cope with the changes. The aim of this study is to document the changes livestock farming systems are going through and compare the strategies developed by livestock owners in mountainous regions in Morocco and Portugal. Our results show that in the Middle Atlas, farmers opt for diversification of agricultural activities with an intensification of livestock systems. The cost of production for livestock is increasing as consequences of rangeland degradation due to overstocking. In Portugal, pastoralism based on daily grazing routes, has constantly decreased over the years. As a result, rangelands are often under-grazed and wildfires have and are continuously increasing.

## **Sy16005**

### **Innovation and tradition in livestock farming in the south-western Alps**

Massimiliano Probo, Giampiero Lombardi  
*University of Torino, Torino, Italy, Italy*

In the Western Italian Alps, profound socioeconomic changes have affected traditional livestock farming systems during the last 50 years, with the number of livestock farms, permanent grasslands, and numbers of cattle decreasing by 92, 62, and 44%, respectively. However, semi-natural grasslands still cover about 370,000 ha within the Piedmont Region, 75% of which are located in mountain areas and exploited by farms that yearly move about 70,000 heads from the Po Plain and valley-floors to summer pastures. As semi-natural grasslands provide a wide set of ecosystem services to society, the Rural Development Programme (RDP) 2007-2013 used agro-environmental payments to subsidize grassland management planning through Pastoral Plans (PP) and implement restoration actions, such as Temporary Night Camp Areas (TNCA) for cattle. The PP promoted the implementation of rotational grazing systems with stocking rates based on recommended levels calculated from vegetation characteristics to enhance the uniformity of grazing and avoid problems of undergrazing and subsequent shrub-encroachment. TNCA were implemented to restore shrub-encroached grassland using livestock. Case studies to analyze the effects produced by PP and TNCA and compare them with the common management system based on continuous grazing were conducted within the Val Tronca Natural Park (SW Alps). With the implementation of PP, cattle distribution patterns were less clustered and the selection of different vegetation communities was more homogenous than under the continuous grazing system. The implementation of TNCA was effective in reducing shrub cover and increased the herbaceous cover and height, as well as the cover of meso-eutrophic grassland species with higher pastoral values. In conclusion, the innovative approaches developed to manage grasslands appear to have the potential to both improve grazing distribution and restore semi-natural grasslands, but further efforts are needed to implement them over a wider scale and in the framework of the new RDP 2014-2020.

## **Sy16006**

### **Recovery of mountain rangelands**

Esther Fernández-Núñez, Ricardo Faria, Margarida Arrobas, Thiago Rizzi, Carlos Aguiar, Manuel Rodrigues, Nuno Moreira, Jaime Pires

*Mountain Research Centre, Instituto Politécnico de Bragança, Bragança, Portugal*

In the Northeast of Portugal, sowing rainfed pastures based on self-reseeding annual legumes could be a viable option to return abandoned cropland into agriculture. In this context, an experiment was carried out in Vila Meã (Bragança) since autumn 2012, which has as main goal the evaluation of the best technology to recover abandoned cropland or unproductive pastures, based on either spontaneous vegetation or sown species, in any case considered as rangeland areas. The experiment comprised the study of 12 treatments, three sowing techniques, such as, sowing with sheep trampling, sowing with scarification, direct sowing and no sowing (existing vegetation), crossed with three types of fertilization, organic fertilization, mineral fertilization (Ca+P+K), and no fertilization. The main results showed an important increase in dry-matter yields, when organic fertilization was applied, allowing the replacement of the conventional mineral fertilization. In respect to sowing techniques, the sheep trampling presented dry-matter yields with no significant differences to, sowing with scarification and direct sowing techniques. All macronutrient contents, except for potassium and magnesium, presented enough values to satisfy the cattle and sheep needs. In respect to the micronutrients, the values encountered were enough to satisfy the needs of these livestock, except for copper.

## **Sy17001**

### **Karst depressions as sediment traps for glacial deposits: Case studies from the Dinaric karst**

Manja Žebre, Petra Jamšek Rupnik, Jernej Jež  
*Geological Survey of Slovenia, Ljubljana, Slovenia*

The Dinaric karst presents the largest continuous carbonate karst area in Europe. High elevated plateaux of the Dinaric karst were affected by Quaternary glaciations, leaving abundant glacial features and a variety of closed depressions, which can be attributed to the interaction between glacial and karst processes. These karst depressions act as sediment traps, preserving a record of glacial events, and are therefore of great importance for studying the glacial history of karst terrains. We present here sedimentological, geomorphological and geophysical evidence of glaciation from several karst depressions located in the area of Snežnik and Gorski kotar in the northern Dinaric karst, and discuss the relationship between karst and glacial processes. In this research we focus on large karst depressions with diameters greater than 500 m that are located inside or at the margin of the known palaeoglacial extent. All potential depressions presenting a sediment trap for glacial deposits in the study area were extracted with the algorithm for the automated recognition of depressions and later checked on the field. Preliminary results indicate that large karst depressions in this formerly glaciated area host allochthonous deposits of different effective porosity, having an impact on a karst aquifer functioning, and thus interchanging subsurface/surface drainage. We identified examples of karst depressions filled by subglacial till and/or lacustrine deposits, pointing to an inefficient subglacial or proglacial karst drainage. Some of the studied karst depressions are almost entirely flattened by outwash deposits, indicating a dominating surface runoff over karst drainage during glaciation, especially where distal outwash deposits with low effective porosity functioned as an aquitard. In one case, an almost entirely buried moraine within outwash plain was recognised, which was essential in reconstructing the glacial front movements inside one karst depression.

## Sy17002

### **Environmental changes in a high Atlantic mountain area (Western Massif of the Picos de Europa, NW Iberia) since the Last Glaciation**

Jesús Ruiz-Fernández<sup>1</sup>, Marc Oliva<sup>2</sup>, Anabela Cruces<sup>3</sup>, Vera Lopes<sup>3</sup>, Maria da Conceição Freitas<sup>3</sup>, César Andrade<sup>3</sup>, José Antonio López-Sáez<sup>4</sup>, Cristina García-Hernández<sup>1</sup>, David Gallinar<sup>1</sup>, Miguel Gerales<sup>2</sup>

<sup>1</sup>*Department of Geography, University of Oviedo, Oviedo, Spain,* <sup>2</sup>*Centre for Geographical Studies - Institute of Geography and Spatial Planning, University of Lisbon, Lisbon, Portugal,* <sup>3</sup>*IDL, Faculty of Sciences, University of Lisbon, Lisbon, Portugal,* <sup>4</sup>*Center for Humanities and Social Sciences, CSIC, Madrid, Spain*

The Western Massif of the Picos de Europa (43°N – 4-5°W) includes some of the highest peaks in the Cantabrian Mountains. This massif was heavily glaciated during the Last Glaciation, though the post-glacial environmental evolution is still poorly understood. Using a geomorphological and sedimentological approach, we have reconstructed the environmental events occurred in this massif since the Last Glaciation. The geomorphological distribution of glacial landforms suggests the occurrence of four main glacial stages: maximum glacial advance, glacial expansion after the maximum advance, Late Glacial and Little Ice Age. Moreover, a 5.4-m long sedimentary sequence was retrieved from the karstic depression of Belbín providing a continuous record of the paleoenvironmental conditions in this area since the Last Glaciation until nowadays. This section suggests that the maximum glacial expansion occurred at a minimum age of 37.2 ka cal BP, significantly prior to the global Last Glacial Maximum. Subsequently, periglacial processes prevailed in the mid lands of the massif until glaciers expanded between 22.5 and 18.7 ka cal BP. Following the melting of the glaciers, a shallow lake appeared in the Belbín depression. Lake sediments do not show evidence of a cold stage during the Late Glacial, when moraine systems formed at higher locations. The terrestriation of this lake started at 8 ka cal BP and the area turned into grassland. At 4.9 ka cal BP the existence of charcoal particles in the sediments of Belbín sequence reveals the onset of human occupation in the massif through the use of fire activity for grazing purposes. Finally, the presence of moraines inside the highest northern cirques shows evidence of the last glacial phase that occurred during the Little Ice Age. Since then, the warming climate has led to the melting of these glaciers and periglacial processes prevail in the high lands of the massif.

#### Acknowledgments

Cristina García-Hernández gratefully thanks the Ministerio de Educación Cultura y Deporte fellowship programme FPU.

**Sy17003**

**Morphometry and interpretation of Pleistocene and Holocene mass movements at Ancares Range (NW of Iberia)**

Alexandre Luis Vázquez-Rodríguez, Marcos Valcárcel Díaz

*University of Santiago de Compostela, Santiago de Compostela, Spain*

The Ancares Range is a mountain area located at the northwestern of Iberian Peninsula. During the Pleistocene cold stages host a set of alpine glaciers which the evidence of this glaciation has been conserved in different places in form of as morainic ridges, glacial cirques or glacial troughs. After the progressive retreat of the glacial fronts, during the Late Pleistocene and the Holocene, the relief presented suitable conditions for multiple landslides that affected mountain slope dynamic (Valcárcel, 1998). Nowadays, it's easy to identify their appearance and their conservation status, as well as other evidences, which allow to establish their origin and their relative age. Both postglacial - paraglacial dynamic and anthropic activity, related to mining activities in the Roman period, altered the mountain slope stability. Identified 16 mass movements and counting with the 5 meters digital elevation model and with the geomorphological cartography, we have proceeded to their morphometric characterization using Geographic Information Systems (ArcGIS 10), as well as to their interpretation. Finally, it's discussed the role of the paleoenvironmental studies and of the historical context of this area, because the settlements can be affected by the evolution of the mountain slope, as well as they are factors that influences in any territorial planning actions.

## **Sy17004**

### **Pleistocene glaciation in low altitude atlantic mountains: The Xistral mountains (NW Iberia)**

Marcos Valcárcel, Alexandre Luis Vázquez-Rodríguez, Jonathan Hall-Riaza  
*University of Santiago de Compostela, Santiago de Compostela, Spain*

During the Pleistocene cold climates stages, many mountains in the Northwest of the Iberian Peninsula were occupied by local glaciers. The palaeoclimatic conditions allowed the presence of cold climate processes to sea level and the glacial dynamics of the mountain areas. Exceptionally also have existed in mountains whose highest elevations are placed between 700 and 1200 meters above current sea level (Schmitz, 1969, Valcárcel, 1998, Pérez-Alberti et al 1998). The Xistral mountains are located at north of the territory, just 20 km from the coastline and barely exceed 1000 m (Chan de Lamoso peak 1060 m, Xistral peak, 1036 m, Cuadramón peak, 1060 m), although most of the raised surface is a flattened level of 900 m. At its maximum glacial extent were ice caps, formed from the flat surfaces summits and channelled through the pre-glacial valleys of gentle slope. That is why the glacial erosion forms are poorly developed, although their paleoenvironmental meaning is very significant because, along with glaciers described by Schmitz in 1969 in the Serra de Faro de Avión (SW of Galicia), and Daveau et al. (1985) in the Sierra de la Cabreira (N of Portugal), it would be the the lowest glaciers described in the Iberian Peninsula. Moreover, the presence of glaciers of low altitude is well documented throughout the European Atlantic area, from the Hartz Mountains (Hövermann, 1953, 1956, 1974), in northern Germany, to the mountains of North and NW of the Iberian Peninsula (Lotze, 1962; Kopp, 1965; Pérez Alberti et al., 1993; and Valcárcel et al., 1996, 2001), through the Dartmoor (Evans et al. 2012) and Exmoor mountains (Harrison et al. 1998) in the South of England. In this work aims to highlight the importance of low altitude glaciation in the European Atlantic context from the study of Xistral Mountain example and its paleoenvironmental implications.

## Sy17005

### **The periglaciation of the Iberian Peninsula. Spatial and temporal variability**

Marc Oliva<sup>1</sup>, Enrique Serrano<sup>2</sup>, Antonio Gómez-Ortiz<sup>3</sup>, María José González-Amuchastegui<sup>4</sup>, Alexandre Nieuwendam<sup>1</sup>, David Palacios<sup>5</sup>, Augusto Pérez-Alberti<sup>6</sup>, Ramon Pellitero-Ondicol<sup>7</sup>, Jesús Ruiz-Fernández<sup>8</sup>, Dermot Antoniades<sup>9</sup>

<sup>1</sup>*Centro de Estudos Geográficos, IGOT - Universidade de Lisboa, Lisboa, Portugal,*

<sup>2</sup>*Department of Geography, University of Valladolid, Valladolid, Spain,* <sup>3</sup>*Department for Physical and Regional Geography, University of Barcelona, Barcelona, Spain,*

<sup>4</sup>*Department of Geography, Prehistory and Archaeology, University of the Basque Country, Spain, Vitoria, Spain,* <sup>5</sup>*Department for Regional and Physical Geography, Complutense University of Madrid, Madrid, Spain,* <sup>6</sup>*Department of Geography,*

*University of Santiago de Compostela, Spain, Santiago de Compostela, Spain,*

<sup>7</sup>*Department of Geography and Environment, University of Aberdeen, Aberdeen, UK,*

<sup>8</sup>*Department of Geography, University of Oviedo, Spain, Oviedo, Spain,* <sup>9</sup>*Department of Geography & Centre for Northern Studies (CEN), Université Laval, Laval, Canada*

Active periglacial processes are currently marginal in Iberia, spatially limited to the highest mountain ranges. However, a wide variety of periglacial deposits and landforms are distributed in low and mid-altitude environments, which shows evidence of past periods of enhanced periglacial activity. The purpose of this paper is to summarize the present knowledge of past periglacial activity in the Iberian Peninsula. The chronological framework takes four main stages into account: the last glaciation, deglaciation, Holocene and present-day processes. This study focuses on the highest massifs (Pyrenees, Cantabrian Range, NW ranges, Central Range, Iberian Range, Sierra Nevada) as well as other lower elevation environments, namely the central Meseta. During the last glaciation the periglacial belt extended to much lower altitudes than today, reaching current sea level in the NW corner of the Iberian Peninsula. A wide range of geomorphological landforms and sedimentary records is indicative of very active periglacial processes during that phase, in some cases related to permafrost conditions (block streams, rock glaciers). Most of the inactive landforms and deposits in low and mid-elevations are also related to this phase. The massive deglaciation of the Iberian massifs was caused by a gradual increase in temperatures. The deglaciation phase was only interrupted by a short period with colder conditions (the Younger Dryas) that reactivated periglacial processes in the formerly glaciated cirques of the highest lands, specifically with the widespread development of rock glaciers. During the Holocene, periglacial processes have been only active in the highest ranges, shifting in altitude according to temperature regimes and moisture conditions. The Little Ice Age saw the reactivation of periglacial activity in lower elevations than today. Currently, periglacial processes are only active in elevations exceeding 2500 m in the southern ranges and above 2000-2200 m in the northern, higher in Sierra Nevada, in the south of Iberia.

## **Sy17006**

### **Macro-fabric analysis in relict rock glaciers, Cantabrian Mountains (NW Spain)**

Rosa Blanca González-Gutiérrez<sup>1</sup>, Javier Santos-González<sup>1</sup>, João António Bessa Santos<sup>2</sup>, José María Redondo-Vega<sup>1</sup>, Amelia Gómez-Villar<sup>1</sup>, Jeffrey Reed Irwin<sup>3</sup>

<sup>1</sup>*University of León, León, Spain,* <sup>2</sup>*San Jose State University, San Jose, California, USA,*

<sup>3</sup>*South Dakota State University, Brookings, South Dakota, USA*

Approximately 180 relict lobate and tongue-shaped rock glaciers are widespread in the Cantabrian Mountains, indicating past permafrost distribution in these mid-latitude mountains. They are primarily located within glacial cirques, facing north and northeast, at the foot of quartzite and sandstone escarpments and over 1600 m, with some exceptions. Surficial macro-fabric analysis of over 40 rock glaciers including both ridges and furrows were conducted. In each case the orientation and dip of 50 clasts was determined. Only clasts over 10 cm (normally 20 cm) and L/W ratios over 1,5 were measured. All data was represented in equal-area nets providing information about fabric distribution. Eigenvalues were also calculated for each sample. In a few scenarios, exposures in the rock glaciers allowed internal macro-fabric and grain size analysis to be conducted, something very rare in the literature. Data presents weak fabric in furrows, but dominant clast alignments in ridges, showing parallel and, in some cases, perpendicular alignments to the rock glacier paleoflow. These differences are likely related with compressive flow in the ridges and extensional flow in the furrows. Clast collapse and mobilization may also occur after the rock glacier ice melts but generally they maintain their original form. When compared with active rock glaciers they shown similar dynamics. Significant differences between lobate and tongue-shaped rock glaciers were observed, probably related to the greater size of the second. Lithology also had an influence in rock glacier shape preservation with quartzite-composed rock glaciers being better preserve than sandstone rock glaciers. Rock glaciers with other type of lithology are quite rare, probably due to post depositional modification.

## **Sy18001**

### **20 years developing models and tools for forest growth and yield in a sustainability context in Galicia (Spain)**

Alberto Rojo-Alboreca, Juan G. Álvarez-González, Ulises Diéguez-Aranda, Roque J. Rodríguez-Soalleiro

*Unidade de Xestión Forestal Sostible, Escola Politécnica Superior, Universidade de Santiago de Compostela, Lugo, Spain*

We present the results of twenty years (1995-2015) of research on the growth and yield of the major forest species in Galicia by the Sustainable Forest Management Unit (UXFS). We describe the network of permanent plots installed to gather the necessary information to develop growth models for supporting forest-management decision-making in the region, funded by public and private organizations. The analysis of the data resulted in numerous doctoral theses, bachelor theses, congress communications, and scientific articles. In 2009 we did a review and compilation of the models and published the book "Silvicultural tools for sustainable forest management in Galicia" (available at [www.usc.es/uxfs](http://www.usc.es/uxfs)), which includes a CD-ROM with software applications, namely (i) several files in the Microsoft® Office Excel spread sheet which allow a simple but versatile use of most of the tools presented in the different chapters of the book (site index curves, yield tables, stand density management diagrams, diameter distributions, generalized height-diameter equations, merchantable volume equations, volume equations from stump dimensions, and biomass equations), and (ii) the growth and yield simulator GesMO® (initially developed in 2004), which allows simulation and economic evaluation of management prescriptions at stand-level. In 2012 we updated the book, the spread sheet files, and GesMO®, which currently includes dynamic models for single-species, even-aged stands of *Betula pubescens*, *Pinus pinaster*, *P. radiata*, *P. sylvestris* and *Quercus robur*. In 2015 we developed a dynamic model for first rotation clonal and seedling *Eucalyptus globulus* plantations, which has been implemented in the free-access web application EucaTool® (available at <http://app.eucatool.com/>). We finally discuss some future research lines concerning growth and yield modelling as key components for forest-management decision-making in Galicia.

## **Sy18002**

### **Providing tools to improve forest management in the northeastern region of Portugal**

Fernando Pérez-Rodríguez<sup>1,2</sup>, Luís Nunes<sup>1,2</sup>, Ângelo Sil<sup>1,2</sup>, João Azevedo<sup>1,2</sup>

<sup>1</sup>*Instituto Politécnico de Bragança, Bragança, Portugal*, <sup>2</sup>*Centro de Investigação de Montanha, Bragança, Portugal*

The sustainable use of natural resources, such as forest resources, require sound management practices, from both environmental and socioeconomic perspectives, supported by reliable and accurate models and tools developed at proper scales. In forestry, however, tools that use regionally adjusted growth and yield models may not always be available, in particular in mountain areas where local environmental conditions affect tree growth in particular ways. In order to solve existing technical constraints that limit sustainable forestry at the stand and at the landscape level and to encourage and support sustainable wood mobilization in the northeastern region of Portugal, we developed a set of tools targeted to both forest managers and forest owners: FlorNExT<sup>®</sup> and FlorNExTPRO<sup>®</sup>. FlorNExT<sup>®</sup> is a friendly-user cloud computing tool for the simulation of forest growth and thinning operations, directed to forest managers and owners. This application was designed to allow estimates of current stand volume, biomass and carbon content of maritime pine and Pyrenean oak stands to be made easily by any stakeholder, as well as to estimate future forest growth and yield based on four stand variables: age, density, dominant height and basal area. FlorNExTPRO<sup>®</sup> is a desktop tool that provides a spatial framework to forest optimization using a linear programming approach. The tool tests all the possible combinations of silvicultural plans defined by the user for a set of management units. In addition, the user can apply constraints to the simulations, such as maximum harvested or thinned area, or minimum volume to be removed per period, among other options. Both tools implement a dynamic growth and yield model framework which integrates different transition functions for dominant height (site index curves) and basal area, along with equations of tree and stand volume and structural models to plan thinning operations of variable intensity.

#### Acknowledgments

SIMWOOD project (Sustainable Innovative Mobilisation of Wood), EU FP7 Collaborative Project 2013-2017 Grant Agreement No. 613762.

## **Sy18003**

### **Decision Support System for Sustainable Forest Management in Galicia (Spain)**

Ulises Diéguez-Aranda, José Mario González-González, Manuel Arias-Rodil  
*University of Santiago de Compostela, Lugo, Spain*

In Galicia, forestry is a very important ecological, economic, and social activity. In order to help forest managers in their decision-making process, one of the main tasks of the Sustainable Forest Management Unit (UXFS, University of Santiago de Compostela) during the last 20 years has been the development of growth and yield models for the major forest species in the region. Their implementation in computer programs freely available, such as GesMO<sup>®</sup> and EucaTool<sup>®</sup> (a desktop and a web application, respectively), enables the simulation of different silvicultural prescriptions and evaluation of their consequences in the forest system, facilitating the use of the models by practitioners. Nevertheless, all these tools do not constitute a truly decision support system (DSS) for forest management, which should integrate a database management system (DBMS) with analytical and operational research models, graphic display, tabular reporting capabilities and the expert knowledge of scientists, managers and decision makers to assist in specific decision-making activities. We explain in this work the current state of development of a forest management DSS for Galicia, which is being developed by UXFS members. At the moment, this computer-based information system includes a DBMS and modules for data acquisition and processing, stand growth simulation, and optimization at both stand- and forest-levels using different objective functions (which may involve a single objective or several goals) and various optimization techniques (e.g. linear programming, binary integer programming, heuristics).

#### Acknowledgments

Contracts with the company "CERNA, Ingeniería y Asesoría Medioambiental S.L.P." under projects funded by the Xunta de Galicia 10MRU009E, 07MRU027E, PGIDIT04RFO002E.

## **Sy18004**

### **SIMANFOR. Support tool on cloud for simulate alternatives in sustainable forest management in Spain.**

Felipe Bravo, [A.Cristóbal Ordóñez](#)

*University of Valladolid, Palencia, Castilla y León, Spain*

Growth and yield models at different scales are useful tools for forest stakeholders. Adequate simulation of forest stand conditions after different silvicultural scenarios allows stakeholders to adopt appropriate actions to maintain forest integrity while forest products and services are obtained to benefit society as a whole. SIMANFOR was been conceived as a free use web platform able to gather growth and yield models as well as forest inventories for which it has scalable structure integrating different modules to manage forest inventories, simulate and project stand conditions and maintain systems security and integrity. Within this SIMANFOR environment it is possible to simulate sustainable forest management alternatives, obtaining outputs compatible with an Office environment (Microsoft or Open), allowing users to exchange data and files between SIMANFOR and their own software. New modules are being developed such as representation system or optimization ones.

## **Sy18005**

### **AppTitude: Integration of different ecosystem services in forest optimization approaches**

Fernando Pérez-Rodríguez<sup>1,2</sup>, João Azevedo<sup>1,2</sup>

<sup>1</sup>*Instituto Politécnico de Bragança, Bragança, Portugal*, <sup>2</sup>*Centro de Investigação de Montanha, Bragança, Portugal*

Forests provide many goods and services supported by different functions and involving different stakeholders. For example, the actual social context favours recreational uses of forests but, at the same time, forest managers and owners aim the highest production of wood products. It means that depending on the point of view of person that is seeing the forest, this has different value. Or, in other words, the value of forest is subjective depending on the demand of services and productions. In this case the human factor appears, and psychology should be taken into account in the decision-making process. In these terms, expert opinion is characterized by a large experience in the forest sector and can provide enough information to evaluate suitability of forests according to different objectives, products, services, and uses. In this context, the forest management has to integrate many disciplines and the trend in decision making is to use a multi-actor approach, overall in mountains region, where several ecosystem services and products could be necessary evaluated in decision making to identify conflicts among uses/objectives. The combination of: i) expert opinion, by analysis judgments methods like Analytic Hierarchy Process (AHP) or Multi-Attribute Utility Theory (MAUT), ii) growth forest dynamic models, iii) different spatial information and iv) Multi-criteria Decision Making methods like linear programming (LP), we have the capability of simulate different and complex scenarios in temporal and spatial scales. This combination of methods is not easy because require of the use of too large data and calculation process. To solve it we developed AppTitude<sup>®</sup> to automatize the hierarchy of methods to evaluate the suitability of the Nordeste region for different forest management objectives and will compare it with the actual distribution forests and their uses/objectives.

#### Acknowledgments

SIMWOOD project (Sustainable Innovative Mobilisation of Wood), EU FP7 Collaborative Project 2013-2017 Grant Agreement No. 613762.

