

# Perth III: Mountains of Our Future Earth

## 4–8 October 2015



### Programme Titles Presenters

#### Mountain ecosystem services, adaptive management and global change (1)

Tuesday 6 October 2015, Tuesday 6 October 10.30 - 12.30

Gannochy Trust Auditorium, Perth Concert Hall

Chair: Maria Nijnik

- 13-1 The Drakensberg mountains as a source of essential ecosystem services for local communities  
 Willem Ferguson\*<sup>1</sup>, Sipiwe Ngwenya<sup>2</sup>  
<sup>1</sup>University of Pretoria, South Africa, <sup>2</sup>University of Pretoria, South Africa
- 13-2 Rural forest-dependend communities' well-being nowadays: focus on the Ukrainian Carpathian Mountains region  
 Mariana Melnykovich\*, Ihor Soloviy  
 Ukrainian National Forestry University, Ukraine
- 13-3 Spatial and temporal analysis of management impacts on ecosystem services - scenario modeling in a highland watershed of northwest Ethiopia  
 Menale Wondie\*<sup>1</sup>, Klaus Katzensteiner<sup>2</sup>, Werner Schneider<sup>2</sup>, Demel Teketay<sup>3</sup>, Reinfried Mansberger<sup>2</sup>  
<sup>1</sup>Amhara Regional Agricultural Research Institute, Ethiopia, <sup>2</sup>University of Natural Resources and Life Sciences, Austria, <sup>3</sup>Botswana College of Agriculture, Botswana
- 13-4 Tradeoffs among provisioning and regulation ecosystem services in mountain areas in the north of Portugal affected by fast landscape change  
 Angelo Sil<sup>1</sup>, Ana Paula Rodrigues<sup>1</sup>, João Pedro Nunes<sup>2</sup>, Claudia Carvalho-Santos<sup>2</sup>, João Honrado<sup>4</sup>, Joaquim Alonso<sup>3</sup>, Cristina Marta-Pedroso<sup>1</sup>, João Azevedo\*<sup>1</sup>  
<sup>1</sup>CIMO - Polytechnic Institute of Bragança, Portugal, <sup>2</sup>University of Aveiro, Portugal, <sup>3</sup>Polytechnic Institute of Viana do Castelo, Portugal, <sup>4</sup>InBIO - University of Porto, Portugal
- 13-5 Characterisation of ecosystem functions on mountain habitats in the Cairngorm national park.(Scotland)  
 Alessandro Gimona\*, Laura Poggio, Marie Castellazzi, Andrea Baggio  
 The James Hutton Institute, UK
- 13-6 Projected changes in flow regimes, stream temperature, and native fish habitat extent in the mountains of the Southwestern U.S.  
 Iris Stewart\*<sup>1</sup>, Darren Ficklin<sup>2</sup>  
<sup>1</sup>Santa Clara University, USA, <sup>2</sup>Indiana University, USA

**Tradeoffs among provisioning and regulation ecosystem services in mountain areas in the north of Portugal affected by fast landscape change**

Angelo Sil<sup>1</sup>, Ana Paula Rodrigues<sup>1</sup>, João Pedro Nunes<sup>2</sup>, Cláudia Carvalho-Santos<sup>2</sup>, João Honrado<sup>4</sup>, Joaquim Alonso<sup>3</sup>, Cristina Marta-Pedroso<sup>1</sup>, João Azevedo<sup>1</sup>

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Mountain areas in Portugal provide a diversity of essential ecosystem services, including many provisioning and regulating services. These areas have gone through fast and significant landscape change over the past decades mainly driven by depopulation and agriculture abandonment. To understand how these changes affect the provision of ecosystem services (ESs) in mountain areas in Portugal and to gain insight into how ESs can support management and planning in these changing landscapes, we conducted an assessment of a set of ecosystem services, specifically timber, firewood, mushrooms, freshwater supply, and agriculture crops production (provisioning services), and carbon storage and sequestration, fire regulation, and water regulation (regulating services) in a medium-sized watershed (Alto Sabor) in northern Portugal. The assessment of each ecosystem service included biophysical quantification and economical valuation, using surveys, published statistics, and modeling tools (e.g., InVEST and SWAT) in a spatially explicit manner and was supported by land use/land cover change data from 1990 and 2006. Additionally, scenarios for 2020 were created based on observed land use and land use cover change in the region during the latest decades, namely further expansion of forest stands (FOREST), further abandonment of agriculture (ABANDONMENT), and expansion of shrublands (SHRUBLANDS). Trade-off analysis was conducted in order to evaluate not just the possible combinations of outcomes of landscape structure but also the impact of current and future land use/land cover changes in the provision of ecosystem services. Over the 1990-2016 period the landscape of the Alto Sabor basin showed an increase in forest area (21%) and a decrease in agriculture land (14%) and shrublands (3%). The heterogeneity of the landscape increased slightly as indicated by a decrease in metrics such as patch size, distances among patches, and size of the largest patch in each land class, and an increase in number of patches, extension of edges, and diversity and evenness indices. Simultaneously to these changes in landscape structure, the value of agriculture production in the area decreased strongly in opposition to the remaining provisioning ESs that increased in value. From these, freshwater supply was the most valuable of all. Overall, the value of provisioning ESs increased over this period of time. Among regulating ES, carbon storage and sequestration were the most valuable services showing also a significant increment from 1990 to 2016. Scenarios ABANDONMENT and FOREST indicate continuous or moderate increases in the value of provisioning ESs in the area in opposition to the SHRUBLANDS scenario according to which this value tends to decrease in 2020. The same pattern was observed for the regulating services evaluated in this study. A graphical comparison of the value of pairs of ESs suggest the existence of ES frontiers in value corresponding to optimal solutions of ESs values. However, the exact shape and location of these frontiers in the graphs cannot be yet exactly located. Plots of the total value of regulating ESs against the total value of provisioning ESs suggest that the total value of ESs in the watershed has not reached a maximum value which can be reached according to the landscape change trends defined for the FOREST and ABANDONMENT scenarios. Tradeoff analysis revealed therefore that for the mountain landscape in Portugal under consideration it is possible to find optimal or sub-optimal combinations of landscape conditions (represented by the landscape in 1990, 2006 and in the three scenarios for 2020) in terms of the value and type of ecosystem services evaluated. The results of this study are important because they can effectively support planning and management in this landscape either based on the optimization of the value of ESs or on the importance of particular ESs. This study can, therefore, contribute significantly to the multifunctionality of the Portuguese mountain landscapes. Further research is, however, required to test the effects of other drivers of change on ESs in the landscape, individually or collectively, and to develop tool for stakeholders to promote participative planning and management in mountains in Portugal.