**Sy19001**

**Testing Lithogenic Thorium-232 for Fingerprinting of Slush Flows Debris Sources and Sinks in the Khibini Mountains, Kola Peninsula, North-Western Russia**

Ekaterina V. Garankina, Vladimir R. Belyaev, Maxim M. Ivanov  
*Lomonosov Moscow State University, Moscow, Russia*

The Khibiny mountains is a developing ski resort at the Kola Peninsula, Northern Russia. At the same time it is an arena of widespread hazardous processes, most dangerous amongst which are slush flows and snow avalanches. Hackman valley located in the southern Khibini is affected by frequent slush flows. This process is similar to debris flows, but most of the oversaturated flow mass is represented by snow and ice, while debris compose about 10%. To evaluate geomorphic effects of these hazardous processes it is important to distinguish both main sediment sources with their relative contribution and zones of debris deposition. Fingerprinting approach has been proved to be useful for determination of sediment sources and sinks in wide variety of geomorphic landscapes. Radionuclides can be used for fingerprinting purposes in cases if their chemical properties determine dominant redistribution in fixed conditions with sediment particles. We attempted to apply the natural lithogenic radionuclide Thorium-232 ( $^{232}\text{Th}$ ) for slush flows debris fingerprinting. Hackman Valley geological structure is characterized by alternation of plutonic complexes with different content of radioactive isotopes. In addition, radioactive mineral exploration was active in the Hackman basin in 1930s. Later it was closed, but its dumps on the valley slope under the mine entrance still represent the potential source of the radioactive material for the main stream and slush flows sediment transport. The mine entrance is located on upper part of the right valley slope in its middle reach. We have attempted to assess the radioactive  $^{232}\text{Th}$  transfer from the sediment sources (slope scree, avalanche channel fans and eroded banks) into the main stream channel bed sediment and debris deposition zone. The results show that the fingerprinting approach make it possible to assess sediment sources, debris transport distance and some specifics of slush flows dynamics in the case study basin.

## Sy19002

### **Spatial variation of Hydrological processes in slope Intability evaluation in agricultural terraces: S. Luiz Estate, Alto Douro Wine Region.**

Joana Fernandes<sup>1</sup>, Carlos Bateira<sup>4</sup>, Laura Soares<sup>2</sup>, António Costa<sup>1</sup>, Bruno Fonseca<sup>1</sup>, Rui Moura<sup>3</sup>

<sup>1</sup>FLUP – Faculty of Arts of the University of Porto, Porto, Portugal, <sup>2</sup>CEGOT – Centre of Studies on Geography and Spatial Planning, Porto, Portugal, <sup>3</sup>FCUP - Faculty of Sciences of the University of Porto, Porto, Portugal, <sup>4</sup>Riskam, CEG, IGOT/FLUP, UP, Porto, Portugal

The construction of terraces, in the Douro Region (Adorigo, Tabuaço), with earthen risers a set of problems related to the hydrological flow processes. The main objective of this work focuses on the evaluation of the spatial variation of potentially saturated areas and establish a correlation with the contributing areas used in modelling the susceptibility to landslides. The combination of the electrical resistivity values with the hydrologic modelling and topographic indexes, intended to correlate the spatial variation of subsurface hydrological processes and the hydrological models used to evaluate the slope instability. As input data was used a digital terrain model with a pixel of 1m<sup>2</sup>, obtained by automatic stereo-correlation. The main objective is to evaluate the viability of the use of digital terrain models in the spatial variation of the hydrological process. The results analysis shows a moderate statistical correlation between electrical resistivity and with the distributed flow used by Shalstab model, assuming that the lowest resistivity values correspond to areas of water circulation under the main path internal flow. Lastly, we proceeded to a concordance analysis of the areas identified as saturated with inventory of instability processes related to landslides along the terrace earthen risers.

#### Acknowledgments

CloudMapper - Plataforma de processamento e disseminação de dados georreferenciados.

### **Sy19003**

#### **Using roughness and C-factor in a connectivity index to evaluate the impact of land use/cover changes in a Mediterranean mountain catchment**

Ivan Lizaga<sup>1</sup>, Laura Quijano<sup>1</sup>, Leticia Palazón<sup>1</sup>, Leticia Gaspar<sup>2</sup>, Ana Navas<sup>1</sup>

<sup>1</sup>EEAD-CSIC, Zaragoza, Spain, <sup>2</sup>MNCN-CSIC, Madrid, Spain

Sediment connectivity has an important effect on the development of morphological landforms features being one of the greatest landscape modifiers. Therefore variations in connectivity have a great effect in organic matter distribution and soil quality. Land use and land cover patterns are linked to natural and anthropogenic activities. Particularly, in the Mediterranean region, the development of agriculture with a long history of cultivation is associated with significant changes in the original landscape. Agriculture intensification in Mediterranean agroecosystems and posterior land abandonment and reforestation have significantly affected the hydrological behavior and the connectivity pattern. In Spain land abandonment has particularly increased since the 1960s as a consequence of complex socio-economic changes leading to depopulation of rural areas. In this study, a medium size catchment (23 km<sup>2</sup>) located in the central part of the Ebro Basin in the north-east of Spain, representative of Mediterranean mountain agroecosystems was selected to assess the effect of land use changes during the last decades on the hydrological system and the connectivity of runoff. To this purpose a topography - based index "Connectivity index" has been estimated and further complemented with two land use maps for 1957 and 2012. Sediment connectivity was estimated using a numerical modeling approach to simulate how connectivity changes due to the different land covers. To improve this model we use land cover C-factor and roughness index as a weight factor to model how connectivity changes with land uses/cover and also considering the low strata bedding and the steep slope agriculture. A high resolution (2m) DEM was created filtering and applying a multiscale curvature classification algorithm over IGN unclassified LIDAR data since the accuracy of models is highly dependent on the quality of DEM and its resolution. Understanding landscape patterns and interactions of human activities are essential for land management in Mediterranean agroecosystems.

#### **Acknowledgments**

Formación de personal investigador: BES-2015-071780 Asociado al proyecto "Redistribucion de suelo y nutrientes y cuantificacion de aportes de distintos usos de suelo:geoespacializacion y modelizacion isotopica en un agroecosistema de montaña" CGL2014-52986-R.

## **Sy19004**

### **Soil Erosion Risk Modeling in the Alps - Modeling Approach and Importance for a Soil Erosion Risk Assessment in Swiss Alpine Grassland**

Simon Schmidt, Katrin Meusburger, Christine Alewell

*Environmental Geosciences, University Basel, Basel, Switzerland*

Soil erosion on grassland is generally neglected due to its protective character of dense grass vegetation on soil loss. However, recent studies by Meusburger et al. (2012), Konz et al. (2012) and Alewell et al. (2014) showed that large amounts of topsoil are also mobilized on grassland, especially in the Alpine area. Furthermore, it is expected that rainfall erosivity is going to increase from May to October with impacts on soil erosion in Switzerland (Meusburger et al., 2012). So far, seasonal erosion dynamics on grassland in Switzerland is not assessed yet. To map the spatial and temporal extent of soil erosion risk by water, we are using the Revised Universal Soil Loss Equation (RUSLE) with adapted factors for alpine grasslands. Among the five factors R (rainfall erosivity), C (cover management), K (soil erodibility), LS (slope length and steepness), and P (support practice), R and C are highly dynamic within a year. To account for this seasonality, the R-factor is calculated on a monthly scale and spatially interpolated with a regression-kriging approach based on high spatiotemporal covariates. The seasonal cover management factor on grassland (mainly assessed through soil coverage) is derived from high resolution satellite images. An expanded data set of the Land Use/Cover Area frame Statistical Survey (LUCAS) is used for estimating the soil erodibility. Modifications for alpine LS-factors are evaluated regarding their suitability. Support practices first need to be parameterized and tested with different scenarios on alpine grassland practices. The combination of the factors R and C highlights temporal time slots with highest soil erosion risk. Selective erosion control is enabled due to the high spatiotemporal resolution of the modified RUSLE approach on alpine grassland. The model can be seen as a prototype for grassland erosion modeling in European high mountainous regions based on the excellent database for Switzerland.

#### Acknowledgments

The research has been funded by the Swiss Federal Office for the Environment (FOEN) (project N° N222-0350).

**Sy19005**

**Soil rock fragment profiles in degraded and pristine sites of a mountain area, NE Portugal**

Felícia Fonseca<sup>1</sup>, Tomás Figueiredo<sup>1</sup>, Ana Sofia Pires<sup>1</sup>, Jean Poesen<sup>2</sup>

<sup>1</sup>*Instituto Politécnico de Bragança, Bragança, Portugal,* <sup>2</sup>*Catholic University of Leuven, Leuven, Belgium*

Soil rock fragments are an important feature in the analysis of geomorphological and pedological processes. The rock fragment profile of a soil reflects the prevailing weathering / pedogenetic conditions and the geomorphological instability, namely that associated to erosion. Accelerated erosion resulting from human activities may further disturb topsoil rock fragment profile, so that high surface rock fragment contents commonly indicate a severe soil degradation status. Soils with high rock fragment contents are significantly present in Mediterranean Europe. Leptosols (shallow, with high rock fragment content) are the most represented in NE Portugal in mountain areas. The potential erosion risk in these areas is severe and, due to actual and past land use options or practices and to extensive wildfires, mountain areas depict large tracts of degraded soils. This study compares rock fragment profiles in two sites of a mountain area of NE Portugal, aiming at testing the reliability of using topsoil rock fragments as an indicator of soil degradation. Selected sites were: climax forest (Serra da Nogueira), a pristine area; burnt scrubland (Aveleda), a severely degraded area. In both, lithology (schist), topography, elevation and climate are similar. Samples correspond to soil collected at 6 random points on a 100 m radius area in each site, in a 20x20cm square, successively removing a 3-5cm layer down to 20cm depth. During sampling, depth from a reference level to each freshly exposed layer surface was measured with a laser meter at 9 grid-fixed points. Samples were oven-dried and sieved, and rock fragments (>2mm) mass, volume and mean size were determined. Besides the expected significantly higher rock fragment contents in all layers of the degraded site as compared to the pristine one, results interpretation opened promising developments of rock fragment based indicators of soil degradation, presented and discussed in the paper.

## **Sy20001**

### **The renaissance of draught animal power in Europe**

Pit Schlechter

*FECTU, Schoos, Luxembourg*

At the beginning of the 1990ies young people in Northern and Western Europe started to show interest for a horse-based technology that was about to completely disappear. They repaired old machinery and developed new items while relying largely on their own ideas and means. Some of them were part of the 68 generation. They draw inspiration from the "back to the countryside" movement, from remaining horse-farmers refusing motorization, from the Amish in the US and from the animal traction evolution in developing countries. Working horse associations started almost simultaneously in different countries and made contact, thus laying ground for a European network and a comeback of the working horse for a range of different uses. At the same time an opposing trend is to be seen in Central and Eastern Europe, where hundreds of thousands of small farmers would like to replace their draught animals with tractors. Although there are a number of constraints opposing a wider and faster development of a modern use of animal energy - the poor profile of working animal technology, the lack of skilled horsemen, of new machinery and equipment, of public support etc. - the societal surrounding has never been as favourable as today. A general awareness for sustainable energy sources, for sound techniques in agriculture, forestry, environment management and mobility lead to a growing interest amongst people outside of the closed circle of horse enthusiasts. Animal traction is reappearing in scientific research, in agricultural and forestry schools, in rural and urban development programs etc. Horses, mules and donkeys have always served in mountainous areas and they doubtlessly can compete with the most modern technical options.

## **Sy20002**

### **Animal traction in the Portuguese mountain areas: challenges and opportunities towards sustainable production systems.**

João B. Rodrigues

*APTRAN - Associação Portuguesa de Tracção Animal, Bragança, Portugal*

Working animals represent a very important source of energy all around the world and still play a key role in agricultural and industrial activities, in rural areas but also in urban and peri-urban areas in developing countries, supporting a large population who rely directly on them. Although there is little doubts about the importance of working animals as a source of renewable energy, less impact and economically viable, the recognition of their role remains a neglected area. When facing the Portuguese national reality, the farming sector (even that based in mountains areas) has undergone significant changes over the past few years, with a reduction of about 50% in the number of farms between 1989 and 2009 and the reduction of livestock, with the agricultural landscape to reorient to extensive production systems, leading to a slight increase in average farm size. However, Portugal has still very favourable conditions for the use of animal traction both in agriculture and forest sectors. It is important to mention that 75% of production units still operating less than 5 hectares or 80% of the agricultural workload is based on a family farming system, so Portugal should follow some of the good examples practiced in central Europe, leading to the emergence of competitive models of sustainable development, environmentally friendly and able to fixate population in the productive mountains areas. The (re) use of this technology also plays a key role in the preservation of our animal genetic resources, by promoting the use of native breeds with better aptitude for animal traction. Thus contributes to the preservation and expansion, while respecting their dignity, integrating them again in the farming model where animals are a key element.

## **Sy20003**

### **The working horse in Swiss mountain agriculture**

Henri Spychiger

*Association Suisse des Attelers Professionels, Sumiswald, Switzerland*

There are still some favourable predispositions for mountain agriculture in Switzerland, where the cavalry was abolished only in 1972. The army still can mobilize 300 horses for transport operations in difficult mountainous surroundings. Ploughing with horses was part and parcel of final exams in agricultural schools up to 1960. Knowledge and experience linked to these facts are disappearing once and for all. In order to ensure the future of horse-based agriculture this indispensable know-how must be preserved and used. At the same time machinery and equipment of the 1950ies should be replaced with new items made of novel materials. The weight of equipment can be considerably reduced by using new steel chains, by replacing traditional cables, swingle-trees and collars with newly developed synthetic items. Technical progress should be encouraged. For example the "docker", a horse-drawn vehicle with electric energy assistance, recently developed in Switzerland. The energy produced by braking friction downhill is stored in a battery and assists the horses when going uphill or pulling heavy loads, thus reducing the input of external energy and improving animal welfare. Women should be welcomed in the working horse industry as they are far more interested in horses than men. Equipment should be adapted to their physical capacities. Their specific intuition and approach would certainly enrich the working horse community. On the other hand technical innovations like the "docker" could bring back young men to a world they now consider as backwards. We need a modern perception of environment and nature, new materials, revolutionary techniques and gender complementarity in order to ensure the inevitable come-back of the working horse to modern society.

## **Sy20004**

### **Ardennes horses in Sintra forests - tradition and sustainability**

Nuno Oliveira

*Parques de Sintra Monte da Lua, Sintra, Portugal*

In 2010, Parques de Sintra (PSML) began a project designed to reintroduce traditional techniques and means of managing forested areas and thereby recovering the socio-cultural heritage lost both in the Sintra hills and in Portugal in general. The most innovative component of this project consists in the utilization of the Ardennes breed of horse which, when trained for forestry work, respond to monosyllable voice commands and are led by but a single rein. The mechanization of forestry practices should be restricted whenever the local topography is highly irregular and there is a strong risk of soil erosion thus putting at risk values important to the preservation of natural and cultural heritage, as is the case in Sintra. With their strength and agility, these horses are a viable alternative and contribute to the environmental balance of forests. The horses are a renewable energetic resource, of low investment, without ecological impacts on the soil, safeguarding the natural regeneration and minimizing damages on trees, which remain on the stands after wood removal. Waste (manure) produced in this activity are composted and used to fertilize garden areas managed by PSML. In addition to the environmental benefits, some studies demonstrate that the use of draft horses have high rates of productivity and profitability compared with machines. On the other hand, this project allows the revitalization of traditional occupations (attendants, farriers, manufacturers of leather straps) and job creation (new forest operators), as opposed to the use of machines that replace human work. Furthermore, the communication of practices and techniques of reduced environmental impact, allows to raise awareness and encourage the local populations, and the target-audiences from the recreational and leisure activities developed by PSML, to adopt more sustainable behaviours and in harmony with the environment.

## **Sy20005**

### **Animal and mechanical traction in forest operations: substitution or synergy?**

Raffaele Spinelli

*CNR IVALSÀ, Sesto Fiorentino, Italy*

In most industrialized countries, the rapid mechanization of rural activities has brought animal power to the brink of extinction. However, there are still several reasons for resorting to animal power, and in particular to draught horses. Special opportunities could be offered by the current interest in mobilizing non-industrial private forestry (NIPF) resources. NIPF ownership is often too small for cost-effective mechanized harvesting, especially in mountain terrain. Here, draught horses are still somewhat popular, even in industrialized Europe and North America. Furthermore, animal power can be deployed with much benefit in protected areas, where it configures as a low-impact alternative to conventional operations. Comparative studies have found that the percent of damaged trees drops to half and damage severity to one third when animals are used instead of tractors. However, the benefits can also be financial, not just environmental. The study presents two case studies where horse skidding is matched with tractor skidding, under the condition of mountain logging in close-to-nature forestry settings. In the first case, horse skidding is shown to be 30% cheaper if the extraction distance does not exceed incurs lower unit costs than tractor skidding, when the extraction distance is within 100 m and the cost of opening a tractor trail is included in the calculation. The cost-efficiency of horse skidding is significantly increased by detaching two horses per driver, since the additional cost of the second horse is lower than the additional productivity it generates. The second study shows that teaming horse and tractor is a very effective strategy. If the horse pre-bunches for subsequent tractor skidding, total extraction cost becomes half as high as if extraction was performed exclusively by horse, and three times as low as extraction was performed exclusively by tractor. As often, cooperation is better than competition!

## Sy20006

### **Comparing effects of tillage treatments performed with animal traction on soil physical properties: preliminary experimental results**

Aitor García-Tomillo<sup>1</sup>, Tomás de Figueiredo<sup>2</sup>, Arlindo Almeida<sup>2</sup>, Jorge Dafonte<sup>3</sup>, Antonio Paz-González<sup>1</sup>, João Rodrigues<sup>4</sup>, João Nunes<sup>4</sup>

<sup>1</sup>*Facultad de Ciencias - Universidad de Coruña, Coruña, Spain,* <sup>2</sup>*Escola Superior Agraria - Instituto Politécnico de Bragança, Bragança, Portugal,* <sup>3</sup>*Escuela Politécnica Superior - Universidad de Santiago de Compostela, Lugo, Spain,* <sup>4</sup>*Associação Portuguesa de Tracção Animal- APTRAN, Bragança, Portugal*

Compaction is a reduction in the pore space in an aggregated soil structure. Compacted soils provide inadequate space for air and water storage or movement. In addition, soil compaction is commonly regarded as the most difficult type of land degradation to locate and rationalise because it is a sub-surface phenomenon. Compaction results from compressive forces applied to compressible soil by machinery wheels, combined with some tillage operations, particularly when the soil is moist to wet and most prone to deformation. Human and draft animal-pulled equipment may also cause soil compaction, but a huge gap exists on experimental data to adequately assess their impacts and, actually, animal traction is an option seen with increasing potential to contribute to sustainable agriculture, especially in (but not restricted to) mountain areas. This study was conducted to assess the impacts on soil compaction of tillage operated with motor tractor and draft animals. In a farm plot (Vale de Frades, NE Portugal) treatments were applied in sub-plots (30 m x 3 m), consisting in a two-way tillage with tractor (T), pair of cows (C) and pair of donkeys (D). Undisturbed soil samples (120) were taken before and after operation for bulk density (BD) and saturated hydraulic conductivity (Ks). BD means before operation in T, D and C sub-plots were  $1.12 \text{ g}\cdot\text{cm}^3 \pm 0.145$ ;  $1.06 \text{ g}\cdot\text{cm}^3 \pm 0.09$  and  $1.11 \text{ g}\cdot\text{cm}^3 \pm 0.12$ , respectively, while after operation BD means were  $1.17 \text{ g}\cdot\text{cm}^3 \pm 0.13$  (T),  $1.10 \text{ g}\cdot\text{cm}^3 \pm 0.08$  (D) and  $1.09 \text{ g}\cdot\text{cm}^3 \pm 0.10$  (C). Before operation, Ks class was rapid in 60 % of the samples and after operation this value reduced to 33% in T, whereas it increased to 67% in C and D (assembled). These preliminary results confirm the potential of animal traction as an option for mountain agri-environments, yet requiring much wider research to soundly ground its assets.

## **Sy21001**

### **Relevance of social capital in the institutionalization process of a socio-environmental conflict around water management in a micro basin in the Andes Region: Llullán-Parón basin – Huaylas – Perú.**

Fabio Azzolin

*University of Genova, Genova, Liguria, Italy*

In 2008, the conflict around the water management of an important Andean lake basin (Parón lake), was considerably aggravated. The hydroelectric installation, granted to Duke Energy company, was in fact occupied by Cruz de Mayo, a Peruvian Andean rural community. This nonviolent conflict, after several years of impasse, has seen the recent introduction of various negotiating tables between Cruz de Mayo, Duke Energy, CEAS (Episcopal Commission for Social Action), local institutions (Huaylas provincial municipality) and state institutions (Ministry of Environment, Water National Authority and National Institution of Civil Defense). Our research focuses on socio-cultural community factors and on the socio-political interactions that have addressed the conflict towards a mediation and institutionalization process, as well as on resulting social facets. The social capital concept is useful for analyzing the type of socio-environmental conflict at hand. Moreover, it could contribute to developing environmental conflict theories that take into account the socio-cultural complexity of involved populations, a feature often overlooked by these theories. Social capital, as a social resource embedded in a networks association, gives us a detailed picture of interactions, which in a struggle process, can be deconstructed and reconstructed inside and between socio-political groups. Our hypothesis suggests that the conflict has been gradually institutionalized mainly due to the improvement of bridging social capital, which has conducted towards the progressive opening of community social boundaries and has encouraged the crucial alliance with CEAS. This catholic organization represented an importance reference actor for Cruz de Mayo, which indeed played a decisive role in easing the tension of the ongoing conflict. However, there is a likelihood that the recent agreement reached through the mediation of CEAS and state institutions, could not entirely solve the dispute. Actually, the socio-environmental situation of Llullán-Parón basin now appears indefinite and unclear, since governance failed to implement the agreement.

## **Sy21002**

### **Challenges for cross-level watershed governance and sustainable water provision in the mountains of Honduras**

Catherine Tucker

*University of Florida, Gainesville, Florida, USA*

Honduras is among the many mountainous nations that face challenges to provide their population with access to safe drinking water. In rural areas, each municipality has the responsibility to arrange for water provision, and one of principal mechanisms is to create community-level water committees. This study examines governance of the Montaña Camapara watershed reserve, which provides water for nearly 30 towns (each with its own water committee) in four municipalities. Compared to many other rural water systems in Honduras, the water committees that jointly govern Montaña Camapara have been largely successful in providing drinking water to beneficiaries, and creating a regional water committee to coordinate efforts. Through interviews, participant observation and archival research conducted over more than a decade, the study shows that watershed governance has been supported by coordination within and across water committees and municipalities, along with considerable creativity in finding technical and financial resources to build and maintain gravity-driven drinking water systems. Assessment of conditions on the mountain indicates that few incursions have occurred, and the watershed appears to be managed sustainably. Even so, local committees face problems related to inadequacies of national entities charged with overseeing water governance, which have confounded local efforts to improve water systems and meet growing demands. Paradoxically, the strength of these watershed governance arrangements relates to minimal intervention by the nation's water management entities, thus local water committees have been able to design and enforce rules that fit their circumstances and foster resilience despite national economic and political uncertainties. Given the current contexts of Honduras, the analysis uses a social-ecological systems perspective to examine the challenges and risks of cross-level governance for sustainable management of the Montaña Camapara watershed reserve and its water systems.

#### **Acknowledgments**

InterAmerican Institute for Global Change Research, Wenner Gren Foundation for Anthropological Research, Indiana University, University of Florida, Contributing field assistants: Jessica Fonseca, Martha Moreno, Victor Moreno, Ignacio Perez, and the residents of the study communities in Honduras.

## **Sy21003**

### **Management of National Parks in Norway, Sweden, Austria and Scotland.**

Kjell Overvåg<sup>1</sup>, Terje Skjeggedal<sup>2</sup>

<sup>1</sup>*Eastern Norway Research Institute, Lillehammer, Norway,* <sup>2</sup>*Norwegian University of Science and Technology, Trondheim, Norway*

The paper discusses and compares management models for National Parks in Norway, Sweden, Austria and Scotland. Management models which ensure the balance between protection and use of resources, participation of different stakeholders and government levels/sectors, and can spur regional development is stated to be important in all these countries. The comparison is done along three dimensions: (1) decentralization (to what degree power is delegated to local levels), (2) inclusion (to what degree actors/stakeholders other than politicians are involved in decision-making) and (3) integration (to what degree political sectors, especially environment and regional development, are integrated and balanced). The analysis shows considerable differences between management models in the four countries along these dimensions.

#### Acknowledgments

The Research Council of Norway.

## Sy21004

### **Applying analyses of historical conservation policies and rural livelihoods strategies to inform development of socio-ecological climate change adaptation strategies in Afromontane East Africa.**

Aaron Russell<sup>2,1</sup>, Abwoli Banana<sup>3</sup>, Emily Obonyo<sup>4</sup>, Wen Zhou<sup>1</sup>, Joel Serovic<sup>5</sup>, Allan Bomuhangi<sup>3</sup>, Daniel Waiswa<sup>3</sup>, Kennedy Githinji<sup>4</sup>, David Langat<sup>4</sup>, Houria Djoudi<sup>1</sup>  
<sup>1</sup>*Center for International Forestry Research, Bogor, Indonesia*, <sup>2</sup>*Independent, Leuven, Belgium*, <sup>3</sup>*Makerere University, Kampala, Uganda*, <sup>4</sup>*Kenya Forestry Research Institute, Nairobi, Kenya*, <sup>5</sup>*Rotterdam University, Rotterdam, The Netherlands*

Recent years' episodes of weather-related extreme events and landslides around one of East Africa's key water-towers, Mt.Elgon, has raised policy maker concerns over climate change impacts on local communities. These in turn impact government approaches to protected area management and disaster preparedness policies. However, any solutions for addressing rural vulnerability require a clear understanding of how a complex array of socio-economic, demographic, and political forces have resulted in, and perpetuate, the growth of already high population densities on the steep slopes of Mt.Elgon. Furthermore, the impacts of climate variability, and any potential solutions to address them, require an understanding of differences among stakeholder levels of exposure, sensitivity and adaptive capacities. This paper presents the results from Cristal Forest Participatory Rapid Appraisals (PRA) with women's and men's groups on Kenyan and Ugandan slopes of Mt.Elgon, focus group discussion with district extension services. From these discussions a nested hypothesis to explain the underlying dynamics of vulnerability in Afromontane communities was developed. Potential contributing factors include historical and ongoing patterns of governance, livelihood strategies, demographic change, identity-politics, physical in/security, and exposure to actual climate variability. The resultant conceptual framework was ground-truthed by district stakeholders, and substantiated through a literature review of relevant literature. We discuss how key stakeholder groups are disproportionately impacted by episodes of climate variability around Mt.Elgon and identify challenges to addressing their vulnerability using present policy approaches. A key conclusion for policy makers is that the heterogeneity in cultural, socio-economic, ecological, and climate conditions in complex topographical contexts like those in Afromontane socio-ecological-systems require nuanced understandings of local vulnerability, and interdisciplinary trans-sectoral climate change adaptation strategies that go beyond the capacity of any quick technological intervention or individual ministry to address.

### Acknowledgments

Community members, district and county stakeholders who live and work around the Ugandan and Kenyan slopes of Mt.Elgon; all members of the AdaptEA project team and supporting staff at the Center for International Forestry Research (CIFOR), Makerere University, Kenya Forestry Research Institute (KEFRI), and WorldAgroforestry Center (ICRAF); the Rockefeller Foundation for funding the AdaptEA project (Grant: 2011 CRD 306) within which this research was conducted; complementary funding was received from AusAID (63560) and UNITAR (G.EGP.2011.03), CIFOR, and the CGIAR Research Program on Forests, Trees and Agroforestry.

## **Sy21005**

### **Globalisation, climate change and traditional social-ecological systems: Insights from transhumance system in the Himalayas**

Suman Aryal

*University of Southern Queensland, QID, Australia*

Traditional social-ecological systems (SESs) are facing challenges to adapt with new disturbances. Transhumance system in the Himalayas was evolved to utilise the seasonal availability of grazing resources distributed at different elevations and has been shaped by centuries of trial and errors generating experiences and ideas for sustaining livelihood and natural resources. Recently, this system is experiencing a number of threats arose from globalisation (eg. international labour migration and tourism) and climate change among others. This study explored recent trends in the systems and local practices that the transhumant herders are practicing and how they could be useful in adapting new disturbances and enhance the resilience of transhumant communities and sustainability of the systems. One hundred and forty five transhumant herders were surveyed and 6 focus groups were conducted across three mountainous protected areas of Nepal. It was found that fewer households were involved in the transhumance system, herd sizes had decreased, movement patterns have been changed, dependency on transhumance was reduced and the involvement of younger generations in transhumance systems has declined. These changes can decouple social and ecological subsystems that can induce adverse social-ecological impacts. The likely social impacts are decreased livelihood options, reduced agricultural production, loss of customary lifestyle and traditional knowledge and culture. The potential ecological impacts from the loss of transhumance systems can be on biodiversity, vegetation and land use, and ecosystem functions and services. Mobility of herd, diversification of livestock in a herd, storage of feeding resources and communal pooling were local practices of transhumant herders. Strengthening those practices provide a window of opportunity to reduce risk and enhance resilience of the transhumance system.

## **Sy21006**

### **Understanding the relevance of the Biosphere Reserve concept for the provision of public goods in the mountain region of Lungau, Austria**

Thilo Nigmann, Thomas Dax, Ingrid Machold

*Federal Institute for Less-Favored and Mountainous Areas, Vienna, Austria*

This paper focuses on the relationships between agriculture and forestry and the provision of public goods by combining research analysis of an EU Horizon 2020 project (PEGASUS, 2015-2017) and a national study on regional resilience. It elaborates the main region-specific ecological and social beneficial outcomes and the role of diversity and resilience by making use of the concept of Social-Ecological-Systems (SES). The study region Lungau (Austria) was approved as Biosphere Reserve by UNESCO in 2012. It is a high plateau mountain regions located at an altitude of more than 1,000 meters in the southeast of the federal state of Salzburg. It is characterized by a low population density which moreover is increasingly aging due to continued out-migration of young people. Core regional problems are linked to trends of land abandonment which have an impact on the landscape character, the level of biodiversity and also threatens cultural heritage. In order to oppose these adverse trends, local action groups aim at the strategic use of the designation as a Biosphere Reserve. The research is based on a multi methodological approach using document analysis, semi-structured interviews, focus groups, by making reference to the SES framework and a structured set of indicators measuring sustainability dimensions (MONET indicators). Thereby, it envisages to understand the impact of the Biosphere Reserve concept on a social, economic and ecological level. First analyses show that an inclusive multi-level governance structure is beneficial. Yet, also challenges arise due to different goal setting agendas and divergences in power structures of stakeholders involved as well as institutional inefficiencies. Although the project is ongoing, the linkages of the diverse approaches shall contribute to the discussion concerning the valuation and improvement of public goods provision in a mountain context.

#### Acknowledgments

EU Framework Programme Horizon 2020: project PEGASUS (Public Ecosystem Goods and Services from land management - Unlocking the Synergies); national study "Diversity and regional resilience of Biosphere Reserve Lungau" (BF141/15), commissioned by Ministry of Agriculture, Forestry, Environment and Water Management.

## **Poster sessions**

## **S01P01**

### **Regulated deficit irrigation on cv. Touriga Nacional in the Douro Demarcated Region, Portugal - Physiological responses, productivity and quality effects on grapes**

Igor Gonçalves<sup>1</sup>, Ana Morais<sup>1</sup>, Bruno Teixeira<sup>1</sup>, Paulo Santos<sup>1</sup>, Rui Soares<sup>2</sup>, Cristina Carlos<sup>1</sup>

<sup>1</sup>*ADVID, Vila Real, Portugal*, <sup>2</sup>*Companhia Geral da Agricultura das Vinhas do Alto Douro SA, Pinhão, Portugal*

The weather and climate conditions are crucial for the success of any agricultural system, since they influence the adaptation of the cultures to certain regions, control the quantity and quality in a large scale and contribute, in an ultimate analysis, to the economical sustainability. Douro's Demarcated Region, located in the northeast of Portugal, is characterized by a typical Mediterranean climate, with hot and dry summers, which induce water deficit and thermal and radiative stress, influencing physiological processes, production and quality parameters of the grapevine. These conditions acquire a growing relevance, especially under a climate change impact scenario, as demonstrated in recent studies conducted in the region. Therefore, there is a need to improve the crop water use efficiency, based on physiological indicators, which provide additional information about plant water status. To fulfil this need, an experimental design was conducted during 2015 in a commercial vineyard located in 'Cima Corgo' sub-region (Demarcated Douro Region) including three water treatments: 1) 'Rain-Fed'; 2) 'Regulated deficit irrigation - RDI' (25% of ET<sub>c</sub>); and 3) 'Regulated deficit irrigation - RDI' (50% of ET<sub>c</sub>), established since 2002. The aim of this study was to understand better the impact of the different water regimes on the physiology, productivity and quality parameters of cv. Touriga Nacional. For this purpose, an evaluation of several parameters was done including predawn leaf water potential ( $\Psi_{pd}$ ), productivity and qualitative parameters such as titratable acidity, pH, probable alcohol and phenolic compounds (total tannins, anthocyanins and polyphenols). The results obtained in 2015, a year with scarce precipitation (320 mm between November and August), showed that, in both RDI modalities, the productivity was improved (RDI2: 20%, RDI3: 33%), increasing berry weight, but without compromising quality parameters. Concerning these lasts, RDI modalities did not reduce phenolic compounds and probable alcohol content were enhanced at harvest time.

## **S01P02**

### **Geo-information for strengthening mountain community in climate change adaptation**

Adish Khezri, Arbind Man Tuladhar, Jaap Zevenbergen  
*Twente University, Enschede, The Netherlands*

As suggested by the UNFCCC, any adaptation programme consists of five process steps starting from observation, assessment, planning, implementation, and monitoring and evaluation. Each process varies in time and scale depending upon location. In the case of mountainous areas, where the community is highly vulnerable, the programme requires adaptive capacity that links to these five process steps so that the community becomes resilient to climate change. The aim of this paper is to elaborate on an approach that determines the elements of adaptive capacity to be included in the adaptation programme. This research argues that geo-information including information on land tenure for mountainous areas is the most important element for the adaptive capacity to strengthen the resilience of mountain community. Since mountains do not have easy accessible transportation because of rugged topography and jagged forests, the stakeholders (i.e. policy makers, governments and non-government organizations, community groups, etc.) often face problems in implementing an adaptation programme because of absence of geo-information and approach. This paper reviews the existing literature on adaptation policies and programmes in mountainous areas, and discusses the relevance of geo-information in the adaptation process steps at the country level. Then it presents the results of a case study to examine how (and if) geo-information is incorporated in practice to enhance the adaptive capacity of the mountain communities. Since acquiring, processing and integrating spatial data play a prominent role, this research will demonstrate an approach in integrating geo-information in order to improve the resilience of the mountain community in a complex system such as climate change.

#### **Acknowledgments**

This research paper was conducted at Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, and funded by Erasmus Mundus Action 2 Project SALAM, International Scholarship of the European Commission.

### **S01P03**

#### **Climatic Change. Human Influence?**

Dionísio Gonçalves<sup>1</sup>, Solange Leite<sup>2</sup>, António Ribeiro<sup>1</sup>, Tomás Figueiredo<sup>1</sup>

<sup>1</sup>*Mountain Research Centre- IPB/ESA, Bragança, Portugal,* <sup>2</sup>*Centre for the Research and Agro-Environmental and Biological Sciences-UTAD, Vila Real, Portugal*

We begin by presenting the functioning of the Climate System and the variety of climates that occurs on the surface of the globe. We analyze climate change based on the sun's orbital parameters and other causes, focusing on the current interglacial period and the influence it had on the development of human societies. The following text looks on developing of the climate of the last 1000 years, with considerations about the warm medieval climate, the little ice age, the recovery of temperatures since the nineteenth century, the global cooling of the 60s and 70s of last century and global warming observed since the late 80s of last century. Human influence is analyzed as part of the climate subsystem Biosphere and the concerns that have been linked by the Intergovernmental Panel on Climatic Change. We comment the various scenarios of greenhouse gas emissions and their relation to global warming. In this context, we discuss the reasons for the discrepancy that has been observed between the predictions of global temperature increase of models and reality.

## **S01P04**

### **Climate change impacts on water supply: implications for reservoir management in Alto Sabor, northeast Portugal**

Claudia Carvalho-Santos<sup>1</sup>, António T. Monteiro<sup>2</sup>, João C. Azevedo<sup>3</sup>, João Pedro Nunes<sup>1</sup>  
<sup>1</sup>*CESAM & Dept. Environment and Planning & CESAM, University of Aveiro, Aveiro, Portugal,* <sup>2</sup>*CIBIO/InBIO – Research Center in Biodiversity and GeneHc Resources , University of Porto,, Porto, Portugal,* <sup>3</sup>*CIMO, Instituto Politécnico de Bragança, Bragança, Portugal*

Climate change is expected to bring warmer temperatures and a change in the precipitation pattern associated with less rain in the Mediterranean watersheds. This can aggravate drought conditions, with negative impacts on water supply. Here, reservoirs may play an important role to mitigate these impacts. However, the implications of climate change are not always considered in the reservoir planning and management. This study aimed to address this issue for the Alto Sabor watershed, northeast Portugal. The Soil and Water Assessment Tool (SWAT) was used for a climate change impact assessment, considering the current water supply regime (single reservoir) and the construction of the new reservoir. SWAT was calibrated and validated against daily-observed discharge and reservoir volume, with a good agreement between model predictions and observations. Results from four GCMs (General Circulation Models) for two scenarios (RCP 4.5 and 8.5) were statistically downscaled and bias-corrected with ground observations. In the future, a general increase of temperatures is expected, but the change in precipitation is more uncertain, with larger differences according to the selected climate model. Annual precipitation would slightly decrease, but seasonal changes would be more significant, with more precipitation in winter and much less in spring and summer. Results showed that the existence of two reservoirs will solve the water supply problems in current climate conditions, but in the future the reliability of this solution will decrease (reliability of water supply below 85%). Here, the variability given by the different climate models simulated in SWAT brings some uncertainty. The main conclusion of this study is that the solution for water supply in this region, calculated taking only present-day climate into account, will be inefficient for water supply management under future climate. Taking climate change into account would have avoided the need for further investment in the near future.

#### **Acknowledgments**

This work was funded by FEDER funds through the Operational Programme for Competitiveness Factors - COMPETE and by National Funds through FCT - Foundation for Science and Technology under the project PTDC/AAG-MAA/4539/2012 / FCOMP-01-0124-FEDER-027863 (IND\_CHANGE).

## **S01P05**

### **Planning the urban green infrastructure in a complex mountain terrain - the case of Bragança (Portugal)**

Artur Gonçalves

*CIMO - Mountain Research Centre, Instituto Politécnico de Bragança, Bragança, Portugal*

The Urban Green Infrastructure (UGI) is an essential asset in cities development that can help balance the negative effects that arise from the concentration of artificial structures in urban fabrics. In fact, the presence of vegetation in cities carries multiple benefits from the social, environmental and even economical perspectives. In the case of mountain cities, planning must account for the presence of active biophysical processes that can have major intensity in complex terrains, such as water drainage, slope stability, cold air drainage, among others, therefore demanding for a careful definition of the urbanization processes. Under such conditions, the UGI must be planned to answer to the biophysical demands of the terrain while prompting urban development to take place under a confined and compact perspective. This presentation discusses the need to adequate the urban development to the existent conditions through the development functional UGIs, incorporating/preserving green spaces (public and private) while integrating fundamental territorial elements such as watersheds, quality soil or steepest slopes. As a case study, the mountain city of Bragança (Portugal) is addressed, identifying potential biophysical elements that should carefully integrated in the urban development process, describing the existent conflicts and providing a proposal that could help to balance such requirements with the necessary density in the urbanization process. To illustrate this case study, a set of maps representing the existent biophysical constraints are presented along with a proposal for the adequate integration of the urban development processes, ranging from landscape and vegetation preservation to the definition of different levels of urbanization regarding buildings density and soil sealing rates.

## **S01P06**

### **LIFE CLIMATREE - A novel approach for accounting & monitoring carbon sequestration of tree crops and their potential as carbon sink areas**

Kostas Bithas, Antonios Kolimenakis

*Institute of Urban Environment and Human Resources, Panteion University, Athens, Greece*

Climate change mitigation is a crucial objective of the Kyoto Convention, and is oriented towards reducing GHG emissions. By 2013, the EU reduced its greenhouse gas (GHG) emissions by 11%, a progress achieved through multidisciplinary strategic planning and applying measures in numerous EU policies. However, only forests' capacity as carbon sinks were taken into consideration in the calculations, while agricultural land and farming practices were not acknowledged in GHG accounting for storing carbon in soil. This may have possibly resulted in incorrect estimations of the carbon dioxide balance in the atmosphere. Accurate monitoring and accounting of carbon stocks and fluxes is a serious challenge, which will result in an improved assessment of climate change and its impacts. The main indicator for measuring agricultural land and farming practices with regard to securing carbon stored in soil is the carbon dioxide balance with respect to CO<sub>2</sub> capture and storage capacity through the application of land use, land use change and forestry. In the EU, the agricultural sector has been embedded in a consistent strategic framework in the form of common agricultural policy (CAP) since 1954. In its latest reform (2013), the CAP acknowledged the significance of agriculture for climate change policy. GHG emissions from stock breeding have been found to contribute significantly on a global level. On the other hand, agriculture is also a significant factor for carbon capture. The assessment of this capture and consequent storage of carbon in the form of plant tissues relates to the production of GHG during cultivation and to the annual life cycle of most crops. The ClimaTree project aims to contribute to the development of a new methodology and provide policy-makers with an innovative tool for the quantification of carbon storage in permanent tree-crops.

#### Acknowledgments

LIFE CLIMATREE PROJECT: LIFE14 CCM/GR/000635.

## **S01P07**

### **Ecosystem integrity state assessment in mountainous regions in the Amazon, Brazil.**

Margareth Simoes<sup>1,2</sup>, Rodrigo Ferraz<sup>1</sup>, Andrei Alvez<sup>2</sup>, Rachel Prado<sup>1</sup>

<sup>1</sup>*Brazilian Agricultural Research Corporation - Embrapa, Rio de Janeiro, RJ, Brazil,* <sup>2</sup>*Rio de Janeiro State University-UERJ, Rio de Janeiro, RJ, Brazil*

Ecosystem Integrity can be understood as a dynamic state of natural ecosystems in which it's observed maximum capacity of resilience and self-organization. This state is specific for ecosystems with great biodiversity, able to maintain many ecosystem processes related to most terrestrial biogeochemical cycles. Land use changes in large-scale and high-intensity are intrinsically related with biodiversity loss and integrity decrease of natural systems. Nevertheless, the anthropic occupation is inhibited by the relief conditions consequently, the mountainous environments, normally tend to be more preserved areas. The objective of this paper was to assess the state of ecosystem integrity in different topographic gradients in rugged landscape regions in the Brazilian Amazon. The methodological approach, consisted on the generation of an ecosystem integrity spatial model, on a regional scale, based on probabilistic distribution of evidences based on learning process (data-driven models) through the Expectation Maximization algorithm (Buntine, 1994). Bayesian network has been established from an expert conceptual model that related different remote sensing dataset: EVI- Enhanced Vegetation Index; LAI- Leaf Area Index; CCF - Vegetation Continuous Fields; GPP- Gross Primary Productivity (MODIS/ USGS - NASA). It was also used a map of relief (RADAM) encompassing the classes; strong corrugated, mountainous and rugged areas. The results showed that, according to the Ecosystem Integrity Spatial Index, rugged relief areas remain more preserved than those within more favorable relief, due the limitations for human occupation. For the Brazilian Amazon this situation was more evident in regions where presenting some territorial occupation pressure. In geographically isolated regions it was not possible to find any difference due the relief conditions.

#### Acknowledgments

ROBIN Project - Role of Biodiversity in Climate Change Mitigation – European Union (FP7 Edict ENV. 2011.2.1.4 -1); Brazilian Agricultural Research Corporation – Embrapa.

## **S01P08**

### **Ecosystem integrity state and above-ground carbon stocks in rugged landscape in the Amazon, Brazil.**

Rodrigo Ferraz<sup>1</sup>, Margareth Simoes<sup>1,2</sup>, Andrei Alves<sup>2</sup>, Rachel Prado<sup>1</sup>

<sup>1</sup>*Brazilian Agricultural Research Corporation - Embrapa, Rio de Janeiro, RJ, Brazil,* <sup>2</sup>*Rio de Janeiro State University - UERJ, Rio de Janeiro, RJ, Brazil*

According to the Convention on Biological Diversity there are clear interlinkages between biodiversity and climate changes, because biodiverse ecosystems provides many services related with the climate change mitigation. In this sense, one of the most important ecosystem services from tropical forest is the capacity for carbon uptake and storage. But in the tropical regions there are many vegetation types with different floristic composition, structural and functional features that interfere in the carbon cycle. The different types of vegetation are conditioned by abiotic factors such as climate, water availability, soil physical properties, soil fertility, among others. In turn, the relief features have a great influence in the soil formation and climatic local characteristics. The objective of this paper was to assess the above-ground carbon stocks and the ecosystem integrity state of different vegetation types in function of topographic gradients in rugged landscape in the Amazon region. The methodological approach consisted on Ecosystem Integrity spatial modeling based on probability distribution of evidence parameters. The modeling was based on learning process using the Expectation Maximization algorithm (Buntine, 1994). Bayesian network has been established from an expert conceptual model using remote sensing data: EVI- Enhanced Vegetation Index; LAI- Leaf Area Index; CCF - Vegetation Continuous Fields; GPP- Gross Primary Productivity (MODIS/ USGS - NASA). The methodology for the aboveground carbon stocks spatial model was based on ground data, MODIS 500m imagery and GLAS LiDAR data (Baccini et al., 2004 - Woods Hole Research Center - MA, USA). The results show that areas with more rugged relief tend to have greater integrity but not necessarily higher carbon stocks that are closely related with the type and density of vegetation.

#### Acknowledgments

ROBIN Project - Role of Biodiversity in Climate Change Mitigation – European Union (FP7 Edict ENV. 2011.2.1.4 -1); Brazilian Agricultural Research Corporation – Embrapa.

## **S02P01**

### **The vegetation of a mountain area of the Scalve Valley (Southern Alps) twenty years after environmental restoration work**

Luca Giupponi<sup>1</sup>, Gian Battista Bischetti<sup>2</sup>, Annamaria Giorgi<sup>1,2</sup>

<sup>1</sup>*Università degli Studi di Milano, Ge.S.Di.Mont., Edolo, Italy,* <sup>2</sup>*Università degli Studi di Milano, DISAA, Milano, Italy*

The restoration of highly natural areas, such as mountain territories, is a very important issue for those involved in land management and nature conservation. This study reports data provided by the analysis of the vegetation of an area of the Scalve Valley (Lombardy, Italy) which underwent environmental restoration and soil stabilization work using soil bioengineering techniques following a landslide that occurred in 1992. Data on the vegetation, acquired by performing several phytosociological relevés (inside and outside the area) according to the Braun-Blanquet method (1964), were used to analyze the floristic and ecological characteristics of the plant communities currently present in the area. The Ecological Index of Maturity (EIM) (Giupponi et al. 2015) was applied in order to assess the level of disturbance to which the various plant communities are currently subject. The EIM is the result of the elaboration of flora and vegetation indices proposed by Taffetani & Rismondo (2009) and Rismondo et al. (2011) for the evaluation of the functionality of agro-ecosystems, and provides values ranging from 0 (high disturbance of vegetation) to 9 (undisturbed vegetation). Results showed that, in the study area, there are some plant communities typical of forest margins, some typical of less evolved soils, and others with a high proportion of exotic species that were introduced in 1995 (at the end of slope stabilization work), when a mixture of commercial seed was sown. The results obtained calculating the EIM showed the presence of high disturbance for the plant communities with high percentages of exotic species and for those on unstable soils.

## **S02P02**

### **Human-Canids Conflict in Dhorpatan Hunting Reserve, Nepal**

Prakash Thapa

*Institute of Forestry, Pokhara, Nepal*

Canids are one of the least studied groups of carnivores. They are widely distributed, occurring on all continents except Antarctica. Canids play an important role in food chains and ecological balance. The present study was conducted to show the information of human-canids conflict in Dhorpatan Hunting Reserve of Nepal. Direct field observation, household survey, group discussion, key informant interview and preliminary survey were carried out to collect the data. Household survey was conducted to 90 household randomly out of 531 households. Reserve Staffs, school teachers, local political leaders, old persons and hunters were taken as key informants. Similarly two group discussions were carried out to extract more information on conflict. The results showed the decreasing status of canids within the reserve with increasing level of livestock depredation. This increasing level of livestock depredation was found due to shared habitat of canids with livestock during grazing inside the reserve. Yearly more than eighty thousand livestock graze inside the reserve. People have negative attitude towards canids conservation due to human-canid conflict. Retaliatory killings, illegal hunting, land encroachment, deforestation and grazing were found to be the major anthropogenic problems for canids conservation. Wildlife preference ranking showed Wolf as the most dislike species inside the reserve whereas Blue Sheep as the most likely one. Similarly, use of canids body parts in the form of traditional medicine was prevalent in households inside the reserve. Local people have belief that alcohol prepared from fermentation of Golden Jackal can cure many diseases. Also, people have belief upon the use of Wolf bones to treat disease of body pain. Canids are facing high level of human threats in Dhorpatan Hunting Reserve. Finally comprehensive canids conservation action plan is recommended for the long term survival of canids in reserve.

#### Acknowledgments

The Rufford Foundation.

## S02P03

### Knockdown of *Phytophthora cinnamomi* GIP gene by RNA interference

Altino Choupina<sup>1,2</sup>, Maria joao De souza<sup>1</sup>, Rodrigo Costa<sup>2</sup>, Abdessalem Chahed<sup>2</sup>  
<sup>1</sup>Polytechnic Institute of Braganca, Braganca, Portugal, <sup>2</sup>CIMO Campus de Santa.  
Apolónia, Braganca, Portugal

The ink Disease is considered one of the most important causes of the decline of the chestnut orchards. The break in productivity and yield of *Castanea sativa* Mill is caused by two species; *Phytophthora cinnamomi* and *P. cambivora* being the first one is the foremost pathogen of the ink disease in Portugal. *Phytophthora cinnamomi* belongs to the most aggressive and widespread plant pathogen with nearly 1,000 host species. This oomycete provoke enormous economic losses and it is responsible for the decline of many plant species in Europe and worldwide and up to now no efficient treatments are available to fight these pathogens. Because of the importance of the chestnut at economical and ecological levels especially in Portugal it becomes essential to explore the molecular mechanisms that determine the interaction between *Phytophthora* species and host plants through the study of protein GIP (glucanase inhibitor protein) produced by *Phytophthora cinnamomi* during the infection, as a response mechanism to plant hydrolytic proteins, endo- $\beta$ -1,3-glucanases. The technique of RNA interference was used to knockdown the gene *gip* of *Phytophthora cinnamomi* after that the transformants obtained with the silenced gene will be used to infect *Castanea sativa* Mill, in order to determine the effect of gene silencing on the phenotype of the plant. The results obtained prove that RNAi could be a promising alternative biological tool in the control and management of *Phytophthora cinnamomi*.

#### Acknowledgments

Project COMBATINTA/SP2.P11/02.

## **S02P04**

### **Determination of the subcellular localisation of GIP and NPP1 proteins in *Phytophthora cinnamomi* tagged with green fluorescent protein**

Altino Choupina<sup>1,2</sup>, Maria joao De souza<sup>1</sup>, Rodrigo Costa<sup>2</sup>, Abdessalem Chahed<sup>2</sup>  
<sup>1</sup>*Polytechnic institute of Braganca, Braganca, Portugal,* <sup>2</sup>*CIMO Campus de Santa. Apolónia, Braganca, Portugal*

The oomycete pathogen *Phytophthora cinnamomi* is the causal agent of the devastating plant Ink disease on Chestnut. The most common symptoms are root necrosis and a reduction in root growth, which invariably lead to the death of the trees. *P. cinnamomi* is considered one of the world's worst invasive pathogens with a serious threat to a wide range of plant species throughout the world, including economically important crop plants such as Avocado, Chestnut, Pineapple, Peach, and Macadamia. These species cause several billions of dollars of damage on crop, ornamental, and native plants and so far no efficient solutions have been found to control the disease. A notable characteristic of the interaction between plants and their microbial pathogens is the secretion by both partners of proteins that are associated with attack, defense, and counterdefense so it's fundamental to improve our knowledge about these proteins with the intention of finding a solution to the disease affecting the Chestnuts. In order to know more about the function of the protein GIP and NPP1 produced by *P. cinnamomi* during the infection of *Castanea sativa* Mill., the subcellular localization of these proteins was studied by cloning target genes into pTOR-EGFP vector containing a *ham34* promoter and a *gfp* gene which allow to discriminate the place and time of activity of each protein in *Phytophthora cinnamomi* cells. The observation of *Phytophthora*'s mycelia with confocal microscopy confirm the secretory destiny of both GIP and NPP1 proteins.

#### Acknowledgments

Project COMBATINTA/SP2.P11/02.

## **S02P05**

### **Land cover in karst terrains - review of impacts on karst aquifer ecosystems from temperate and Mediterranean ecoregions**

Sanda Iepure<sup>1,2</sup>, Tiziana Di Lorenzo<sup>3</sup>, Andrea Castaño<sup>1</sup>, Francisco Carreño<sup>4</sup>, Javier Lillo<sup>4</sup>  
<sup>1</sup>*IMDEA Water Institute, Alcalá de Henares, Spain*, <sup>2</sup>*Institute of Speleology 'Emil Racoviță, Cluj Napoca, Romania*, <sup>3</sup>*Instituto per lo Studio degli Ecosistemi ISE-CNR, Florence, Italy*, <sup>4</sup>*Rey Juan Carlos University, Madrid, Spain*

Land cover change is the most important anthropogenic factor that affects subterranean ecosystems. Land cover directly impacts biological diversities, contributes to local and regional climate changes as well as to global warming, and may cause land degradation by altering ecosystem services and livelihood support systems. Karst ecosystems harbor globally rare aquatic biota and represent an important water source worldwide, but they are highly vulnerable to land cover shifts and climatic changes. The consequences are reflected in alteration of seasonal distribution of precipitation, temperature increase and changes in evapotranspiration, as a result of changes in vegetation cover. There is an acknowledged lack of available information on the influence of land cover and vegetation type on these sensitive subterranean ecosystems. In the context of an exponential increase of human interference on land use and cover in mountain landscape and the shifts in climate which is particularly critical at mid-altitudes, in the present study we aimed to undertake a broad-scale analysis on the influence of vegetation cover on karst aquifers from mid-elevation mountains across ecoregions with temperate (Carpathian Mountains, Romania) and Mediterranean climate (Pyrenees Mountains, Spain). We analysed georeferenced data records of aquatic crustaceans and chemico-physical parameters from karst aquifers and used a comparative approach to assess the effect of vegetation cover and climatic parameters on the regional-scale richness, endemism and distribution patterns of karst aquifer fauna. In addition, we examined the driving forces for the observed pattern of distribution and richness linked to contemporary (groundwater habitat fragmentation and heterogeneity, climate, vegetation) and historical (past climate and vegetation) environmental conditions from each selected region. Following our exploratory approach we targeted to shed a light in understanding the influence of regional climate and vegetation cover on karst ecosystems, and on predicting aquatic species vulnerability and the resilience of karst water resources to climatic shifts.

#### **Acknowledgments**

IMDEA Water Institute.

### **S03P01**

#### **Mountain's farmers and their perception of wildlife, values and relationships.**

Rosario Fanlo<sup>1</sup>, Montserrat Bou<sup>1</sup>, Daniel Paton<sup>2</sup>

<sup>1</sup>*University of Lleida-Agrotecnio,, Lleida, Spain,* <sup>2</sup>*University of Extremadura, Badajoz, Spain*

The majority of mountain's farmer has a traditional perception of wildlife categorizing them in bad, good, profitable or indifferent. The study was carried out in Andorran Pyrenees by conducting surveys to all current farmers (71 exploitations). All of them use the alpine and subalpine pastures during the four summer months to feed the livestock. It is in this period when the animals may come into contact with wildlife. Another moment of interference is when wildlife uses meadows or spring and autumn crops to feed themselves and destroy they. In absolute values roe deer is the most disturbing (eating in meadows and low pastures), followed by wild boar (destructions in pastures); abandoned dogs and vultures (the latter for direct attacks on people and livestock). But these results may be influenced by other components of pastoral systems, such as famer age, kind of livestock, number of farm employees, infrastructure in pastoral areas, etc. This influence has been studied using a multinomial log-linear model via neural networks analysis discriminates between qualitative variables of the survey.

#### Acknowledgments

Agreement between the University of Lleida and the Andorra's government.

## **S03P02**

### **Classifying beef carcasses according to meat quality using animal/carcass characteristics and pH/temperature decline descriptors early post-mortem**

Cristina Xavier<sup>1,2</sup>, Ursula Gonzales-Barron<sup>2</sup>, Alexandra Müller<sup>1</sup>, Vasco Cadavez<sup>2</sup>

<sup>1</sup>*Instituto de Ciências Biomédicas de Abel Salazar, ICBAS, Porto, Portugal*, <sup>2</sup>*Instituto Politécnico de Bragança, IPB, Bragança, Portugal*

During beef carcass chilling, the eating quality of meat can be severely affected by either hot- or cold-shortening. With basis on previous knowledge that meat of optimal tenderness can be produced when rigor mortis (pH=6.0) is attained when carcass temperature falls between 12-35°C, the objective of this study was to predict meat quality from modelled pH/temperature decay descriptors and informative animal/carcass characteristics. Temperature and pH from a total of 103 beef carcasses were logged during 24 h post mortem, and subsequently modelled by exponential decay equations that estimated temperature (kT) and pH (kpH) decay rates. In addition, a number of pH/temperature decay descriptors were estimated from the fitted models. From linear models adjusted to each of these descriptors, it was found that, generally, hot carcass weight, age, gender and class (male, female, young animals) had significant influence on pH/temperature decay. Thus, bringing together the orthogonal variables kT and kpH, and the aforementioned animal/carcass characteristics as linear predictors of discriminant functions, a classification analysis was performed. While cold-shortened and hot-shortened carcasses were classified correctly for all samples, optimal quality carcasses were correctly classified in 87.5% of the samples.

#### **Acknowledgments**

Dr. Gonzales-Barron acknowledges the financial support provided by the Portuguese Foundation for Science and Technology (FCT) through the award of a 5-year Investigator Fellowship (IF) in the mode of Development Grants (IF/00570).

### S03P03

#### **Meta-analysis of the incidence of *Salmonella* spp., *Listeria monocytogenes* and *Staphylococcus aureus* in Portuguese traditional meat products**

Vasco Cadavez, Cristina Xavier, Ursula Gonzales-Barron  
*Polytechnic Institute of Braganza, Braganza, Portugal*

Meat and meat products are the main vehicles of foodborne diseases in humans caused by *Salmonella* spp. *Listeria monocytogenes* and *Staphylococcus aureus*. In order to prioritise research on those microbial hazards, a meta-analysis study was conducted to summarise available information on the presence of such pathogens in traditional meat products produced in Portugal. Sixty-nine observations on the three pathogens were found for 26 types of product, which were categorised as 'to be eaten raw', 'to be eaten cooked' and 'cured'. Utilising a logit-transformed proportion as effect size parameterisation, random-effect meta-analysis models were fitted to estimate mean occurrence rates, and compare them among the three product categories. *S. aureus* was the pathogen of greatest concern given its high occurrence (22.6%; 95% CI: 15.4–31.8%) in meat products. *S. aureus* occurrence in products to be eaten cooked (25.8%; 95% CI: 15.7–39.3%) was significantly higher than in those to be eaten raw (18.4%; 95% CI: 9.7–31.9%). The incidence of *L. monocytogenes* in products intended to be eaten cooked was high (9.8%; 95% CI: 6.6–14.4%) and not different from the occurrence in fermented sausages (8.3%; 95% CI: 5.1–13.1%). Among the three categories, there were significant differences in *Salmonella* occurrence, with the meat products intended to be eaten cooked having the highest incidence (13.4%; 95% CI: 9.2–19.0%). The non-compliance to EU microbiological criteria for *L. monocytogenes* (8.8%; 95% CI: 6.5–11.8%) and *Salmonella* spp. (9.7%; 95% CI: 7.0–13.4%) at sample units level, in the categories 'intended to be eaten cooked' and 'to be eaten raw', were considerably higher than EU levels for ready-to-eat products. Thus, these results emphasised the necessity of Portuguese food safety agencies to take monitoring and training actions for the maintenance of good hygiene practices during the production of the great variety of traditional meat products.

#### Acknowledgments

Dr. Gonzales-Barron acknowledges the financial support provided by the Portuguese Foundation for Science and Technology (FCT) through the award of a 5-year Investigator Fellowship (IF) in the mode of Development Grants (IF/00570).

### **S03P04**

#### **Development of tools and guidelines to support Water Programs of Payments for Environmental Services in rural areas in Brazil**

Rachel Prado<sup>1</sup>, Elaine Fidalgo<sup>1</sup>, Ana Paula Turetta<sup>1</sup>, Azeneth Schuler<sup>1</sup>, Carla Macário<sup>2</sup>, Bernadete Pedreira<sup>1</sup>, Joyce Monteiro<sup>1</sup>, Alba Martins<sup>1</sup>, Eliane Clemente<sup>1</sup>, Aline Oliveira<sup>1</sup>, Maria Fernanda Moura<sup>2</sup>, Ricardo Lima<sup>1</sup>

<sup>1</sup>*Embrapa Solos, Rio de Janeiro, Brazil,* <sup>2</sup>*Embrapa Informática Agropecuária, Campinas, Brazil*

Payment for Water Environmental Services (Water PES) schemes are expanding throughout Latin America. In Brazil, since Water Producer Program creation, by the National Water Agency, several schemes have emerged, reinforcing its importance for the water conservation. This study presents results from a project developed by Embrapa Soil team and partners that aimed to approach research results to decision makers related to Water PES in Brazil. The main activities were: database development and supply; mapping and description of Water PES evolution; definition of criteria and guidelines for the identification of priority areas for intervention; selection and ranking of indicators and establishment of guidelines for monitoring Water PES impacts; elaboration of a catalog of Embrapa projects on the topics ecosystem and environmental services; elaboration of a handbook to disseminate guidelines for identification of priority areas for intervention and monitoring Water PES. The results have shown that the number of Water PES increased from 42 in 2011 to 52 in 2014, mainly in Atlantic Forest and Cerrado biomes. A set of steps has been identified to guide the prioritization areas for intervention such as the identification of the objective of the interventions, categorization of types of intervention and definition of criteria for selecting these areas. Regarding the indicators, a model was obtained to guide the selection and ranking indicators of the main ecosystem services and benefits related to Water PES in a participative process. About the monitoring it was observed that many challenges has been found such as the feasibility of applying indicators, frequency of monitoring, equipment cost, organization and dissemination of the results and effectiveness in the responses. The catalog of Embrapa projects will strengthen partnerships to support the Water PES schemes. And the handbook in simplified language will guide decision-makers in implementing the Water PES, reducing the risks and difficulties.

#### Acknowledgments

Embrapa Project number 05.11.11.004.00.00.; National Water Agency (ANA) and The Nature Conservancy (TNC).

## **S03P05**

### **How precipitation variation influences reservoir limnology? The case of Azibo Reservoir**

Ana Maria Gerales

*CIMO, Escola Superior Agrária do Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal, Bragança, Portugal*

Reservoirs are important for supporting economic growth and can provide numerous cultural and ecological services. Currently, water quality degradation and algal blooms are among the issues that threaten reservoirs services. Climate change, due to the substantial changes expected in the annual precipitation cycle, can exacerbate these problems by increasing nutrient export from the surrounding lands. Therefore, this study intends to provide information on how precipitation variation may impact several limnological parameters, such as total phosphorus, water temperature, pH, conductivity, dissolved oxygen, water transparency, chlorophyll a and cyanobacteria abundance. Samples were collected monthly from October 2000 to September 2002 and from October 2007 to September 2009 at one single sampling station located at the deepest point of the Azibo Reservoir (latitude: 41°32'50"N; longitude 6° 53' 38"; altitude: 500 m). All data were obtained in the euphotic zone. The highest values of total phosphorous concentrations were reported together with the maximal values of precipitation. Conversely, conductivity water transparency decreased during the wet periods. Cyanobacteria presence was only detected when a dry summer was preceded by an extremely wet winter (chlorophyll a peaked during cyanobacteria presence). Obtaining longer data series enabling a simultaneous analysis of intra and inter-annual ecosystem changes will allow a better understanding of the complexity of interactions between climate and limnological parameters. This can in turn reveal the role played by climate change and other disturbance events on reservoir limnology.

### **S03P06**

#### **Mining wastes spill into a mountain stream (Douro basin, NE Portugal): Impact on water quality and macroinvertebrate assemblages**

Ana Maria Gerales<sup>1</sup>, Maria João Parada<sup>1</sup>, Elsa Ramalhosa<sup>1</sup>, Conceição Fernandes<sup>1</sup>, Miguel Caetano<sup>2</sup>, Amilcar Teixeira<sup>1</sup>

<sup>1</sup>*Mountain Research Centre (CIMO), ESA-Polytechnic Institute of Bragança, Campus de Stª Apolónia 5300-253 Bragança, Bragança, Portugal,* <sup>2</sup>*IPMA, Instituto Português do Mar e da Atmosfera, Avenida Brasília, 1449-006 Lisboa, Lisboa, Portugal*

A large spill of mining wastes into Portelo Stream a tributary of Sabor River (Douro Basin; NE Portugal) occurred in January 2010. In order to access the impact of this event, the aim of the present research was to evaluate the amplitude of the initial effects of the spill on the aquatic ecosystem, as well as, the recovery of the aquatic ecosystem after the mining spill. Water and macroinvertebrates were sampled monthly from January to July 2010, 2011 and 2012. Samplings were carried out in eight locations (P1 to P8) distributed along 20 km. Concentrations of Al, Mn, Co, Cu, Ni, Cd and As were measured in the dissolved fraction (<0.45 µm) of the water samples. Sampling stations located closer to the spill point (Portelo Stream) presented a low pH ( $\approx 4$ ) and a potential toxicity due to the high Cu concentrations. The stations located at 15 km or more from the discharge point seemed not to have been significantly impacted by the mining spill. In terms of abundance and diversity of macroinvertebrate assemblages, a slow and progressive recovery was detected, with a gradual colonization by different taxa in disturbed areas, after their disappearance in January 2010. It should be emphasized the presence of organisms belonging to faunistic groups relatively sensitive to disturbance, like different insects of Trichoptera and Ephemeroptera orders, in the sites closer to the mine, three years after the disaster.

### **S03P07**

#### **Can zooplankton biodiversity be used to evaluate trophic state and water quality of a mountain reservoir?**

Ana Maria Geraldes<sup>1</sup>, Rajeev Pasupuleti<sup>2</sup>, Miguel Alonso<sup>3</sup>

<sup>1</sup>*Mountain Research Centre (CIMO), ESA-Polytechnic Institute of Bragança, Campus de Santa Apolónia 5300-253 Bragança, Bragança, Portugal,* <sup>2</sup>*ESA-Polytechnic Institute of Bragança, Campus de Santa Apolónia 5300-253 Bragança, Bragança, Portugal,*

<sup>3</sup>*Departament d'Ecologia Facultat de Biologia Universitat de Barcelona Avda. Diagonal 643. 08028 Barcelona, Baracelona, Spain*

Zooplanktons are a keystone in the ecosystem functions transferring energy to higher trophic levels. Moreover, zooplankton community is susceptible to quick responses with changes in the environment. Therefore, this community can be regarded as a valuable indicator of ecological integrity and water quality. Serra Serrada is a mountain meso-eutrophic reservoir (latitude: 41°57'12"N; longitude: 6° 46' 44"W; altitude 1300 m) in Portugal, which is prone to water level fluctuations. Despite of being an artificial lake, zooplankton showed high biodiversity including 13 taxa of Rotifera, 12 taxa of Cladocera and 3 of Copepoda. Some of these species, such as *Ceriodaphnia quadrangula*, *Drepanothrix dentate* and *Holopedium gibberum* are classified as rare in the context of Iberian Peninsula. In order to assess the role of zooplankton community composition as environmental indicator, the present research aimed to compare the values obtained for Carlson's Trophic State Index (TSI) (based on total phosphorous concentration (TP), water transparency (SD) and chlorophyll 'a' concentration) to the obtained zooplankton metrics like: (1) The trophic state index of rotifer abundance (TSI N rot); (2) the ratio of crustacean abundance to rotifer abundance and (3) the ratio of large (>10 µg) cladoceran abundance to total cladoceran group abundance. All the components of TSI increased during the low level phase. Although, rotifer being dominant in all phases (except in the emptying phase, where Copepoda was dominant), TSI N rot increased in the low level phase, when TP and Chl a concentrations increased and SD decreased. Crustacean/Rotifer ratio also followed the same pattern, showing the lowest value in the low level phase. Results for large Cladocera/total Cladocera ratio were not so elucidative. Therefore, zooplankton metrics were in line with TSI, confirming that zooplankton community can be a good indicator of reservoir water quality and of ecological integrity.

### **S03P08**

#### **Environmental drivers of productivity and isotopic ratios ( $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ ) in high-mountain wetlands in the Eastern Pamir**

Malgorzata Suska-Malawska, Marcin Sulwinski, Piotr Chibowski, Pawel Pawlikowski,  
Monika Metrak  
*University of Warsaw, Warsaw, Poland*

Eastern part of the Pamir Mountains (Tajikistan, Central Asia) is characterized by great aridity and continentality (annual precipitation of c.a. 100 mm), which results in local and altitudinal environmental differences, determining biological diversity and productivity of alpine ecosystems. The most pronounced local differences concern soil moisture and salinity. We determined abiotic environmental factors that influence productivity of high-mountain wetlands in the Eastern Pamir, and that affect isotopic ratios in plant biomass. We chose three shallow lakes with adjacent wetlands: (1) Bulunkul (3740 m a.s.l.), (2) Rangkul (3790 m a.s.l.), (3) Sassykul (3830 m a.s.l.). From vegetation patches covered in at least 50% with one of three sedge species (*Blysmus rufus*, *Carex orbicularis*, *Carex microglochis*), vascular plant biomass (1m x 1m plots) and soil were sampled. A series of analyses of biomass and soil were performed, including total content of C, N, P and K,  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ , pH, electrolytical conductivity (EC) and content of various ions. Obtained results were used in step-wise regression analyses. Productivity in the studied plots was strongly diversified and ranged from 1.4 to 14.3 g/m<sup>2</sup>. Though we anticipated, that either soil moisture (a gradient of 20 to 86%) or salinity (EC gradient of 1 to 9 dS/m) would influence productivity of the studied wetlands, the only statistically significant factor was pH, explaining 13% of the observed variance ( $p=0.035$ ). As far as isotopic ratios are concerned,  $\delta^{15}\text{N}$  in plant biomass was strongly influenced by  $\delta^{15}\text{N}$  in soil ( $R^2=0.82$ ,  $p<0.0052$ ). Moreover, biomass rich in N and C was characterized by higher (less negative)  $\delta^{15}\text{N}$  ( $R^2=0.33$ ,  $p<0.0009$ ).  $\delta^{13}\text{C}$  of biomass reflected  $\delta^{13}\text{C}$  of dominating species, while  $\delta^{15}\text{N}$  was significantly lower than for dominating species. Altitude had no significant effect on productivity and isotopic ratios.

#### Acknowledgments

This work was supported by the National Science Centre (Grant No 2013/09/B/ST10/01662).

#### **S04P01**

### **Planning agritourism like a factor of the environmental conservation in a city located in a river basin bordered by a mountainous region in RJ, Brazil.**

Bernadete Pedreira, Elaine Fidalgo, Rachel Prado  
*EMBRAPA, Rio de Janeiro, RJ, Brazil*

The Cachoeiras de Macacu municipality is located in Guapi-Macacu river basin, in a region surrounded by mountains in the Rio de Janeiro state, Brazil and it is rich in natural resources and protected by conservation units, with vocation for the operation of tourist activities of rural and ecological character. It also presents significant agricultural potential to explore agritourism. However, for the activity be developed based on environmental conservation, requires feasibility study considering physical, social, cultural, economic and environmental indicators. Thus, from the results of a local diagnostic study on the potential and limitations of the municipality in relation to its agritouristic viability, it was prepared a preliminary plan to support the sustainable development of the local agritourism. To this, secondary and primary data were compiled. Secondary data consulted refer to the results from researches and projects carried out in the region by research and educational institutions. Primary data were collected from the local actors (rural family farmers and their representatives, employees of governmental institutions, rural businessmen, owners of lodgings) through field campaigns conducted between 2012 and 2014 in rural communities based on family agriculture in this city. This plan contains guidelines, action proposals, a map with places of interest to agritourism, suggestion of visitation itineraries of agritourism, in order to support decision-making and even develop public policies for agritourism management. It represents a first step to guide the planning of agritourism integrated to the family-based agricultural production in the municipality, aiming to bring socio-economic benefits associated with environmental conservation.

#### Acknowledgments

National Council for Scientific and Technological Development /CNPq and EMBRAPA.

## **S04P02**

### **Arenas of power in mountain environments in Brazil and Argentina**

Amazile López Netto<sup>1</sup>, Renato Assis<sup>2</sup>, Adriana Aquino<sup>3</sup>

<sup>1</sup>*Universidade do Estado da Bahia, Juazeiro, Bahia, Brazil,* <sup>2</sup>*Embrapa Agrobiologia - NPTA, Nova Friburgo, Rio de Janeiro, Brazil,* <sup>3</sup>*Embrapa Agrobiologia - NPTA, Nova Friburgo, Rio de Janeiro, Brazil*

The mountains occupy approximately a fourth of the earth's surface. The mountain environments are the direct basis of livelihood of nearly 12% of the world population; and provide basic goods and services to more than 50% of humanity. The Member States which established the MERCOSUL, only Brazil and Argentina are in the relationship of the twenty countries with the largest mountain area in the world, considering the low, medium and high mountains. Despite the great extent and representativeness that mountain areas occupy in Argentina and Brazil, public actions aimed at these regions are incipient. These policies generally do not consider the specifics of mountain environments. In this context, the exception is the Argentine experience of institutional policy, Committee for the Sustainable Development of Mountain Regions (*Comité para el Desarrollo Sustentable de las Regiones Montañosas - CDSM*) which can contribute to the Brazilian public policy directed to mountain environments. This is because the main objective of the CDSM is to be instance of articulation and discussion of strategies to facilitate joint work in the Argentine mountain environments. Considering this universe, the objective of this study is to analyze whether the Argentine experience CDSM is adaptable in its application to the Brazilian reality. The methods used were critical survey and analysis of secondary data, desk research and interviews. It is observed that in Brazil there are no arenas of power directed to mountain environments. We conclude that the Argentine experience CDSM can be adapted to the Brazilian reality, promoting social dialogue between the spheres of government and civil society. In Brazil may enable the joint actions that promote sustainability in mountain environments, as already done by CDSM, taking as example, database training related to the issue and publication of books and information material.

### **S04P03**

#### **Public policies to stimulate the labor inducers of innovation - INDILABs**

Leonardo Faver

*Universidade Católica de Petrópolis, Petrópolis, Rio de Janeiro, Brazil*

Direct incentives for innovation at work, such as the expansion of markets, public and profitability, or indirect, such as those derived from government incentives to enterprises, have not been sufficient for the realization of an innovative institutional and organizational culture. They are needed working devices aimed at innovation. Innovation instruments implemented in the horticulture sector have generated limited and discontinuous results, especially in the mountainous region of the state of Rio de Janeiro. This article aims to support the formulation of public policies for farmers, able to stimulate the reference model of inducing labor innovation, INDILABs based on Faver (2014) for the establishment of a culture capable of developing and deploying recurring systems with a working mentality innovation. The reference model of innovation through work consists of four inductors: technology, management, attitude and action and the cognitive process. The technology is related to the use of products or new products, new ways of responding to problems, new organizational forms, new techniques, management advocates positive attitudes toward new encouraging reward risk initiatives, creativity expanding skills and abilities, the process cognitive seeks to articulate and harmonize social systems with more ethical and human values and attitude and action develop and strengthen proactive behavior. Faver (2014) classified the barriers and obstacles to the development of INDILABs seven (7) forms: Educational barriers, cultural barriers, barriers to technological development, dissemination and transfer of technology, information and knowledge, institutional barriers, Characteristics of Rural Work and Marketing. This paper discusses the public policy based on Hofstede, 1991, Putnam (2000), Chaffotte and Chiffolleau (2007) to promote social balance or introduce imbalances intended to modify the realities to better combining the techniques of "midwife" and "grazing" ( Evans, 1995).

#### Acknowledgments

FAPERJ.

## **Sy02P01**

### **Endogenous territorial development in mountain environments: the case of the territory of the Alto Camaquã – Brazil**

Viviane Cristina Silva Lima<sup>1</sup>, Renato Linhares de Assis<sup>2</sup>, Adriana Maria de Aquino<sup>2</sup>, Marcos Flávio Silva Borba<sup>3</sup>

<sup>1</sup>*Universidade Federal Rural do Rio de Janeiro, Rio de Janeiro, Brazil,* <sup>2</sup>*Embrapa Agrobiologia, Rio de Janeiro, Brazil,* <sup>3</sup>*Embrapa Pecuária Sul, Bagé, Brazil*

The territory of Alto Camaquã, in the southern state of Rio Grande do Sul - Brazil, it has been highlighted by the strengthening of family livestock from associative process based on the construction of collective territorial mark that identifies the production with the landscape socially constructed of local mountain environments. The collective mark in question is the result of territorial development process founded on the advancement of the site, the conservation of natural resources, the knowledge produced locally by actors in communication networks and cooperation in building the brand, which is the territorial capital to meet the needs of a different market. The appreciation of food origin and the differentiation of these products are directly related to culture and knowledge to the farmers of the Alto Camaquã, which in a mountainous landscape, has historically maintained their modes of production. The introduction of capitalism in the territory contributed to the marginalization and exclusion of farmers, qualifying them for livestock capitalized as delay symbol. However, from promoting local action of endogenous territorial development process is reality has since become the appreciation of local production from its identification with the mountain scenery of the environments in question as a result of the appreciation of space of the farmers the production and the socially constructed landscape, including its cultural manifestations historically established based on ties of these actors with mountain environments in which they live and reproduce.

## Sy02P02

### **Historical evolution of forest landscape in areas populated by autochthonous broadleaf forests of northwestern peninsular: how historical data can be used in conservation strategies?**

Ignacio J. Diaz-Maroto<sup>1</sup>, Olga Vizoso-Arribe<sup>2</sup>, Maria C. Diaz-Maroto<sup>3</sup>

<sup>1</sup>University of Santiago de Compostela, Lugo, Spain, <sup>2</sup>University of Santiago de Compostela, Lugo, Spain, <sup>3</sup>University of Castilla-La Mancha, Lugo, Spain

The current forest ecosystems are the result of a mixture of human intervention and vegetation dynamics during the last glacial-interglacial cycle, and their evolution can be drawn by palynological studies. In the north-west Iberian Peninsula there is evidence of the presence of *Quercus* species since the Cretaceous Era, and their diversification during the Tertiary period. The decline of broadleaved forests began in prehistoric times and coincided with the expansion of human activity and the establishment of crops and pasture. The spread of agriculture and cattle breeding began between 4000 and 5000 years BC. Other causes of their decrease were the expansion of the naval industry, extraction of wood and firewood for domestic/industrial use and, forest fires. All these activities have caused a reduction in the area occupied by these woodlands until the middle of the 19th century, without making any management proper action to enable their natural regeneration. The existing forests were either not managed at all or were subjected to inappropriate silvicultural treatments, such as pollarding and felling of the best trees. In the second half of the 19th century, there was a rapid change in this trend, and an increase in the area occupied by broadleaved species. This increase was due to the abandonment of certain activities such as the use of firewood, agriculture and extensive pasture in mountain areas, and even the diminution in the shipbuilding. Much of smallholder farms have also recently disappeared, and have been replaced by protection forests, reforestation with fast growing species and unproductive land. As a result, in the last decades, there has been a considerable increase in the area occupied by natural broadleaved forests.

## **Sy02P03**

### **Recent land use changes in Inner Areas of Italy**

Marco Marchetti<sup>1</sup>, Lorenzo Sallustio<sup>1</sup>, Andrea De Toni<sup>1</sup>, Caterina Palombo<sup>1</sup>, Giovanni Santopuoli<sup>1</sup>, Carmen Giancola<sup>1</sup>, Marco Ottaviano<sup>1</sup>, Daniela Tonti<sup>1</sup>, Bruno Lasserre<sup>1</sup>, Paolo Di Martino<sup>1</sup>, Vittorio Garfi<sup>1</sup>, Rossano Pazzagli<sup>1</sup>, Matteo Vizzarri<sup>1</sup>, Roberto Tognetti<sup>1,2</sup>

<sup>1</sup>*Centro di Ricerca per le Aree Interne e gli Appennini (ARIA), Università degli Studi del Molise, Molise, Italy,* <sup>2</sup>*The EFI Project Centre on Mountain Forests (MOUNTFOR), San Michele all'Adige (TN), Italy*

Several international initiatives have been recently established to promote sustainable development in European mountain areas. Contextually, different research initiatives and project centers have been developed to offer scientific support and share experience and knowledge. With the main purpose to fill the existing knowledge gaps in ancient human-dominated mountain areas, the Research Centre for Inner Areas and Apennines (ARIA) has been established at the University of Molise, Central Italy. Indeed, the Apennines Mountains are an essential part of the Mediterranean biome, recognized as a biodiversity hotspot worldwide. As a consequence, allowing the adaptation of these areas to new environments, as well as the exploitation of more needful resources, is simultaneously a challenge and an opportunity. In this context, the National Strategy in favor of Inner Areas was presented and formalized by the Italian Government in 2012. The aim of the Strategy is to a) identify marginal areas at national scale based on the demographic, economic and natural territorial assets, b) promote sustainable strategies and initiatives, and c) revert the negative demographic trend. The resulting geography of Inner Areas in Italy is partially overlapped with that of mountain and protected areas. This implies the need for offering perspectives towards a new balance of services (education, mobility, information, health), even considering that these areas represent about 60% of the national territory, and host a quarter of the Italian population. The aim of this contribution is to provide a first characterization of Inner Areas of the Italian Peninsula, mainly focusing on their natural, demographic and economic assets and recent development trends. Emphasis is particularly given to land use changes occurred in the last decades, which have been characterized by land abandonment and woodland encroachment. The analysis was carried out using transition matrices derived from the Italian Land Use Inventory (IUTI), from 1990 to 2008.

## **Sy02P04**

### **Forest certification: is it recognized by social, research and enterprise elements?**

Pablo Vila-Lameiro, Adriana Conde-Fernandez  
*University of Santiago de Compostela, Lugo, Spain*

The European Union Forest Law Enforcement Governance and Trade (FLEGT) Action Plan sets out actions to prevent the import of illegal wood into the EU, to improve the supply of legal timber and to increase demand for wood coming from responsibly managed forests. Nowadays, the vast majority of the population have information from the local governments and public institutions that sustainable timber procurement can reduce overall costs. Specifically, products derived from sustainable timber procurement policies are accepted that implies the demonstration the legal and regulatory compliance, the performance of cost savings and financial benefits, the local innovation and developing of potential markets, the creation of local green jobs, contributes to global sustainability, and, in summary, demonstrates the responsibility to the local constituency, improving public image. However, lot of times, this is an unclear image confused with quality, labour risks, sustainable management... In this work it's analysed what's known by several actor related to Forest Certification.

#### Acknowledgments

University of Santiago de Compostela; Irish Distillers Ltd - Pernod Ricard.

## **Sy02P05**

### **Statistical model to predict land-use change in mountains**

Xabier Baches, Ricardo Blanco, Rosario Fanlo  
*University of Lleida, Lleida, Spain*

Mountain land-use changes are produced either by social or physiographic variables. In the first case, the depopulation due to economic issues or tragic social events (e.g. wars, climatic disasters), is difficult to be foreseen. On the other hand, physiographic variables could be measured year by year, studying their behaviour as land-use change driving forces. In this article, we present a predictive logistic model to prevent land use changes from forest to grassland or crops, and reversely. For that purpose we have used slope, altitude, orientation and land use data from a Pyrenean little valley during fifty-five years period in twentieth century, to design a statistical model of forecast changes.

## **Sy04P01**

### **Agrifood product family in mountain environment in Rio de Janeiro State , Brazil - case of local sociocultural practice strengthening**

Alessandro Melo Rifan, Adriana Maria de Aquino, Renato Linhares de Assis, Maria Clara Estoducto Pinto  
*Embrapa Agrobiologia - Núcleo de Pesquisa e Treinamento para Agricultores (NPTA), Nova Friburgo, Brazil*

It has been sought to characterize the clay oven used in the preparation of the "plant broa", traditional food product in the family based production systems of upper river Grande, in Nova Friburgo, in the mountain range region of the state of Rio de Janeiro - Brasil, and reflect about its inter-relation with culinary practice and domestic cultivation, as well as its maintenance as a local sociocultural and dietary practice. Data collection was done based on a semi-structured interview with the farmers and systematic recording of direct observations, and informal talks. It has been verified that the rescuing and systematization of traditional knowledge associated with the manufacture of the broa, the building of ovens and the cultivation of indigenous plants, become relevant as long as they are valued by the general public, and recognized by the farmers as having intrinsic value related to the feeling of recognition and belonging to the mountainous territory in which they live, contributing to the reaffirmation of their identities. These production traditions of peasant origin, resignified with the farmer families in their mountain environments, can contribute locally to the promotion of a process of endogenous territorial development. For this, considerations point to the need to value practices based on resources available in the region, and of the demand raised in the context of mountain agriculture with a family and agroecological basis; providing that the agroenvironmental aspects are adequate, through processes of sensibilization and valorization, for the understanding of the notion of territory by the farmers. For the strengthening of the "plant broa" as a socially identified product linked to the territory and mountainous scenery, it becomes necessary to involve and value protagonists in the participative bulding of process and proposals which generate occupation, jobs and income from the valorization of local sociocultural and socioambiental products.

#### Acknowledgments

Embrapa - Empresa Brasileira de Pesquisa Agropecuária; CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico.

## **Sy06P01**

### **Nutritional value and chemical composition of *Cichorium spinosum* L. under saline conditions.**

Spyridon Petropoulos<sup>1</sup>, Antoniadis Vasilios<sup>1</sup>, Levizou Efi<sup>1</sup>, Ângela Fernandes<sup>2</sup>, Lillian Barros<sup>2</sup>, Isabel Ferreira<sup>2</sup>

<sup>1</sup>*University of Thessaly, Magnissia, Greece,* <sup>2</sup>*Polytechnic Institute of Bragança, Bragança, Portugal*

Soil salinity is an ever-growing problem that hinders vegetable cultivation in many areas within the Mediterranean basin. *Cichorium spinosum* is native to the Mediterranean basin and is usually found in coastal areas and plateaus. In the present study, *C. spinosum* plants were grown under saline conditions (1.8, 4 and 8 dS/m), in order to evaluate the effect of salinity on their nutritional value and chemical composition. From the results it was observed that high salinity levels (8 dS/m) affected nutritional value by increasing dry matter and ash content, whereas carbohydrate content decreased. Sugar composition and total sugar content was also affected, since a decrease in fructose and glucose content as well as in total carbohydrates content was observed. Increasing salinity resulted in an increase of  $\alpha$ - and  $\delta$ -tocopherol and consequently of total tocopherols. Ascorbic acid was not detected in any of the studied treatments, whereas chlorophyll a and b content increased under high salinity conditions. Fatty acids consisted mainly of linoleic,  $\alpha$ -linolenic and palmitic acid, whereas no significant differences were observed between control and salinity treatments. PUFA/SFA and n-6/n-3 ratio was higher than 0.45 and lower than 4.0, for all the treatments respectively. Considering the great genetic diversity and the adaptation under harsh conditions that various *C. spinosum* ecotypes exhibit, this species could be a potential alternative crop for mountainous areas and especially in soils with salinity problems.

## **Sy06P02**

### **Saffron quality (*Crocus sativus* L.) of the Alpine areas**

Annamaria Giorgi<sup>1</sup>, Daniela Pentimalli<sup>1</sup>, Luca Giupponi<sup>1</sup>, Sara Panseri<sup>2</sup>

<sup>1</sup>*Centre for Applied Studies in the Sustainable Management and Protection of the Mountain Environment-Ge.S.Di.Mont, University of Milan, Edolo (BS), Italy,*

<sup>2</sup>*Department of Veterinary Science and Public Health, University of Milan, Milan (MI), Italy*

Saffron is the most expensive food spice obtained from the drying process of the pistils of *Crocus sativus* L. flowers. The quality of saffron is determined according to the ISO 3632 1,2:2010-2011 which classifies the spice in three different categories (I, II, and III) depending on the amount of Crocins (color), Picrocrocins (flavor) and Safranal (aroma). In recent years, there has been a greater interest in saffron and consequently an increase in its production, especially in mountain regions like Alps. This has been mostly evident, where land was abandoned due to emigration to the cities. This new trend might have a strong impact in the exploitation and economical recovery of the mountain areas. In the present study we investigate the quality of saffron produced in the Italian Alps by using a spectrophotometric analysis according to the ISO 3632 1, 2:2010-2011. All the samples were produced between November 2015 and March 2016, in different areas of the Central Italian Alps at an altitude up to 1143 m. The results confirmed a high quality of the spice as most of the samples are belonging to the "I Category" according to ISO classification. Thus, our study provides valid information about the quality of saffron produced in the Alpine areas and suggests this culture as a powerful as well as strategic resource for mountain economy. Moreover, it brings sustainable economic value to multifunctional farms in mountain areas such as the Alps.

### **Sy06P03**

#### **Saffron (*Crocus sativus* L.) production as strategies in a mountain contest**

Annamaria Giorgi<sup>1</sup>, Daniela Pentimalli<sup>1</sup>, Luca Giupponi<sup>1</sup>, Sara Panseri<sup>2</sup>, Gigliola Borgonovo<sup>3</sup>, Angela Bassoli<sup>3</sup>

<sup>1</sup>*Centre for Applied Studies in the Sustainable Management and Protection of the Mountain Environment-Ge.S.Di.Mont.- University of Milan, Edolo (BS), Italy,*

<sup>2</sup>*Department of Veterinary Science and Public Health, University of Milan, Milan (MI), Italy,* <sup>3</sup>*DeFENS – Department of Food, Environmental and Nutritional Sciences, University of Milan, Milan (MI), Italy*

Saffron has been used for a long time in the food industry as a colouring and flavouring agent but it is also known for a wide range of health promoting benefits. The main components that determine the quality of this spice are: Crocins (color), Picrocrocin (flavor) and Safranal (aroma). Safranal belongs to the group of VOCs (volatile organic compounds) that are present in different concentrations in this spice. It is the most abundant VOC in Saffron, although other molecules, even if in small quantities, contribute to the aroma too. We focused our research to investigate the VOCs profile by changing growing conditions of the *Crocus sativus* L. For this purpose, we cultivated saffron in field and in vase as well, maintaining the other factors (soil composition, light, irrigation, etc.) constant and we analyzed the obtained spice by Solid-Phase-Microextraction coupled with Gas-chromatography/mass-spectrometry (SPME-GC/MS) in order to elucidate the volatile profile. VOCs profile of the two samples was different, in particular for Safranal concentration. Saffron cultivated in vase showed a higher concentration of Safranal respect to the sample in the field. The higher stress conditions of the plant in vase probably provoke an inner reaction and consequently a variation in the chemical composition of it. Both products were analyzed by spectrophotometry too, in order to determine the quality according to the ISO 3632 1, 2:2010-2011 and they showed a different profile. Saffron is easily cultivated in vase and for a bigger production we suggest the use of plant racks. This alternative production could help to solve problems due to extreme slopes of some mountain regions as well as represent an economic value for those territories that nowadays are abandoned.

## **Sy06P04**

### **An ancient pointed maize rich in phlobaphenes: the "Nero Spinoso" from Valcamonica(Brescia, Italy)**

Puglisi D.<sup>1</sup>, Cantaluppi E.<sup>1</sup>, Landoni L.<sup>2</sup>, Giupponi L.<sup>3</sup>, Giorgi A.<sup>3,1</sup>, Pilu R.<sup>1</sup>

<sup>1</sup>*Università degli Studi di Milano, DiSAA, Milano, Italy,* <sup>2</sup>*Università degli Studi di Milano, DBS, Milano, Italy,* <sup>3</sup>*Università degli Studi di Milano, Ge.S.Di.Mont., Edolo, Italy*

The variety of the species *Zea mays* called "Nero Spinoso" is a traditional crop in the Middle Valle Camonica (Northern Italy) although its cultivation was almost completely abandoned during the second half of the twentieth century due to the introduction of commercial hybrids and to a reduction in the consumption of polenta, for centuries a staple food of the rural population. This work characterized this ancient pigmented maize. A preliminary spectrophotometric analysis revealed the presence of flavonols, phenolic acids and in particular phlobaphenes, probably responsible for ear coloration. Phlobaphenes are reddish insoluble substances synthesized in maize through the flavonoids pathway by the polymerization of flavan-4-ols. In maize this pigment is due to the presence of the pericarp1 gene (p1), a transcription factor belonging to the MYB gene family driving the accumulation of the pigment in the pericarp layer. Genetic and molecular analysis confirmed the presence of the P1 gene in this landrace and histological analysis confirmed that the pigment is accumulated in the pericarp. In the meantime HPLC analyses also showed the presence of a large amount of carotenoids and, probably thanks to the high amount of pigments, this maize variety showed very high antioxidant ability. Given the chronic disease prevention properties of antioxidant molecules, this variety could be of great interest also from a nutritional point of view. Characterization will allow an accurate description of this landrace with the aim of studying and preserving maize biodiversity in Europe and in particular in Italy. We have collaborated with the municipalities of Esine and Piancogno in the application process needed to register this ancient cultivar on the National Register of conservation varieties with the aim of valorizing this ancient landrace. The "Nero Spinoso" maize was recorded in the National Register in January 2016.

## **Sy06P05**

### **Experience of agroecologic transition using cover crop in family production systems at the hills environment of Rio de Janeiro State - Brazil**

Gerson Antonio<sup>1</sup>, Renato Assis<sup>2</sup>, Adriana Aquino<sup>3</sup>

<sup>1</sup>EMATER-RIO, Nova Friburgo, Rio de Janeiro, Brazil, <sup>2</sup>EMBRAPA, Nova Friburgo, Rio de Janeiro, Brazil, <sup>3</sup>EMBRAPA, Nova Friburgo, Rio de Janeiro, Brazil

The case study at the mountain environments in the mountain region of Rio de Janeiro - Brazil, in family production systems focusing on vegetables, revealed important information in the understanding of the obstacles to adopting agroecological practices and the agronomic conditions to innovation integration, specially cover crop usage, with focus on black oat (*Avena strigosa*). It was observed that the causes to the dissemination were related to the easy management and adaptability of this plant to the local mountain environments, due to its rusticity and effectiveness in competing against native weed, contributing to the soils recovery and improving the productivity capacity at mountain environments, reducing erosion and demand of external inputs to the production units. The soils recovery capacity at the local mountain environments was the key aspect for the dissemination of the green manure technique, which, for being a winter plant, adapted really well to the lower production period and higher availability of resting fields. The soil quality valuation through the participative methodology showed that this improvement was clearer perceived by the farmers due to the plants roots better development and the soil "softness", presence of beneficial invertebrates and biologic activity and better soil humidity retention. Besides that, the farmers observed an increase of productivity and quality of the harvested products, as well as an improvement of the plants health, especially the reduction of "hérnia das crucíferas" (cruciferous vegetables hernia), very common in the cauliflower fields of the region, among others fungi and bacteria related diseases. Finally, the transition demand comes less from the farmers than from the institutions. Consequently, a agroecological transition at the mountain environments depends on a joint action by farmers and technicians, with emphasis on the monetary benefit, the most well appreciated aspect for the farmers.

#### Acknowledgments

EMBRAPA, EMATER-RIO, CNPQ.

## Sy06P06

### **Soil carbon stocks in no-tillage vegetables areas in the mountain region of the Rio de Janeiro state, Brazil**

Aline Oliveira<sup>1</sup>, Joyce Monteiro<sup>1</sup>, Ademir Fontana<sup>1</sup>, Nuno Madeira<sup>2</sup>, Carlos Eduardo Lima<sup>2</sup>, Rachel Prado<sup>1</sup>

<sup>1</sup>Embrapa Solos, Rio de Janeiro, Brazil, <sup>2</sup>Embrapa Hortaliças, Brasília, Brazil

In the mountain region, Rio de Janeiro state, the traditional agriculture is carried in hilly landscape. In these places, sharp erosion, soil degradation, and plant health problems are found, mainly due to the vegetable cultivation under intensive systems. This has led to losses in ecosystem services. An alternative is conservative agriculture, such as no-tillage, which consists of direct planting of the main crop on cultural remains of cover crops cultivated to keep the soil covered, reducing the use of agricultural inputs, improving soil quality, contributing to the increase in carbon stock and reducing greenhouse gas. However, there is a deficit of quantitative information on carbon stored in no-tillage system. This paper presents the carbon stock values in soil under three no-tillage areas. This study was done in the mountainous area in Nova Friburgo municipality. The carbon stock values in soil was quantified under three no-tillage areas: a lowland area cultivated with cucumber (*Cucumis sativus*) on mulch of black oat (*Avena strigosa*) and, in slope condition, an area used to grow cauliflower (*Brassica oleracea* var. botrytis L.) on mulch of black oat, and a third one even with oat desiccated for ground cover. The soil carbon stocks to 30 cm depth ranged from 41.1 to 59.6 Mg ha<sup>-1</sup>. The average values of carbon stock are in this following sequence: 45.0 Mg ha<sup>-1</sup> in the lowland area with cucumber, 45.1 Mg ha<sup>-1</sup> in the slope covered with black oat and 53.4 Mg ha<sup>-1</sup> on the slope with cauliflower on mulch of black oat. The information gathered in this work provides the initial diagnosis of the carbon stock in the soil of the site studied and contributes to the creation and input of a soil database on vegetable cultivation which can be used as a basis for the valuation of soil ecosystem services.

#### Acknowledgments

Embrapa.

## **Sy06P07**

### **Production and use of inputs allowed in organic agriculture supporting agroecological transition in mountain region of the State of Rio de Janeiro - Brazil**

Luiz Antonio Oliveira<sup>1</sup>, Osmir Saiter<sup>2</sup>, Maria do Carmo Fernandes<sup>1</sup>, Maria Fernanda Fonseca<sup>1</sup>, Ana Paula Pegorer<sup>3</sup>

<sup>1</sup>PESAGRO, Niterói, Rio de Janeiro, Brazil, <sup>2</sup>UFRRJ/PPGAO, Seropédica, Rio de Janeiro, Brazil, <sup>3</sup>UFRRJ/PPGCTIA, Seropédica, Rio de Janeiro, Brazil

Alternative inputs (biofertilizers, fermented compost Bokashi, Trichoderma) used in the control of pests and diseases, and nutrition of vegetable crops cultivation has been tested by farmers researchers in agroecological transition processes and conversion to organic farming. They are located in watersheds, assisted by the Rural River Program, from the Department of Agriculture of the State of Rio de Janeiro. These experiments have been carried out in the mountain region in the municipalities of Teresopolis, Petropolis and Nova Friburgo, during the year of 2014 and 2015, in vegetable crops production systems. The methodology used is participatory research in which the farmers participate in all research planning, execution, monitoring and evaluating together with researchers and technicians from PESAGRO, agriculture research institution of the State of Rio de Janeiro. As a result, producers observed improvement in productivity, product quality, reducing production costs and improvement in plant health.

#### Acknowledgments

World Bank, PESAGRO.

## Sy06P08

### **Evaluation of sustainability at agroecological production systems in mountain environments at Nova Friburgo - Brazil**

Marcelo da Silva Pereira<sup>1</sup>, Isis Rodrigues<sup>4</sup>, Geraldo Stachetti Rodrigues<sup>4</sup>, Renato Linhares de Assis<sup>2</sup>, José Antonio Azevedo Espindola<sup>3</sup>

<sup>1</sup>*Secretaria Municipal de Agricultura e Desenvolvimento Rural de Nova Friburgo, Nova Friburgo - RJ, Brazil,* <sup>2</sup>*Embrapa Agrobiologia - Núcleo de Pesquisa e Treinamento para Agricultores (NPTA), Nova Friburgo - RJ, Brazil,* <sup>3</sup>*Embrapa Agrobiologia, Seropédica - RJ, Brazil,* <sup>4</sup>*Embrapa Meio Ambiente, Jaguariúna - SP, Brazil*

At mountain environments of the Mountain Region of Rio de Janeiro state - Brazil, agroecology represents an opportunity for improvement of life quality and increasing income for family farmers, especially regarding to the increasing search for food produced in sustainable systems. A study was done on the sustainability of agroecological production systems, in the city of Nova Friburgo. The evaluated production systems were classified as organic or agroecological. The Environmental Impact Assessment System of New Rural Activities (APOIA-NovoRural System) was applied at this study. It consists of a set of 62 indicators of the environmental performance of an economic activity. It were done field and laboratory analysis, related to soil and water quality. The impact indexes for the dimensions "Landscape Ecology" and "Management and Administration" have shown the main differences among organic and agroecological production systems. Organic farms presented a greater productive diversity, and a higher capacity to commercialize their products, in relation to agroecological ones. It was clear the positive contribution of organic agriculture in relation to future benefits, especially if there will be a greater interaction among organic and agroecological farmers, especially in relation to the increasing of productive diversity and sustainability. Besides, an association between productive systems and local mountain landscape may increase sustainability, creating new opportunities to commercialization and aggregating value to the products.

#### Acknowledgments

Embrapa.

## Sy06P09

### **Agroecological strategies and production diversification for food security and sovereignty in family based production systems in a mountain environment in Teresópolis - Brazil**

Hugo de Souza Cerqueira<sup>1</sup>, Adriana Maria de Aquino<sup>2</sup>, Lucia Helena Almeida<sup>3</sup>, José Guilherme Marinho Guerra<sup>3</sup>, Renato Linhares de Assis<sup>2</sup>

<sup>1</sup>*Associação Agroecológica de Teresópolis, Teresópolis, RJ, Brazil,* <sup>2</sup>*Embrapa Agrobiologia - Núcleo de Pesquisa e Treinamento para Agricultores (NPTA), Nova Friburgo, RJ, Brazil,* <sup>3</sup>*Embrapa Agrobiologia, Seropédica, RJ, Brazil*

For the adequate management of agro-systems in mountain environments, it is understood that the agroecological practices should be the appropriate technological basis. For this, work has been carried out with the farmers associated with the "Associação Agroecológica de Teresópolis" (AAT), based on the agroecological strategies prioritized by them aiming the proposal of developing cultivation systems which allow maximum soil coverage in the different periods of the year, as it generates more diversity and abundance of foodstuffs, strengthening food and nutritional security for farmer families. As such, using area set aside for six years, of a conventional farmer in process of agroecological transition, it has been verified initially that the area already possessed abundance of organic material from the native vegetation present. This has been used as starting point to implement economic crops of interest, as well as posterior introduction of green fertilizer. As with the first crops introduced, The use of more extensive plants has been sought, notably roots and tubers in conjunction with green fertilizers (mucuna, pigeon pea, millet and sunflower), prioritizing whenever possible the association of a legume with corn, having this dual role: plant of soil coverage for the production of organic matter, allied to the production of green corn cobs for sale. After two years of work it has been possible to start cultivation of vegetables with a short cycle, with more intensive soil use, but keeping the method of association with green fertilizers. Also, the farmer incorporated general practices of organic agriculture in his production unit as a whole. Incorporated food diversification in his family's day-to-day, as well as sustainability concerning independence from the market, and so improving food security and sovereignty, with consumption of foodstuffs from his production unit. In addition, he became a member of AAT and its collective process, selling produce in organic fairs.

#### Acknowledgments

Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq); Empresa Brasileira de Pesquisa Agropecuária (Embrapa).

## **Sy06P10**

### **Participatory evaluation of soil quality and brassicas crops in the mountain region of Rio de Janeiro, Brazil.**

Eduardo Spitz de Carvalho<sup>1,2</sup>, Adriana Maria de Aquino<sup>1</sup>, Renato Linhares de Assis<sup>1</sup>  
<sup>1</sup>*Colégio Rei Alberto I, Nova Friburgo, Brazil,* <sup>2</sup>*Embrapa Agrobiologia, Nova Friburgo, Brazil*

In the mountain region of Nova Friburgo, Rio de Janeiro, soil degradation process is moving forward with great intensity due to conventional farming practices. This process has led to a significant imbalance, affecting the environment, thus producing impacts on local production. Pathogenic organisms like *plasmodiophora brassicae* has been benefited by these practices, causing huge losses in brassicas production in the city. The application of participatory methodologies with the use of sustainability indicators is an important tool to determine agricultural ecosystems' level of sustainability, as well as pointing out their weaknesses, allowing actions to balance the agro-ecosystem, thus making it more productive. The methodology called Rapid Assessment System of Soil Health and Crops Safety allows evaluation using qualitative indicators relevant to farmers in order to evaluate them as to the level of sustainability. In pursuit of a healthier agriculture development, participatory methods have provided significant gains regarding the empowerment of the actors involved, hence sought the participation of farmers, young people and their families, giving them the opportunity to use evaluation tools and participate in further discussions about necessary action to Production Units (PUs). This study aimed to evaluate the soil, the crops and the potential for hernia of cruciferous using participatory indicators to support discussions about the management adopted by farmers and brassica growers. It was noted that the indicators are straightforward and easy to see by the farmers, which enables them to realize that the current management has a strong negative influence on soil biota and crops.

## **Sy06P11**

### **Growing hops in Bragança (NE Portugal): past, present and future**

Manuel Ângelo Rodrigues, Jorge Sá Morais, João Paulo Castro  
*Polytechnic Institute of Bragança, Bragança, Portugal*

This paper presents an overview of the importance of hops in the past in the region of Bragança (NE, Portugal) and the current situation of the crop. It will be still presented an evaluation of the ecological conditions of the region for growing hops and discussed the future of hop sector and the need for a deep restructuration of the cropping system. The maximum area under cultivation of hops in Portugal reached 205.8 ha in 1976. In the Bragança region, a historic peak of 99.5 ha was recorded in 1986. In 1970 decade Portugal produced hops to fulfil the needs of the national brewing industry and exported hops in two years of that decade. A difficult international situation and problems at farm level originated a progressive disinterest of the farmers in this crop. Currently, there are only 12 ha of hop fields in Portugal, all in the Bragança region. However, the region of Bragança presents very favorable ecological conditions for growing hops. The plant grows spontaneously along the waterways of the region and the producers who resist of abandonment often reach hop yields above 2000 kg/ha, values higher than that are achieved in the main hops producing countries. The current cropping technique is based on an irrigation system consisting of flooding the space between rows, which reduces competitiveness of the crop due to the associated costs (water, energy, labor, ...). We are looking to the future thinking in the restructuration of the whole cropping technique, changing the irrigation system from flooding to drip irrigation. This change reduces the direct costs with irrigation and may improve the microclimate of the canopy which in turn can reduce the phytosanitary pressure. It also allows managing the soil with cover crops as an alternative to tillage, an aspect with positive economic and environmental implications.

## **Sy06P12**

### **Effect of liming and N, P, K or B application as fertilizer on chestnut tree crop nutritional status and growth**

Margarida Arrobas, Isabel Q. Ferreira, Sandra Afonso, Manuel Ângelo Rodrigues  
*Polytechnic Institute of Bragança, Bragança, Portugal*

The chestnut tree is practically the only cash crop grown in the mountain highlands of NE Portugal. Despite the many phytosanitary problems that this crop is currently facing, producers have been increasing the planted areas in response to favorable prices that the chestnut fruit has been reached in the market. The farmers have also been showing a new attitude regarding the cropping technique. In the past, the chestnut groves were a very marginal crop rarely fertilized. Nowadays, the producers seek to make rational fertilizations, hoping to balance the trees, allowing them to better cope with unfavorable biotic and abiotic stresses and stimulate productivity. However, studies on chestnut trees fertilization are rare. Little is known about the response of this species to liming or to fertilizers application. In this work, results are presented on the response of young chestnut plants to liming and nitrogen, phosphorus, potassium or boron application. Three years after planting, the results showed that the application of the nutrients N, P, K or B as fertilizer increased the concentration of each one of the respective nutrients in the leaves. However, the height of the plants was particularly reduced in the plots not fertilized with boron, followed by those not fertilized with potassium, in comparison to the plots receiving the respective nutrients. Boron and potassium appeared as the most limiting nutrients in this early phase of plant growth.

### **Sy06P13**

#### **Fertilizing value of a five years pasture ley in comparison with maize monoculture**

Margarida Arrobas<sup>1</sup>, Peltier Aguiar<sup>2</sup>, Manuel Ângelo Rodrigues<sup>1</sup>

<sup>1</sup>*Polytechnic Institute of Bragança, Bragança, Portugal,* <sup>2</sup>*Instituto Superior Politécnico do Kuanza Sul, Sumbe, Angola*

Crop rotation is one of the basic pillars of agroecology and sustainability of the production systems. Monoculture is only possible in areas without significant ecological constraints (soil fertility, available water, ...). In general, the more severe the ecological limitation for plant growth the longer should be the crop rotation and vice versa. Long-course rotations usually permit the introduction of a pasture ley phase which could lead to a more consistent and fast increase in soil fertility. In this work the fertilizing effect of a ley phase of 5 years was compared with a maize monoculture maintained for an equal period of time. The pasture ley increased the pool of organic matter. In 5 years, the 0-20 cm soil layer of the pasture phase sequestered 17.4 Mg ha<sup>-1</sup> of total organic carbon and accumulated 403 kg N ha<sup>-1</sup> more than the same layer of soil under maize monoculture. A maize crop grown after plough the 5 years pasture ley and after the 5 years of maize cultivation as a monoculture produced, respectively, 15.3 and 8.7 Mg dry matter per hectare and recovered 175.4 and 68.0 kg N ha<sup>-1</sup>, being this difference the result of the nutrient release from the extra pool of organic matter that was built during the ley phase. The residual effect of the organic pool persisted in the second year of maize growth. Dry matter yield and N recovered were 10.0 and 8.4 Mg ha<sup>-1</sup> and 78.3 and 50.3 kg ha<sup>-1</sup>, respectively in the previous pasture ley and maize monoculture

## **Sy06P14**

### **Results from a long-term study on groundcover management in rainfed olive orchards**

Manuel Ângelo Rodrigues, Sandra Afonso, Isabel Q. Ferreira, Margarida Arrobas  
*Polytechnic Institute of Bragança, B, Portugal*

In this work, results of a soil management experiment carried out in a rainfed olive orchard were presented. The treatments were: conventional tillage; herbicide application (glyphosate, a non-selective post-emergence herbicide) in spring; and sheep walking. The results showed better soil fertility parameters in the treatment consisting of natural vegetation managed by grazing (sheep walking). However, this treatment led to the worst results regarding tree nutritional status and olive yields. After 10 years, the accumulated olive yields were 187.2, 142.9 and 89.5 kg tree<sup>-1</sup> respectively in herbicide, tillage and sheep walking treatments. When the differences among the treatments became dramatically high, and no doubt remained about the effect of the treatments, we decided to change the experimental design. The plot previously grazed began to be managed with glyphosate and vice-versa. The plot managed by tillage was kept the same. After four years assessing the three nutritional status and olive yields, it was found that the cumulated production (average 4 years) was already slightly higher in the new plot managed with glyphosate (85.4 kg tree<sup>-1</sup>), followed by sheep walking (80.3 kg tree<sup>-1</sup>) and tillage plot (71.0 kg tree<sup>-1</sup>). The result revealed that in rainfed orchards we could not be overly tolerant to herbaceous vegetation since the excessive competition for water in the spring may reduce productivity. Cover cropping is a sensitive strategy in these agroecosystems.

## **Sy06P15**

### **An insight into the Portuguese sector of aromatic and medicinal plants**

Manuel Ângelo Rodrigues, Sandra Afonso, Isabel Q. Ferreira, Margarida Arrobas  
*Polytechnic Institute of Bragança, Bragança, Portugal*

In recent years in Portugal, many new farmers began to settle in the medicinal and aromatic plants (MAP) sector. They are mostly young, highly educated, though not always in agronomy. Almost all adopted organic farming practices and put soil screen for protection against weeds. In this work, we provide a diagnosis of the situation of the new producers and give up a guideline to mitigate the situation that has arisen. Shortly after installation, virtually all producers are experiencing great difficulties, because they cannot fertilize their plants and the biomass they produce is very low. The application of solid fertilizer and organic amendments is not possible due to soil screen. They have appeared on the market liquid organic fertilizer which can be used in fertigation, but their costs are prohibitive. Studies for three years with verbena, lemon balm and peppermint have shown that these fertilization solutions give tenuous productivity increases, revealing the plants deep symptoms of nitrogen deficiency very quickly. In the future seems to be no alternative to the removal of the screen and to the introduction into the system of a livestock component or legumes with ability to fix atmospheric nitrogen. Some legumes can be grown during the winter in an asynchronous cycle with the main MAP grown in Portugal. However, these cropping technologies have not yet been tested in Portugal, which can leave the producers vulnerable to error.

## **Sy06P16**

### **Protagonism and Rural Rio Programme: an analysis of the participation of farmers in mountains of Atlantic Forest in Nova Friburgo - Brazil**

Ian Luiz Galliez<sup>3</sup>, Cezar Guedes<sup>1</sup>, Renato Linhares<sup>2</sup>

<sup>1</sup>*Universidade Federal Rural do Rio de Janeiro, Seropédica, Rio de Janeiro-RJ, Brazil,*

<sup>2</sup>*EMBRAPA AGROBIOLOGIA, Seropédica, Rio de Janeiro-RJ, Brazil,* <sup>3</sup>*EMBRAPA SOLOS, Rio de Janeiro, Rio de Janeiro, Brazil*

Thinking about development is more than transformation. It is the manifestation of the possibilities of the creative capacity of human beings in the discovery of themselves and seeking to enrich their universe of values, or existential heritage, where the order accumulation comes from and to the community. Especially in mountainous areas where, due to their vulnerability, development models should be adequate and consider the actual demands of local actors, give visibility and voice to farmers in the mountainous region of Rio de Janeiro - Brazil, in an attempt to complement search for solutions that unblocks our ways to end underdevelopment, promotes an inclusive, sustainable and sustained agriculture. The protagonist in the transformation will always be the one that best interacts with the territory in case. This is because the notion of territory between the involved communities can open spaces for collective development pacts based mainly on endogenous movements, always together with the expression of the different spatial scales, in which the success of any endeavor is related to one understanding that nothing is out of the curve, that is, with the protagonism of the subjects in order to understand how and wherever they will be able to overcome the dispute for an inclusive and sustainable model, that presents itself an tension path converging in the destruction of Historic privileges. The appreciation of the farmer as a social agent which enhances and improves the health of the population and the appreciation of the human expertise in order to provide for basic human needs of food, fiber and energy conserving natural resources were the points that achieved greater convergence between farmers on Sustainable Rural Development Programme in watersheds - RIO RURAL interviewed in mountainous areas of the municipality of Nova Friburgo - Brazil.

#### Acknowledgments

Capes; CNPQ; EMATER-Rio.

## **Sy10P01**

### **Erosional response of steep slope vineyards to wind driven rainfalls: a case study in the Douro Region, Portugal**

Tomás Figueiredo<sup>1</sup>, Jean Poesen<sup>2</sup>, Felícia Fonseca<sup>1</sup>, Zulimar Hernandez<sup>3</sup>

<sup>1</sup>*Instituto Politécnico de Bragança, Bragança, Portugal*, <sup>2</sup>*Catholic University of Leuven, Leuven, Belgium*, <sup>3</sup>*Universidad Autónoma de Madrid, Madrid, Spain*

In permanent row crops, wind direction affects the rainfall that hit the ground, with consequences to runoff and soil loss, because rows may intercept a large or a negligible part of the wind driven rains, according to the relative directions of wind and plant row. This study aims at identifying and discussing the effects of wind direction during rainfalls on soil loss from vineyard plots with different slope aspect. Data from 5 erosion plots (32m long x 5m wide), installed in the Douro valley (Portugal), in 45% slope row-planted vineyard, with slope aspect from NW to SW, consisted in long term data series of continuous rainfall records, daily wind direction, and soil loss, were explored separating events only with water loss (NER, 67 non-erosive events) from the others (ERO, 100 erosive events), and assuming for each event wind direction at peak rainfall intensity. Calm atmosphere prevailed but with lower frequency in ERO (65%) than in NER (72%). Most frequent winds were NW (13%) and S (12%) in ERO, and SE (12%) and NW (7%) in NER. Wind direction affected the differences between plots in event soil loss (expressed by the CV of the 5 plots soil loss in each event), with a CV 100% for NW winds, 49% for S, and 63% for Calm. NW winds blow parallel to vine rows in some plots and almost perpendicular in the others. This effect was most evident during the larger erosion events (1:50 ratio in event soil loss in SW plot and NW plot, during a NW driven rainfall). In permanent row crops, the effect of wind direction during erosive rainfalls should be taken into account when analyzing plot soil loss data, especially in the most significant events.

## **Sy10P02**

### **New terraces, geometry optimization for sustainable viticulture: an assay using GIS tools.**

Carlos Bateira<sup>1,2</sup>, António Costa<sup>2</sup>, Joana Fernandes<sup>2</sup>, Bruno Fonseca<sup>2</sup>, Fernando Alves<sup>3</sup>,  
Laura Soares<sup>2</sup>

<sup>1</sup>Riskam/CEG/UL, Lisboa, Portugal, <sup>2</sup>FLUP/UP, Porto, Portugal, <sup>3</sup>Symington Family Estates, Vila Nova de Gaia, Portugal

The Douro Wine Region, characterized by the cultivation of vineyards in terraces (stone terraces) with vertical or near vertical drystone walls, is in a growing process of conversion of old vineyards that are not yet suitable for agricultural mechanization procedures. According to IDVP data, every year 4% of all vineyard enters a restructuring process. This restructuring requires, in many cases, a construction of new (modern) terraces, since the 80's, with one or two row of vines, or a resize of some aged modern terraces to replace the vineyard allowing the circulation of machinery. This new terraces requires a new architecture, building with an earth embankment with a slope usually between 75% and 150%. Current rules / recommendations for vineyard planting in this region require an articulation between systematisation of the landscape and production. In this research we introduce the use of software tools that are not commonly used in the project stage. So in a GIS environment and using the map algebra matrix calculation, it was possible to visualize and design spatial information in a completely different way like the traditional project software (for instance CAD). With this set of computer tools and in order to improve profitability in wine production, it was elaborated a routine procedure that obey to several topographic parameters, such as (1) topographic analysis of the area to be intervened (2) establishment of optimization parameters (platform width, width of the base of the riser and riser height) in order to obtain a project where the number of the vineyards to be planted is optimized. This different method will allow a better conjugation of the topographic variables, increase vineyard density and open doors to a better agricultural management using GIS tools.

#### Acknowledgments

CloudMapper - plataforma de processamento e disseminação de dados georreferenciados.

### **Sy10P03**

#### **Erosion control in sloping vineyards and grape production effects**

Maria Jose Marques<sup>1</sup>, Marta Ruiz-Colmenero<sup>2</sup>, Ramón Bienes<sup>2</sup>, Zulimar Hernandez<sup>1</sup>  
<sup>1</sup>*Autonomous University of Madrid, Madrid, Spain*, <sup>2</sup>*Madrid Institute for Research and Rural Development in Food and Agriculture (IMIDRA), Madrid, Spain*

Vineyards are frequently found in sloping and mountainous landscapes. The goal of this research is to see whether the use of vegetation covers in the rows of dry-farmed sloping vineyards protects the soil, as determined by changes in soil loss and runoff. We also consider how vegetation covers affect vines, measuring vegetative growth and grape and must production during one year. This study was conducted in a sloping vineyard (14% slope) in the south of Madrid, Spain. Minimum tillage is the traditional management practice. Two different sown cover crops were tested: Secale cereale and Brachypodium distachyon. Comparisons between these three treatments (Brachypodium, Secale and minimum tillage) were established for soil loss, runoff and vine production. Tillage practice serves in vineyards to reduce soil compaction, remove weeds and, in drylands, to increase water infiltration. In this vineyard tillage resulted in higher soil loss and runoff rates. Annual sediment yield produced by interrill erosion was 3; 20 and 41 g m<sup>-2</sup>. In turn, considering rainfall events higher than 1 mm day<sup>-1</sup>, average annual runoff coefficients were 0.7%; 1% and 2.3% for Brachypodium, Secale and Tillage treatments respectively. Brachypodium cover caused a significant reduction in production. The vine's vigour measured by the weight of wood produced in a year, was reduced. The weights found for Brachypodium, Secale and Tillage were respectively 0.28; 0.45 and 0.55 kg vine<sup>-1</sup>. Tillage treatment tended to provide highest production. The average weight of grape berries were: 1.64; 1.63 and 2.14 g berry<sup>-1</sup>; the 25 ml must production was 17; 19 and 22 ml for Brachypodium, Secale and Tillage respectively. Significant differences were found only for Brachypodium treatment. We can conclude that Secale covers, mowed in spring can prevent soil erosion and runoff without significant reductions in production.

#### Acknowledgments

Funded projects: FP06-DR3-VID, IMIDRA and RTA07-86, INIA.

## **Sy11P01**

### **Human ecology in mountain environments: analysis of the perception of residents and leaders of the Serra dos Morgados, Jaguarari - Bahia, Brazil.**

Amazile López Netto<sup>1</sup>, Juracy Marques<sup>2</sup>, Adriana Aquino<sup>3</sup>, Renato Assis<sup>4</sup>

<sup>1</sup>*Universidade do Estado da Bahia, Juazeiro, Bahia, Brazil,* <sup>2</sup>*Universidade do Estado da Bahia, Juazeiro, Bahia, Brazil,* <sup>3</sup>*Embrapa Agrobiologia - NPTA, Nova Friburgo, Rio de Janeiro, Brazil,* <sup>4</sup>*Embrapa Agrobiologia - NPTA, Nova Friburgo, Rio de Janeiro, Brazil*

Human ecology is a research area that presents interdisciplinary approach. Studies biotic, abiotic factors that interrelate with the individual and human groups. Human ecology can assist in the understanding of complex environments, such as mountain environments. The objective of this study is to analyze the perception of residents and leaders of the community of Serra dos Morgados, sample Brazilian mountain environment, about their way of life. The methods used were critical survey and analysis of secondary data, desk research, observation and systematic recording, and twenty semi-structured interviews. The Serra dos Morgados located in the municipality of Jaguarari, north of the state of Bahia - Brazil. The mountainous region studied is in the Chapada Diamantina - northern extension of the Serra do Espinhaço and displays altitude of nine hundred meters. Agricultural activities are practiced more than a century. Currently, family farmers produce, especially coffee, jackfruit and banana, marketed mainly at the fair city of Jaguarari. They are also found agroecological yards, producing medicinal herbs, fruits and vegetables for their own consumption. The community of Serra dos Morgados is on hill top and the residents themselves as "groteiros", which are those who live in intersection of two mountains, places that are characterized by the community, for having springs, mild climate and located in the highlands. The "groteiros" understand that their way of life is different, compared to those living in low-lying areas downstream community, characterized by semi-arid climate, where water is a limiting factor and inclement weather. Whereas Serra dos Morgados supplies with water communities that are in the semi-arid, public policy based on promoting the environmental recovery and the payment for environmental services, can work together to improve the income and quality of life in the community of Serra dos Morgados.

## Sy11P02

### **Contamination potential by water erosion under different managements in bullside areas in Southern Brazil**

Douglas Henrique Bandeira<sup>1,2</sup>, Júlio Cesar Ramos<sup>2,3</sup>, Ildegardis Bertol<sup>2</sup>, Antonio Paz González<sup>1</sup>, Hugo Castelani<sup>2</sup>

<sup>1</sup>Universidade da Coruña, La Coruña, Spain, <sup>2</sup>Universidade do Estado de Santa Catarina, Lages, Brazil, <sup>3</sup>Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina, Chapecó, Brazil

The contamination of water sources and the environment is directly related to the concentration and size of the sediment transported by runoff, because even if in lesser amounts, fine-size sediments are rich in nutrients and have greater capacity to adsorb chemical species. This study aimed to quantify the concentration of sediments (CSR) and D50 index of the sediments in runoff under different soil surface managements, in the following treatments: (1) HCR: no-tilled soil, cultivated and covered by ryegrass (*Lolium multiflorum* Lam.) residue (high soil cover and minimal roughness); (2) HCV: no-tilled soil, cultivated and covered by vetch (*Vicia sativa* L.) residue, (high soil cover and minimal roughness); (3) HRR: chiseled soil after ryegrass crop removing the above-ground residues and maintaining only the root system (high roughness); (4) HRV: chiseled soil after vetch crop removing the above-ground residues and maintaining only the root system (high roughness); (5) BHR: bare and chiseled soil (high roughness). The research was conducted in Santa Catarina State (southern Brazil), developed on a Humic Dystrucept under simulated rainfall. The experimental design was completely randomized with each treatment replicated twice. Eight rainfall events of controlled intensity (65 mm h<sup>-1</sup>) were applied to each treatment for 90 minutes. Crop and soil management influenced the D50 index and sediment concentration. The lowest CSR was found in the HCR treatment (0.47 g L<sup>-1</sup>), while the highest values were found in the HRV and BHR treatments (14.55 and 15.23 g L<sup>-1</sup>, respectively). For the D50 index, the lowest value was found in the HCR treatment (0.18 mm), while the highest values were found in the BHR treatments (1.56 mm). No difference was observed between HCV and HRR to CSR and D50. Regardless of the surface condition, D50 index and concentration of sediment in runoff were lower under ryegrass than vetch crop.

#### Acknowledgments

CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico; Universidade do Estado de Santa Catarina.

### **Sy11P03**

#### **Effect of grazing on plant species diversity of wetlands from High Tropical Mountain (Venezuela Andean)**

Zulimar Hernandez<sup>1</sup>, Maximina Monsaterio<sup>2</sup>

<sup>1</sup>*Autonomous University of Madrid, Madrid, Spain,* <sup>2</sup>*University of los Andes, Mérida, Venezuela*

Tropical mountain diversity is not only expressed as richness per unit area but also in terms of the adaptive strategies of species to the widest temperature oscillations. Here, the growth is continuous throughout the year, and dormancy of the meristems occurs during a few hours at night (when temperatures go below 0°C). Andean wetlands, above 3800 m, are located on fluvio-glacial geomorphologic positions, under the influence of continuous daily freeze-thaw cycles. These wet environments are relatively more stable in terms of their temperature, allowing the establishment of highly palatable forbs and grasses. However, the Andean wetlands are seriously threatened by intensive grazing. The aim of this study was to analyze the functional diversity in highland species by using ecological variables such as the biomass rate and growth meristem's protection. The study was undertaken in the Venezuelan Andean wetlands, where the annual isotherm is 2.8°C and the average yearly rainfall is 869.3 mm. The results of this study show that species accumulate a large proportion of phytomass as leaf necromass and show a low proportion of photosynthetic biomass. The stored necromass does not constitute an active energy reserve, but plays a critical role in the protection of the growth meristems from low temperatures, the nutrient translocation and, contribute to water recharge in the top soil profile (e.g., an increase of 16 l. m<sup>-2</sup> was found). The effect of grazing depends on the intensity and frequency. A low animal intensity increases the species richness because the competitive exclusion decreases. However, a high grazing pressure decreases the diversity and increases the fraction of less-palatable forbs. This has effects on the water recharge of the mountain, which constitute the headwaters of important rivers draining into the Amazon catchment. Therefore, conservation of the biodiversity of the Andean wetlands necessarily implies appropriate cattle management strategies.

## **Sy11P04**

### **Spatial variability of soil attributes and the occurrence of landslides in the mountain region of the state of Rio de Janeiro, Brazil**

Fabio Rizzo<sup>1,2</sup>, Adriana Maria de Aquino<sup>1</sup>, Ednaldo da Silva Araújo<sup>1</sup>, Marcos Baccis<sup>2</sup>  
<sup>1</sup>*Embrapa Agrobiology, Nova Friburgo, RJ, Brazil,* <sup>2</sup>*Rural Federal Universidad of Rio de Janeiro, Seropédica, Brazil*

The mountain region of Rio de Janeiro is characterized by a rugged terrain with few flat areas, steep slopes, high density drainage network and shallow soils. In this type of landslides are present cambisols, a type of soil that has a greater vulnerability to geological accidents - such as the mass movement that occurred in January 2011 after a 48 hour long rainfall of 279 mm. This tragedy caused great losses in Barracão dos Mendes' watershed - which is located in Nova Friburgo municipality in the state of Rio de Janeiro - mainly in the agriculture, economic and social fields. In the agricultural sector, the spatial variability of soil attributes, due to the imbalance in fertilizer usage, compromised crop yields and increased production costs. This work was developed in an property with 11.7 hectares by eight farmers. The soil samples were collected after the demarcation 50 x 50 m grid, totaling 105 points georeferenced with geodetic GPS with accuracy of 5 m. At each sampling point one undisturbed sample was taken to measure soil density, and a simple sample for chemical and particle size analysis without subsample. The ranges of depths were 0 - 0.20 m and 0.20 - 0.40 m. Textural classes in the area with sediment deposition derived from the mass movements ranged from open sand to sandy clay franc. In these areas cation levels (K, Ca, Mg) increased due to the leaching of nutrients from the middle third slopes, while transportation of primary minerals by landslides P levels increased due to the lower clay content, which reflects a strong influence of texture.

#### Acknowledgments

Embrapa, Capes, CNPq.

## **Sy11P05**

### **Environmental perception of farmer's families after tragedy in Nova Friburgo - Rio de Janeiro, Brazil**

Maria Clara Estoducto, Renato Linhares de Assis, Adriana Maria de Aquino, Alessandro Rifan

*Embrapa Agrobiology, Nova Friburgo, Brazil*

The city of Nova Friburgo - Brazil, regarded as a regional economic hub, has intense agricultural activity, highlighting the production of vegetables. In January 2011, there was an environmental tragedy characterized by heavy rains, which resulted in losses of crops in the region. The soils were heavily affected by landfill or flooding, changing its properties. From this experience, it was found through research with semi-structured interviews and informal dialogues, which has expanded the perception of farmers related to natural resources available. That is, from the moment that farmers experienced and realized that these resources, if properly managed would be beneficial, have to be aware of the need for partnership between man and nature. One of the changes in the region was the use of green manures and minimum tillage, which has been tried and appropriated by farmers with readjustments in terms the use and management of technology. Thus, the productive processes in general began to be practiced in keeping on a new perception of the environment, perceived then the most subtle way of farmers from principles of respectability to the available natural resources, especially focused on the conservation and maintenance of soil. Some positive environmental impacts identified were among others changes in cultivation methods, with the introduction, especially the practice of green manure and minimum tillage; adequacy of planting so to climate change; increased environmental sensitivity post-tragedy; perceived need to use water properly, including that for the use of drip irrigation and recovery and protection of springs. Thus, it is understood that agroecological transition strategies can encourage farmers to have a more holistic view of their systems, especially in mountain environments.

#### Acknowledgments

Embrapa, CNPq.

## Sy11P06

### **Hill-slope water erosion rates assessed from sediment trapped in check-dams: a case study in Fogo Island, Cape Verde**

Tomás Figueiredo<sup>1</sup>, Zulimar Hernandez<sup>2</sup>, Juan Perez-Trujillo<sup>3</sup>, Ângela Moreno<sup>1</sup>  
<sup>1</sup>CIMO/ESA/IPB, Bragança, Portugal, <sup>2</sup>Universidad Autonoma de Madrid, Madrid, Spain,  
<sup>3</sup>Universidad de La Laguna, La Laguna, Spain, <sup>4</sup>Instituto Nacional de Investigação e  
Desenvolvimento Agrário, Cidade da Praia, Cape Verde

Erosion is one of the major threats to soil resource in arid and semi-arid environments due to coupled effects of water erosion processes during highly intense rainfalls concentrated in short wet periods, with winds blowing over dry and scarcely vegetated soil during long dry periods. In Cape Verde, the strong relief of these volcanic central Atlantic islands magnifies the problem, leading to impressive erosional features spread all over the landscape. Soil conservation structures were built along the country's history and stone-walled check-dams are commonly found in gullied areas. This study aims at presenting a rationale for assessing erosion rates based on sediment trapped in check-dams, applied to an example from Fogo Island, Cape Verde. In Montinho (1800m elevation, NE outer-slope of Pico-do-Fogo volcano caldera), on a pair of sediment filled check dams, built in the main gully beds for erosion control, measurements were taken on check-dam wall size, slope gradients of soil surface upstream, gully bed and adjacent hill-slope, together with field observations to locally define contributing area and its vegetation cover. Soil samples were taken at several points in the contributing area and upstream check-dam. Enquiries to local farmers helped retrieving dates of check-dam construction and infilling. Volume of sediment trapped in check-dams was estimated from field measurements, converted to mass with soil samples bulk density, referred to contributing area and to time of infilling, resulting in an erosion rate. Soil loss rates estimated reach  $100 \text{ Mg ha}^{-1} \text{ y}^{-1}$ , in a 2 years infilling periods of. Poor vegetation cover, highly erodible volcanic ash soils, very steep slopes, under intense rains falling in a short wet season, help explaining these dramatically high erosion rates. They drive the attention for the very short life-time of such costly conservation measures.

#### Acknowledgments

Project "Caracterización Agroecológica de los Suelos Vitícolas de Cabo Verde: Una Propuesta de Conservación y Mejora (ECOVITICAVE)", co-ordinated by Juan Pedro Perez-Trujillo, Universidad de la Laguna, Spain, funded by Programme "Cooperación Interuniversitaria al Desarrollo en el Marco del Proyecto "Fortalecimiento Institucional Universitario del Espacio Canarias Y África – SEMACA (PCT-MAC 2007-2013)", 2013.

## **Sy13P01**

### **Geomorphic consequences of catastrophic flash flood in low mountains of the Western Caucasus (Gelendzhik District of the Krasnodarskiy Region, European Russia)**

Ekaterina V. Garankina, Vladimir R. Belyaev, Elena D. Sheremetskaya  
*Lomonosov Moscow State University, Moscow, Russia*

In July 2012 heavy flash flood hit the Krasnodarsky Region. It was caused by extreme rainfall highest since 1971. Flash floods occurred on a number of rivers and caused severe damages to settlements and infrastructures as well more than 30 casualties in the town of Krymsk, which was hit by the 8 m high flood wave during the night time. In this study, we consider geomorphic consequences of this flash flood in the basin of small river Ashamba located at the southwestern outskirts of Gelendzhik City. The basin area is 42.6 km<sup>2</sup>, length of the river is about 12 km. Its headwaters are located on the Markothskiy Ridge up to 850 m a.s.l., while its most part are within the elevation of 200-300 m a.s.l. Upland headwaters are mainly forested, while middle and lower reaches dominated by alternation of woodland and vineyards with countryside households in valley bottom. Some of these households were also damaged during the July 2012 flash floods, though there were no casualties in this area. In order to evaluate geomorphic consequences of the year 2012 event we combine results of field investigations and comparative interpretation of satellite images from the free access source GoogleEarth dated to 01.05.2012 and 27.04.2013. Main detected features that appeared during that time span include destabilized slopes (landslide scars), intensive channel deformations of main river and its tributaries, formation of debris fans, incision of small gully-type erosion features and destruction of anthropogenic objects. Several of such features were surveyed in the field in order to evaluate their volumes. The most affected part of the Ashamba basin is its lower part beginning about 2 km from its mouth.

## **Sy13P02**

### **Evaluating sediment and metals transport during storm events in a small headwater catchment (Galicia, NW Spain)**

F. Soto-Varela, ML. Rodríguez-Blanco, MM. Taboada-Castro, A. Diéguez, L. Santos, M. Insua, MT. Taboada-Castro  
*University of A Coruña, A Coruña, Spain*

A high amount of sediment and metals transported by streams are caused by a small number of events, which may not necessarily be extreme events and represent short time intervals. The understanding of factors and processes that determine sediment and metal responses during these events is essential for future catchment management plans. The aim of this study was to analyse sediment and metals (Al, Fe, Mn, Cu and Zn) transport during storm events in a humid-temperate small catchment in Galicia (NW Spain) and improve our understanding of the factors controlling sediment and metal loads during storm events. Field measurements were conducted in sub-catchment of the upper Mero basin characterised by a mixed land use (forest: 65% and agriculture: 30%) and steep slopes (mean 19%). Continuous discharge records and water samples collected with an autosampler at the catchment outlet were used to assess the suspended sediment and metal loads of 93 storm events during a period of four hydrological years (2004/05-2007/08). Suspended sediment concentrations were determined by the gravimetric method. Total and dissolved metals were measured with ICP-MS. Particulate concentrations were estimated as the difference between total and dissolved concentrations. Storm events were characterised by a high variability in sediment and metal loads (Al<sub>total</sub>: 0.09-653 kg; Zn<sub>total</sub>: 0.004-3.6 kg). The metal load was highly influence by erosive events because metals are mainly transported in particulate form, i.e. linked to particles. In this study, 16% of the events with the largest sediment loads accounted for approximately 63-69% of load of each metal. These events are characterized by high rainfall, runoff and high peak discharge, so an increase in the frequency of heavy rainfall events in the study area may exacerbate metal losses; this could have implications for downstream water quality and aquatic ecosystem function.

#### **Acknowledgments**

The research is a contribution to the projects 10MDS103031 of the Xunta of Galicia, and CGL2014-56907-R of the Programa Estatal de Investigación, Desarrollo e Innovación Orientada a los Retos de la Sociedad funded by the Spanish Ministry of Economy and Competitiveness.

## **Sy17P01**

### **Late Pleistocene glacial phases in the upper Garonne valley**

Marcelo Fernandes<sup>1</sup>, Luís Lopes<sup>1</sup>, Marc Oliva<sup>1</sup>, Jesus Fernández<sup>2</sup>

<sup>1</sup>IGOT, Lisbon, Portugal, <sup>2</sup>Departamento de Geografia, Oviedo, Spain

The moraine systems provide geomorphological and sedimentological evidence to reconstruct glacial retreat and inferring the chronostratigraphic timing of glacier stages since their maximum. In this preliminary study, we characterize the moraine systems and their geographical distribution in the Garona basin in order to reconstruct the sequence of glacial phases occurred since the last maximum extent. The study area is located in the upper part of the Garona basin, in the northern slope of the central Pyrenees. It covers a drainage surface of 1260 km<sup>2</sup>. The altitudinal range of the basin goes around 500m a.s.l. (near Montréjeau) to 3404m (Aneto-Maladeta). This area is composed of U-shaped valleys aligned E-W in Aran valley and N-S in Maladeta massif and encompasses different lithologies, such as granites, slates and limestones. The moraine systems were firstly identified based previous references and then mapped. Validation in situ and field mapping of newly identified glacial features was conducted in October'15 taking into account geomorphological and sedimentological evidence. Mapping was also accompanied by pictures and GPS points. The glacial depression of Loures-Barousse-Barbazan is located 80 km away from the glacier source (Saboredó peak) and contains two moraine systems: (1) located in a hillside, and (2) three moraine arches distributed across the depression. Up-valleys, (1000-1400m) in the Aran valley, there is a lateral moraine system with abundant boulders. This moraine is approximately 22 km from the headwaters and corresponds to the second glacial stage. Inner in the Ruda valley at 2050-2150m, 3 km away from the source of the glacier, a third moraine system was identified. The high lands Ruda valley massif the cirques contain small moraines which correspond to the last stage. Therefore, we identified four main stages related to the deglaciation of the Garonne glacier. We will complement this preliminary approach with absolute dating techniques to reconstruct the deglaciation process.

## **Sy17P02**

### **Morphometry of glacial cirques in the Central Pyrenees (Boí and Aran valleys)**

Luís Lopes<sup>1</sup>, Marcelo Fernandes<sup>1</sup>, Marc Oliva<sup>1</sup>, Jesus Fernández<sup>2</sup>

<sup>1</sup>*Instituto de Geografia e Ordenamento do Território, Lisbon, Portugal*, <sup>2</sup>*Departamento de Geografia, Oviedo, Spain*

Glacial cirques constitute one of the characteristic glacial landforms and provide insights about past environmental and climatic conditions. The objective of this study is to analyze their properties in two valleys from the Central Pyrenees: Aran and Boí valleys. Aran valley is located in the northern slope and Boí valley is placed in the southern slope. Both correspond to formerly glaciated U-shaped valleys. Aran valley (550 km<sup>2</sup>), aligned E-W between 500-3000 a.s.l., is mostly composed of granites and slates. Boí valley (247 km<sup>2</sup>), which flows NE-SW between 850-3000 m, is composed of granite and shales. Glacial cirques were mapped based on high resolution orthophotomaps. Morphometric analysis was carried out using topographic maps together with geological maps. We generated a database (186 glacial cirques) examining altimetry, geometry, slope and aspect for each landform. A total of 67 glacial cirques were identified in Boí valley between 1700-2600 m, with 75% of them between 2200-2600 m. They have an average size of 102 ha, being larger at lower elevations. The glacial cirques are almost evenly distributed in all aspects. In Aran valley 119 glacial cirques were mapped between 1600-2600 m. 59% of them are located between 2000-2299 m. The average size is 63 ha, being larger below 1700 m (117 ha) and smaller above 2600 m (5 ha). Cirques show a prevailing aspect NE (33%), being almost absent in S-SW exposures (6%). Therefore, no relevant differences are detected on the minimum/maximum altitudinal range, although the elevation where the cirques are more abundant is lower in the northern slope (near 200 m). Significant geometric dissimilarities are found between both (i.e. cirque area, aspect). These results show evidence of the contrasting spatial distribution and morphometry between both valleys. Future research will elucidate the main factors controlling cirque formation and development in the Central Pyrenees.

## **Sy19P01**

### **Land use and cover impacts on the water sediments in a mountainous basin of the atlantic forest biome, Rio de Janeiro, Brazil**

Rachel Prado<sup>1</sup>, Azeneth Schuler<sup>1</sup>, Thales Penha<sup>2</sup>, Elaine Fidalgo<sup>1</sup>, Bernadete Pedreira<sup>1</sup>  
<sup>1</sup>*Embrapa Soils, Rio de Janeiro, Rio de Janeiro, Brazil,* <sup>2</sup>*Federal University Fluminense, Niterói, Rio de Janeiro, Brazil*

Guapi-Macacu basin is located in the Guanabara Bay presenting 1.265 km<sup>2</sup>, ranges from 42°32'-43°3'W and 22°21'-22°41'S and elevation reaching 2.250 m. It supplies water to more than 2 million inhabitants. It is inserted in a land use mosaic, highlighting the remaining forest fragments of Atlantic Forest in the higher areas, as well as pastures and family farming in the lower areas. The land use changes to product sugar, food, coffee, orange, besides wood remove for fuel, urbanization without adequate sanitation, destruction of riparian forests and mineral extraction (clay, limestone and sand) contributed to the erosion process and silting of rivers, reducing water availability. The industry also has created high demands regarding to water. This work proposed to correlate land use and cover classes areas with sediment measured in water in 25 Guapi-Macacu sub-basins. The water parameters (suspended, dissolved, total solids and turbidity) were analyzed in 2011. From Landsat satellite images it was obtained land use and cover map to Guapi-Macacu basin at 1: 50,000 scale applying ENVI tools. Water sediments were spatialized by sub-basin and the classes area (ha) calculated in ArcGIS10. The correlation was done applying X-STAT software. Dissolved and total solids were quite similar and it obtained better correlated to the sub-basins with large areas of pasture and agriculture. Turbidity had a different behavior, but also highly correlated to the pasture and agricultural areas. Suspended solids presented higher correlation to the urbanized sub-basins, but also to the pasture. Sub-basins with larger areas of vegetation were better correlated to low sediment levels in the water, corresponding to the higher areas where are located the springs. It was concluded that could have more investment in sewage treatment and proper management of pastures and agricultural areas, to contain the loss of soil erosion and silting of water bodies.

#### **Acknowledgments**

The authors acknowledge financial support from Embrapa (MP2 Project: Landscape dynamics associated to indicators to support the agro environmental planning in areas at Atlantic Forest.) and IPSWAT Programme financed from the German Federal Ministry of Research-BMBF (DINARIO Project: Climate Change, Landscape dynamics, Land use and Natural Resources in the Atlantic Forest of Rio de Janeiro).

## **Sy19P02**

### **Characterization and cartographic representation of the geometric parameters of the agriculture terraces in the Douro Wine Region.**

Carlos Bateira<sup>1,2</sup>, António Costa<sup>1</sup>, Joana Fernandes<sup>1</sup>, Bruno Fonseca<sup>1</sup>, Fernando Alves<sup>3</sup>,  
Laura Soares<sup>1</sup>

<sup>1</sup>FLUP/UP, Porto, Portugal, <sup>2</sup>Riskam/CEG/UL, Lisboa, Portugal, <sup>3</sup>SYMINGTON FAMILY  
ESTATES, Vila Nova de Gaia, Portugal

In the Douro Wine Region the anthropic landscape caused the complexity of the existing topographic forms, compounded by the evolution of different methods of vineyards planting. Within the same property, it's possible to find (1) vine in vertical rows, (2) pre-phylloxera terraces, (3) post-phylloxera terraces, (4) modern terraces with embankments with variable slope. These complex forms have technical useful information for the vineyard management agents, but it's not simple to extract, synthesize or represent this information on a spatial and cartographic basis. The representation of geographic information is a challenge that has been overcome with the development of GIS tools. The use of this kind of tools in agriculture has already begun several decades ago. For example, in 1968 the documentary "Data for Decision" shows how Canada was initiating the use of GIS and how could be applied to agriculture. All the advances made in GIS allowed the representation not only by vector layers but also with raster (matrix) layers. In this presentation we propose, with the use of vector and matrix models, an automatic and semi-automatic methodology for the interpretation/calculation of trigonometric rules in vineyard terraces. With these procedures it is possible to produce maps stating technical information of the different elements of the terraces such as the width of the terraces, tread width, riser height, size of the riser base and slope riser.

#### Acknowledgments

CloudMapper - plataforma de processamento e disseminação de dados georreferenciados.

### **Sy19P03**

#### **Spatial resolutions of digital elevation models for hydrological processes modeling: a case study in Quinta de São Luíz, Alto Douro wine region**

Carlos Bateira<sup>1,2</sup>, Bruno Fonseca<sup>2</sup>, António Costa<sup>2</sup>, Joana Fernandes<sup>2</sup>, José Gonçalves<sup>3</sup>,  
Laura Soares<sup>2</sup>

<sup>1</sup>Riskam/CEG/UL, Lisboa, Portugal, <sup>2</sup>FLUP/UP, Porto, Portugal, <sup>3</sup>FCUP/UP, Porto, Portugal

It is intended to evaluate the use of digital terrain models (DTM) in the subsurface hydrological processes and instability modeling of agricultural terraces risers in the Douro Region (RDD). Data with different spatial resolutions was used in the construction of MDT (ground sampling distance (GSD) of 5 m, 1 m, 0.4 m and 0.2 m), resulting from two flights, one made with conventional digital aerial photograph (GSD 0.5 m), and the other with a UAV at low altitude (GSD 0.07 m). The two models with higher resolution were obtained from the applicability of UAV systems, as a technology to obtain aerialphoto data, subsequently processed in Agisoft PhotoScan Software using the “Structure-from-motion” technique. The lower resolution models were obtained using conventional digital aerial photography, processed with the same Software. Digital surface models (GSD of 0.4m and 0.2m) have been corrected by photo-interpretation of altimetric data related with the vegetation as well as site surveys with GPS (Global Positioning System) to collect precision elevation points. The construction of the morphometric parameters was performed using the toolbox: Arc Hydro Tools on ArcGIS® software. SHALSTAB model (Shallow Landslide Susceptibility Model) was used to modeling the susceptible areas to landslides. For this were used hydrological (contributing area) and geotechnical (slope) parameters (obtained through different MDT), as well other soil physical parameters (friction angle, specific weight of soil, soil thickness) obtained from the data collected in field. Cohesion was calculated by back analysis using the safety factor. Finally a statistical validation of the results was made using the contingency tables in order to identify which of the MDT is best suited to modeling the susceptibility to landslides.

#### Acknowledgments

CloudMapper - plataforma de processamento e disseminação de dados georreferenciados.

## **Sy19P04**

### **Assessment the vulnerability of water resources in the Upper Mero Basin (NW Spain) to climate change**

ML. Rodríguez-Blanco, MM. Taboada-Castro, R. Arias, L. Santos, M. Insua, MT. Taboada  
*University of A Coruña, A Coruña, Spain*

Climate change is the most discouraging environmental problem facing humanity today. The predictions of the Intergovernmental Panel on Climate Change (2014) on temperature and rainfall warn of increased aridity in the coming decades in Europe, this being particularly evident for the southern regions (such as Spain), where projections indicate aggravation of conditions in a region already vulnerable to climate variability. These shifts in temperature and rainfall can seriously affect the hydrological cycle and alter various catchment-scale processes, including runoff, sediment transport, nutrient enrichment, etc., all of which will affect stream and river ecosystems. The mountainous landscape are very sensitive areas in terms of impacts of climate change on hydrological behaviour and related processes, as water erosion and nutrient transport. Hence, information on the effects of long-term climate change on water resources in headwater catchments are essential to the development of water quantity and quality improvement programs. Within this context, this study provide an initial estimate of the effects of potential climate change on water resources in a rural headwater catchment in Galicia (NW Spain). The Soil and Water Assessment Tool (SWAT) model developed for a headwater subcatchment of the Mero Basin was expanded to quantify the potential effect of various climate change scenarios on catchment hydrology as well as the stream water quality. Simulations showed a noticeable impact of climate change in the stream discharge, with a decreasing stream discharge of about 20%. The decrease in water discharge will lead to an increase in nitrate losses, causing deterioration of stream water quality.

#### Acknowledgments

This paper is a contribution to the projects 10MDS103031 of the Xunta of Galicia, and CGL2014-56907-R of the Programa Estatal de Investigación, Desarrollo e Innovación Orientada a los Retos de la Sociedad funded by the Spanish Ministry of Economy and Competitiveness.

## Sy19P05

### **Displacement of Nim and Moringa seeds as a function of slope and mulching: laboratory experiments**

Cleene A. de Lima<sup>2</sup>, João L.M.P. de Lima<sup>1,4</sup>, Abelardo A.A. Montenegro<sup>2</sup>, Babar Mujtaba<sup>1,4</sup>, João R.C.B. Abrantes<sup>1,4</sup>, Alexandre Silveira<sup>3,1</sup>

<sup>1</sup>*Universidade de Coimbra, coimbra, Portugal*, <sup>2</sup>*Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brazil*, <sup>3</sup>*Instituto de Ciência e Tecnologia, Universidade Federal de Alfenas, Poços de Caldas, Minas Gerais,, Brazil*, <sup>4</sup>*MARE - Centro de Ciências do Mar e do Ambiente, coimbra, Portugal*

Recovery plans of degraded soils in mountainous regions rely on the knowledge of the fate of seeds carried by runoff. This study aimed to evaluate the influence of slope and mulching on the transport of seeds by runoff. Laboratory tests using a rainfall simulator and a rectangular soil flume 2.8 m long and 0.3 m wide were performed to study the transport of Moringa (*Moringa oleifera* Lam ) and Nim ( *Azadirachta indica* A. Juss ) seeds by runoff. Uniform rainfall events with a mean intensity of 90 mm/h and a duration of 15 min were simulated for surface slopes of 10, 30, 50 and 70% in bare soil and mulching conditions. Seeds were distributed evenly over the soil surface. Coconut powder at a density 8 t/ha was used as mulch. Runoff at the downstream end of the flume, associated soil loss and the displacement of the seeds were measured. Velocity fields were estimated by thermal tracer experiments using infrared thermography. For the studied conditions, only slopes of 50 and 70% induced significant displacement of seeds, with the highest values occurring along the longitudinal axis of the channel. Nim seeds positioned with its major axis parallel to the direction of flow had higher displacement than those positioned with its major axis perpendicular to the direction of flow. Moringa seeds showed slightly higher displacements for all investigated slopes due to their lightness and more symmetrical geometric shape than Nim seeds. In general, mulching of coconut powder reduced the displacement of seeds and the soil loss. It was concluded that the characteristics of the seeds, slope and mulch cover affect the transport of seeds, and should be considered in the reclamation of degraded soils in mountainous region.

#### Acknowledgments

Capes, Brasil; Facepe, Brasil; FCT, Portugal

## **List of authors**

A.A. Montenegro, Abelardo	Sy19P05
A. de Lima, Cleene	Sy19P05
Afonso, Sandra	Sy06O05, Sy06O07, Sy06O09, Sy06P12, Sy06P14, Sy06P15
A., Giorgi	Sy06P04
Aguiar, Carlos	Sy16O06
Aguiar, Peltier	Sy06P13
Albuquerque, Bianca	Sy08O05
Alcántara-Ayala, Irasema	Sy13O04
Alewell, Christine	Sy19O04
Algarra-Ávila, Jose A	S01O05
Al-Hirsh, Iman	Sy05O05
Almeida, Arlindo	Sy20O06
Almeida, Lucia Helena	Sy06P09
Alonso, Joaquim	Sy15O05
Alonso, Miguel	S03P07
Alonso, Rocío	Sy13O05
Al-Qaddi, Nisreen	Sy05O05
Altieri, Valeria	S02O06, S02O07
Álvarez-González, Juan G	Sy18O01
Alves, Andrei	S01P08
Alves, Fernando	Sy10P02, Sy19P02
Alvez, Andrei	S01P07
Amorim, Mônica	Sy02O03
Andrade, César	Sy17O02
Andrade, João	Sy10O04
Andra - Toparceanu, Andreea	Sy02O02
Ansari, Abdul Sahim	Sy04O06
Antoniades, Dermot	Sy17O05
Antonio, Gerson	Sy06P05
Aquino, Adriana	S04P02, Sy06P05, Sy11P01
Aquino, Adriana Maria de	Sy02O03, Sy02P01, Sy04P01, Sy06P09, Sy06P10, Sy11P04, Sy11P05, Sy06O04
Araújo, Ednaldo da Silva	Sy11P04
Arias, R	Sy19P04
Arias-Rodil, Manuel	Sy18O03
Arnesen, Tor	S04O03
Arrobas, Margarida	Sy06O05, Sy06O07, Sy06O09, Sy06P12, Sy06P13, Sy06P14, Sy06P15, Sy16O06
Aryal, Suman	Sy21O05
Assis, Renato Linhares de	Sy02O03, Sy02P01, Sy04P01, Sy06P08, Sy06P09, Sy06P10, Sy11P05, S04P02, Sy06O08, Sy06P05, Sy11P01
Assis, Ricardo Linhares de	Sy04O05
Aun, Nádia	Sy06O08
Azevedo, João	S01P04, Sy15O05, Sy18O02, Sy18O05
Azzolin, Fabio	Sy21O01
Baccis, Marcos	Sy11P04
Baches, Xabier	Sy02P05
Balieiro, Fabiano Carvalho	Sy11O02
Banana, Abwoli	Sy05O03, Sy21O04
Bandeira, Douglas Henrique	Sy11P02
Barker, Nigel	S02O04
Baronti, Silvia	S01O03
Barreales, David	Sy10O04
Barreiro, Maria Filomena	Sy08O02, Sy08O04, Sy08O06, Sy08O03
Barrio, Isabel	S01O01, Sy16O02

Barros, Lillian	Sy06P01, Sy08O04, Sy08O05, Sy08O06
Basnyat, Bijendra	S03O04
Bassoli, Angela	Sy06P03
Bateira, Carlos	Sy10P02, Sy19O02, Sy19P02, Sy19P03
Batsatsashvili, Ketevan	Sy04O03
Battisti, Corrado	Sy05O05
Belchior Rocha, Helena	Sy09O02
Beltran, Karla	Sy11O05
Belyaev, Vladimir R	Sy13P01, Sy19O01
Bermejo, Victoria	Sy13O05
Bertol, Ildegardis	Sy11P02
Bhattarai, Teeka	Sy04O04
Bienes, Ramón	Sy10P03
Bifulco, Carlo	S03O05
Bircher, Nicolas	Sy05O06
Bischetti, Gian Battista	S02P01
Bithas, Kostas	S01P06
Blanco, Ricardo	Sy02P05
Bogdan, Sorina Mihaela	Sy02O02
Bolte, Andreas	Sy05O01
Bomuhangi, Allan	Sy05O03, Sy21O04
Borgonovo, Gigliola	Sy06P03
Bou, Montserrat	S03P01
Bravo, Felipe	Sy18O04
Bremer, Ulisses	Sy11O01
B. Rodrigues, João	Sy20O02
Bugmann, Harald	K2, Sy05O06
Bussmann, Rainer W	S04O01, Sy04O03, Sy04O06
Cadavez, Vasco	S03O02, S03P02, S03P03
Caetano, Miguel	S03P06
Cailleret, Maxime	Sy05O06
Calado, Helena	Sy02O07
Calhelha, Ricardo C	Sy08O06
Calvete, Héctor	Sy13O05
Cancela, Javier J	Sy10O03
Cariñanos, Paloma	S01O05
Carlos, Cristina	S01P01
Carreño, Francisco	S02P05
Carvalho, Ana Maria	Sy04O07, Sy08O04
Carvalho, Eduardo Spitz de	Sy06P10
Carvalho-Santos, Claudia	S01P04
Castaño, Andrea	S02P05
Castelani, Hugo	Sy11P02
Castor, David	Sy06O04
Castro, João Paulo	Sy06P11
Castro, Marina	Sy16O03, Sy16O04
Castro Rego, Francisco	S03O05
Cerqueira, Hugo de Souza	Sy06P09
Cesar, Luis Felipe	S04O05
Chachulski, Lukasz	S01O02
Chahed, Abdessalem	S02P03, S02P04
Chelidze, Dato	Sy04O03
Chiatante, Donato	Sy05O09
Chibowski, Piotr	S03P08
Choupina, Altino	S02P03, S02P04

Christopher, Bryant	S02O01
Clemente, Eliane	S03P04
Coelho, Mauricio	Sy06O01
Cojoc, Emilia Ionela	S01O06
Coletta, Vittoria	S02O06, S02O07
Conde-Fernandez, Adriana	Sy02O06, Sy02P04
Costa, António	Sy10P02, Sy19O02, Sy19P02, Sy19P03
Costa, Rodrigo	S02P03, S02P04
C. Ribeiro, António	S01O04
Crispim, Maria Cristina	S03O07
Crook, Darren	Sy11O03
Cruces, Anabela	Sy17O02
Dafonte, Jorge	Sy10O06, Sy20O06
Dax, Thomas	Sy21O06
de Andrade, Aluisio Carvalho	Sy11O02
Dees, Matthias	Sy02O05
Delgado-Capel, Manuel	S01O05
de Mattos, Luciano Mansor	Sy11O02
De Toni, Andrea	Sy02P03
Díaz, Boris	S02O03
Díaz de la Guardia, Consuelo	S01O05
Diaz-Maroto, Ignacio J	Sy02O04, Sy02P02
Diaz-Maroto, Maria C	Sy02O04, Sy02P02
Diéguez, A	Sy13P02
Diéguez-Aranda, Ulises	Sy18O01, Sy18O03
Di Lorenzo, Tiziana	S02P05
Di Martino, Paolo	Sy02P03
Dinis Ferreira, António	Sy15O06
Djoudi, Houria	Sy21O04
Donagemma, Guilherme	Sy11O02
D., Puglisi	Sy06P04
E., Cantaluppi	Sy06P04
Efi, Levizou	Sy06P01
Egarter Vigl, Lukas	Sy15O02
El Aich, Ahmed	S03O01, Sy16O04
Elvira, Susana	Sy13O05
Encina-Zelada, Christian	S03O02
Espindola, José Antonio Azevedo	Sy06P08
Estoducto, Maria Clara	Sy11P05
Eustáquio de Sousa, Cyntya	S03O07
Evans, Aron	Sy04O06
Fandiño, María	Sy10O03
Fanlo, Rosario	S03P01, Sy02P05
Faria, Ricardo	Sy16O06
Farooq, Muhammad	Sy02O05
Faver, Leonardo	S04P03
Feliciano, Manuel	S01O04
Felippe, Eiser	Sy06O06
Fernandes, Ângela	Sy06P01
Fernandes, Conceição	S03P06
Fernandes, Joana	Sy10P02, Sy19O02, Sy19P02, Sy19P03
Fernandes, Marcelo	Sy17P01, Sy17P02
Fernandes, Maria do Carmo	Sy06P07
Fernandes, Paulo M	Sy15O03, Sy15O05
Fernández, Jesus	Sy17P01, Sy17P02

Fernández-Núñez, Esther	Sy16O06
Ferrão, Diogo	Sy10O04
Ferraz, Rodrigo	S01P07, S01P08
Ferreira, Cármen	Sy13O01
Ferreira, Isabel	Sy06P01
Ferreira, Isabel CFR	Sy08O02, Sy08O03, Sy08O04, Sy08O05, Sy08O06
Ferreira, Jorge	Sy09O03
Fidalgo, Elaine	S03P04, S04P01, Sy19P01
Figueiredo, Tomás	S01P03, S03O06, Sy10P01, Sy11O04, Sy11P06, Sy13O01, Sy13O02, Sy19O05, Sy10O05, Sy10O06, Sy20O06
Florencio de Souza, Sergio	Sy11O01
Fonseca, Bruno	Sy10P02, Sy19O02, Sy19P02, Sy19P03
Fonseca, Catarina	Sy02O07
Fonseca, Felícia	Sy10O06, Sy10P01, Sy13O01, Sy13O02, Sy19O05
Fonseca, Maria Fernanda	Sy06O06, Sy06P07
Fontana, Ademir	Sy06P06
Fraga, Helder	Sy15O03
Frazão-Moreira, Amélia	Sy04O01
Freitas, Maria da Conceição	Sy17O02
Freitas, Rui	Sy10O01
Froufe, Elsa	S02O05
Galliez, Ian Luiz	Sy06P16
Gallinar, David	Sy17O02
Garankina, Ekaterina V	Sy13P01, Sy19O01
García-Gómez, Héctor	Sy13O05
García-Hernández, Cristina	Sy17O02
García-Tomillo, Aitor	Sy10O06, Sy20O06
Garfi, Vittorio	Sy02P03
Garnica-Peña, Ricardo	Sy13O04
Gaspar, Leticia	Sy19O03
Geraldes, Ana Maria	S03O07, S03P05, S03P06, S03P07
Geraldes, Miguel	Sy17O02
Giancola, Carmen	Sy02P03
Giorgi, Annamaria	S02P01, Sy06P02, Sy06P03
Githinji, Kennedy	Sy21O04
Giupponi, Luca	S02P01, Sy06P02, Sy06P03
Glasser, Tzach Aharon	Sy15O01
Golukov, Alexey	S03O03
Gómez-Ortiz, Antonio	Sy17O05
Gómez-Pando, Luz	S03O02
Gómez-Villar, Amelia	Sy17O06
Gonçalves, Artur	S01O04, S01P05
Gonçalves, Dionísio	S01P03
Gonçalves, Francisco	S02O04
Gonçalves, Hermínia	Sy09O04
Gonçalves, Igor	S01P01
Gonçalves, José	Sy19P03
Gonçalves, M. Conceição	Sy11O04
Gonçalves, Odinei H	Sy08O06
Gonzales-Barron, Ursula	S03O02, S03P02, S03P03
González-Amuchastegui, María José	Sy17O05
González, Antonio Paz	Sy11P02
González-Fernández, Ignacio	Sy13O05
González-González, José Mario	Sy18O03
González-Gutiérrez, Rosa Blanca	Sy17O06

González, Xesús P	Sy10O03
Gouveia, Eugénia	Sy13O06
Goyder, David	S02O04
Graça, Antonio	Sy10O01
Gratzer, Georg	K4
Guedes, Cezar	Sy06P16
Guerra, José Guilherme	Sy06O04
Guerra, José Guilherme Marinho	Sy06P09
Hall-Riaza, Jonathan	Sy17O04
Hart, Robbie	S04O01, Sy04O02
Hart, Robert	Sy04O03
Hayet, Ilahi	S02O01
Heleno, Sandrina A	Sy08O06
Hernandez, Zulimar	Sy10O05, Sy10P01, Sy10P03, Sy11P03, Sy11P06
Herrero, Javier	S01O05
Hichem, Rejeb	S02O01
Hik, David	S01O01
Honrado, João C	Sy15O05
Huertas Herrera, Alejandro	S02O02, S02O03
Humer-Gruber, Adelheid	Sy06O02
Ibañez, Martha	S03O02
Iepure, Sanda	S02P05
Im, Sergey	S03O03
Insua, M	Sy13P02, Sy19P04
Irwin, Jeffrey Reed	Sy17O06
Islem, Saadaoui	S02O01
Ivanov, Maxim M	Sy19O01
Ivetic, Vladan	Sy05O08
Jamšek Rupnik, Petra	Sy17O01
Jandl, Nathalia	Sy05O04
Jandl, Robert	Sy05O04
Jež, Jernej	Sy17O01
Jones, Richard	Sy11O03
Jónsdóttir, Ingibjörg Svala	Sy16O02
Kaminer, Alberd	Sy15O01
Kapetanovic, Aleksandra	S04O07
Kather, Sarah	S02O03
Kharuk, Viachaslav	S03O03
Khezri, Adish	S01P02
Kikodze, David	Sy04O03
Kikvidze, Zaal	Sy04O03
Kimondo, James	Sy05O03
Klein, Julia	K3
Kolimenakis, Antonios	S01P06
Koprivica, Tatjana	S04O07
Kozhikkodan Veettil, Bijeeesh	Sy11O01
Kunwar, Ripu Mardhan	Sy04O06
Lakovic, Ivan	S04O07
la Marca, Orazio	Sy05O07
Langat, David	Sy21O04
Lanini, Giuseppe Mario	S01O03
Lasserre, Bruno	Sy02P03
Leite, Solange	S01P03
Lencinas, Vanessa	S02O02, S02O03
L., Giupponi	Sy06P04

Lillo, Javier	S02P05
Lima, Carlos Eduardo	Sy06P06
Lima, Ricardo	S03P04
Linhares, Renato	Sy06O04, Sy06P16
Lizaga, Ivan	Sy19O03
L., Landoni	Sy06P04
L.M.P. de Lima, João	Sy19P05
Lobo Roriz, Custódio	Sy08O04
Lombardi, Fabio	S02O06, S02O07
Lombardi, Giampiero	Sy16O05
Lopes-Lima, Manuel	S02O05
Lopes, Luís	Sy17P01, Sy17P02
Lopes, Vera	Sy17O02
López Netto, Amazile	S04P02, Sy11P01
López-Sáez, José Antonio	Sy17O02
Lourenço, Luciano	Sy13O01, Sy13O03
Lourenço, Rui	Sy15O03
Macário, Carla	S03P04
Machold, Ingrid	Sy21O06
Madeira, Nuno	Sy06P06
Madureira, Lúvia	Sy09O01, Sy15O04
Maia, Filipe	S01O04
Mainali, Janardan	Sy04O06
Manso, José	Sy10O02
Mansourian, Stephanie	Sy05O02
Man Tuladhar, Arbind	S01P02
Marchetti, Marco	Sy02P03
Marcianò, Claudio	S02O06
Marques, Juracy	Sy11P01
Marques, Maria Jose	Sy10P03
Marques, María José	Sy10O05
Marras, Tatiana	Sy05O05
Marta-Costa, Ana	Sy16O03
Marta-Pedroso, Cristina	Sy15O05
Marteinsdóttir, Bryndís	Sy16O02
Martínez Pastur, Guillermo	S02O02, S02O03
Martins, Alba	S03P04
Martins, Bruno	Sy13O01
Marziliano, Pasquale	S02O06, S02O07
Matias, Isabel	S04O04
Menguzzato, Giuliano	S02O06, S02O07
Mercurio, Roberto	Sy05O07
Metrak, Monika	S01O02, S03P08
Meusburger, Katrin	Sy19O04
Monsaterio, Maximina	Sy11P03
Montagnoli, Antonio	Sy05O09
Monteiro, António T	S01P04
Monteiro, Joyce	S03P04, Sy06O01, Sy06P06
Morais, Ana	S01P01
Morales, Patricia	Sy08O04
Moreira, Nuno	Sy16O06
Moreno, Ângela	Sy11O04, Sy11P06
Moura, Maria Fernanda	S03P04
Moura, Rui	Sy19O02
Mujtaba, Babar	Sy19P05

Müller, Alexandra	S03P02
Nastase, Irina Iulia	Sy02O02
Navas, Ana	Sy19O03
Nieuwendam, Alexandre	Sy17O05
Nigmann, Thilo	Sy21O06
Nobre, Sílvia	Sy06O03
Nocentini, Leonardo	Sy05O07
Nogueira, Clotilde	Sy13O02
Nunes, Adélia	Sy13O03
Nunes, João	Sy20O06
Nunes, João Pedro	S01P04
Nunes, Luís	Sy18O02
Obonyo, Emily	Sy21O04
Olariu, Bogdan	S01O06
Oliva, Marc	Sy17O02, Sy17O05, Sy17P01, Sy17P02
Oliveira, Aline	S03P04, Sy06O01, Sy06P06, Sy11O02
Oliveira, Luiz Antonio	Sy06P07
Oliveira, Nuno	Sy20O04
Omizzolo, Andrea	S04O02
Ongugo, Paul	Sy05O03
Ordóñez, ACristóbal	Sy18O04
Ortolani, Maria Raffaella	Sy05O05
Ottaviano, Marco	Sy02P03
Overvåg, Kjell	S04O06, Sy21O03
Owuor, Benjamin	Sy05O03
Pais, Luís S	Sy08O02
Palacios, David	Sy17O05
Palazón, Leticia	Sy19O03
Palombo, Caterina	Sy02P03
Paniagua Zambrana, Narel Y	Sy04O03
Panseri, Sara	Sy06P02, Sy06P03
Parada, Maria João	S03P06
Parise, Mario	Sy13O01
Pasupuleti, Rajeev	S03P07
Paton, Daniel	S03P01
Patru - Stupariu, Ileana	Sy02O02
Paudel, Krishna Prasad	Sy04O04
Pawlikowski, Pawel	S01O02, S03P08
Paz-González, Antonio	Sy20O06, Sy10O06
Pazzagli, Rossano	Sy02P03
Pedreira, Bernadete	S03P04, S04P01, Sy19P01
Pegorer, Ana Paula	Sy06P07
Pellitero-Ondicol, Ramon	Sy17O05
Penha, Thales	Sy19P01
Pentimalli, Daniela	Sy06P02, Sy06P03
Pereda, Jorge	S03O02
Pereira, Celeide	Sy08O05
Pereira, Marcelo da Silva	Sy06P08
Pereira, Margarida	Sy02O07
Perera, Ajith	Sy15O05
Pérez-Alberti, Augusto	Sy17O05
Pérez-Rodríguez, Fernando	Sy18O02, Sy18O05
Perez-Trujillo, Juan	Sy11P06, Sy10O05
Pessanha, Miguel	Sy10O01
Petropoulos, Spyridon	Sy06P01

Petrov, Ilya	S03O03
Pinto, Maria Clara Estoducto	Sy04P01
Pires, Ana Sofia	Sy19O05
Pires, Jaime	Sy16O06
Poesen, Jean	Sy10P01, Sy19O05
Pokharel, Ridish K	S03O04
Postolache, Carmen	S01O06
Prado, Rachel	S01P07, S01P08, S03P04, S04P01, Sy06O01, Sy06P06, Sy19P01
Prado, Rachel Bardy	Sy11O02
Price, Martin	K1
Prieto Lage, Miguel A	Sy08O04, Sy08O05
Probo, Massimiliano	Sy16O05
Q. Ferreira, Isabel	Sy06O05, Sy06O07, Sy06O09, Sy06P12, Sy06P14, Sy06P15
Quierrós, Anabela	Sy13O02
Quijano, Laura	Sy19O03
Rábago, Isaura	Sy13O05
Ramalhosa, Elsa	S03P06
Ram, Ashok	Sy04O06
Ramos, Júlio Cesar	Sy11P02
Ramos, Tiago	Sy11O04
Raschi, Antonio	S01O03
Ravazzoli, Elisa	S04O02
R.C.B. Abrantes, João	Sy19P05
Redondo-Vega, José María	Sy17O06
Rey, Benjamin J	Sy10O03
Ribeiro, António	S01P03, Sy10O04
Rifan, Alessandro	Sy11P05
Rifan, Alessandro Melo	Sy04P01
Rimal, Bhagwat	Sy04O06
Rizzi, Thiago	Sy16O06
Rizzo, Fabio	Sy11P04
Rodrigues, Alírio	Sy08O06
Rodrigues, Geraldo Stachetti	Sy06P08
Rodrigues, Isis	Sy06P08
Rodrigues, João	Sy20O06
Rodrigues, Manuel	Sy16O06
Rodrigues, Manuel Ângelo	Sy06O05, Sy06O07, Sy06O09, Sy06P11, Sy06P12, Sy06P13, Sy06P14, Sy06P15
Rodríguez-Blanco, ML	Sy13P02, Sy19P04
Rodríguez-Soalleiro, Roque J	Sy18O01
Rajo-Alboreca, Alberto	Sy18O01
Röndahl, Eje	Sy06O07, Sy06O09
Rosário, Lúcio	S03O06
R., Pilu	Sy06P04
Rudke, Adenilson	Sy08O06
Ruiz-Colmenero, Marta	Sy10P03
Ruiz-Fernández, Jesús	Sy17O02, Sy17O05
Russell, Aaron	Sy05O03, Sy21O04
Saiter, Osmir	Sy06P07
Salick, Jan	Sy04O02
Sallustio, Lorenzo	Sy02P03
Sá Morais, Jorge	Sy06P11
Sandeman, George	Sy10O01
Santana, Isabel	Sy09O05

Santiago, David	S01O05
Santopuoli, Giovanni	Sy02P03
Santos-Buelga, Celestino	Sy08O01
Santos-González, Javier	Sy17O06
Santos, João A	Sy15O03
Santos, João António Bessa	Sy17O06
Santos, L	Sy13P02, Sy19P04
Santos, Paulo	S01P01
Santos Pereira, Luís	Sy11O04
Santos, Teresa	Sy02O07
Sanz, Javier	Sy13O05
Sarateanu, Veronica	Sy16O01
Scheiffer, Tayana	Sy06O04
Schindlbacher, Andreas	Sy05O04
Schirone, Bartolomeo	Sy05O05
Schirpke, Uta	Sy15O02
Schlechter, Pit	Sy20O01
Schmidt, Simon	Sy19O04
Schuler, Azeneth	S03P04, Sy19P01
Scippa, Gabriella Stefania	Sy05O09
Scuderi, Angelo	S02O06, S02O07
Segal, Ella	Sy15O01
Serovic, Joel	Sy21O04
Serrano, Enrique	Sy17O05
Shafique, Muhammad	Sy02O05
Sheremetskaya, Elena D	Sy13P01
Sher, Hassan	S04O01
Sikharulidze, Shalva	Sy04O03
Sil, Ângelo	Sy15O05, Sy18O02
Silva Borba, Marcos Flávio	Sy02P01
Silva Lima, Viviane Cristina	Sy02P01
Silva, Pedro Gabriel	Sy09O01, Sy15O04
Silveira, Alexandre	Sy19P05
Simoes, Jefferson	Sy11O01
Simões, Luis	Sy10O01
Simoes, Margareth	S01P07, S01P08
Siqueira, Ana Paula	Sy06O06
Skjeggedal, Terje	S04O06, Sy21O03
Soares, Laura	Sy10P02, Sy19O02, Sy19P02, Sy19P03
Soares, Rui	S01P01
Sobrinho, Joana	Sy10O04
Soler, Rosina	S02O02
Soto-Varela, F	Sy13P02
Sousa, Maria joao	S02P03, S02P04
Sousa, Ronaldo	S02O05
Spinelli, Raffaele	Sy20O05
Spychiger, Henri	Sy20O03
Streifeneder, Thomas	S04O02
Sulwinski, Marcin	S01O02, S03P08
Suska-Malawska, Malgorzata	S01O02, S03P08
Taboada-Castro, MM	Sy13P02, Sy19P04
Taboada-Castro, MT	Sy13P02
Taboada, MT	Sy19P04
Tamang, Sujata	Sy04O04
Tappeiner, Ulrike	Sy15O02

Tasser, Erich	Sy15O02
Teixeira, Amílcar	S03P06
Teixeira, Amílcar	S02O05
Teixeira, Bruno	S01P01
Teixeira, José A	S03O02
Teixeira, Wenceslau	Sy06O01
Terzaghi, Mattia	Sy05O09
Thapa, Kamal	Sy02O01
Thapa, Prakash	S02P02
Tibério, Manuel	Sy16O03
Tognetti, Roberto	Sy02P03
Tonti, Daniela	Sy02P03
Torres-Manso, Filipa	Sy16O03
Treue, Thorsten	S03O04
Tripathi, Sudhir	Sy11O03
Tucker, Catherine	Sy21O02
Turetta, Ana Paula	S03P04, Sy11O02
Ugolini, Francesca	S01O03
Ullah, Sami	Sy02O05
Uprety, Sudan	Sy04O06
Valcárcel Díaz, Marcos	Sy17O03
Valcárcel, Marcos	Sy17O04
Valdés, Esperanza	Sy10O03
Valiño, Fernando	Sy13O05
Varandas, Simone	S02O05
Vasilios, Antoniadis	Sy06P01
Vázquez-Rodríguez, Alexandre Luis	Sy17O03, Sy17O04
Vessella, Federico	Sy05O05
Vila-Lameiro, Pablo	Sy02O06, Sy02P04
Vilanova, Mar	Sy10O03
Vizoso-Arribe, Olga	Sy02O04, Sy02P02
Vizzarri, Matteo	Sy02P03
Waiswa, Daniel	Sy05O03, Sy21O04
Wang, Shanshan	Sy11O01
WHITE, PIRAN	Sy11O05
Williamson, Scott	S01O01
Xavier, Cristina	S03P02, S03P03
Žebre, Manja	Sy17O01
Zevenbergen, Jaap	S01P02
Zhou, Wen	Sy21O04



# mountains2016

3-7 october · bragança · portugal



União das Freguesias de  
**Sé, Santa Maria e Meixedo**



The Mountain Research Initiative



<http://cimo.esa.ipb.pt/mountains2016>

