



Farmer and professional maize breeder, hand in hand, Guangxi, China. Photo: Ronnie Vernooy.

there are other institutional issues to deal with. Farmers should be officially recognised as “co-authors” of new varieties. Plant breeders should be recognised and rewarded not only for the release of new varieties, but also for their contribution to the process leading to the final products.

### Acknowledgements

We recognise and value the contributions of the Guangxi farmers who are at the heart of our research efforts. We also acknowledge the expertise of many colleagues. The International Development Research Centre of Canada provides financial and technical support. Opinions expressed are those of the authors only.

### References

Song, Y; Zhang S; Huang K; Qin L; Pan, Q; Vernooy, R (2006) Participatory plant breeding in Guangxi, South-west China. In: Almekinders, C; Hardon, J (eds) *Bringing farmers back into breeding: experiences with participatory plant breeding and challenges for institutionalisation*. Wageningen: Agromisa. Agromisa Special 5, pp. 80-86.

Song, Y; Vernooy, R (eds) (2009) *Seeds and synergies: innovating rural development in China*. Ottawa: International Development Research Centre. In preparation.

Vernooy, R; Song, Y (2004) *New approaches to supporting the agricultural biodiversity important for sustainable rural livelihoods*. International Journal of Agricultural Sustainability, Volume 2, Number 1, pp. 55-66.

Vernooy, R; Song Y; Li, J (2007) *Local agricultural innovation in China: ensuring a fair share of rights and benefits for farming communities*. Asia Pacific Technical Monitor, Vol. 24 (2), March-April 2007, pp. 27-33.

Contributor Ronnie Vernooy ([rvernooy@idrc.ca](mailto:rvernooy@idrc.ca)), is a member of the Mountain Forum and Senior Programme Specialist in Environment and Natural Resource Management at the International Development Research Centre, Ottawa, Canada.

## Intensified Sheep Grazing Decreases the Biodiversity of Alpine Grasslands in the Carpathians, Romania

Bruno Baur

In central and eastern Europe, alpine grasslands are unique habitats for a variety of plant and invertebrate species (Nagy et al. 2003). Seasonal pastoral activities have been practiced for many centuries on accessible areas of these natural grasslands. To increase grazing areas, semi-natural grasslands have been created in mountain areas below the tree-line by forest logging. Although vascular plant species richness of various natural and semi-natural grasslands in general increases under moderate grazing, effects of grazing on biodiversity vary considerably among ecosystems and among different taxa (Cremene et al. 2005; Baur et al. 2006). Moreover, patterns of biodiversity and their driving processes vary with spatial and temporal scale. Pasture management should be adjusted to the local conditions to identify and implement the best strategy of biodiversity conservation.

### Threat to biodiversity

Alpine grasslands in the southern Carpathian mountains, Romania, harbour an extraordinarily high diversity of plants and invertebrates. Transhumant shepherding, the seasonal migration of sheep to suitable grazing grounds, is the traditional use of subalpine and alpine grasslands in the southern Carpathian mountains. Historical records document sheep grazing in the Bucegi mountains since the beginning of the sixteenth century. In these mountains, the sheep flocks have always been large, forcing the animals to graze also in adjacent forests, which were clearcut to extend the pastures in the 19th century (Coldea 2003). More recently, the size of the sheep flocks has increased further as a consequence of the altered socio-economic situation since 1989. Detrimental effects of overgrazing and trampling on plant diversity and vegetation structure, and eroded soils have been reported on the plateau of the Bucegi mountains. As a result, grazing pressure has increased on extensively used, adjacent steep mountain slopes. This is of particular concern as the southern Carpathians harbour a high number of endemic and relic plant and invertebrate species (Ioras 2003). Because of limited food resources, sheep are increasingly forced to graze on steep slopes, which were formerly not grazed by livestock and are considered as local biodiversity hotspots.

Species richness, abundance and number of endemic vascular plants and terrestrial gastropods on steep slopes that were either grazed by sheep or ungrazed by livestock in two areas of the southern Carpathians were examined (Baur et al. 2007). On calcareous soils in the Bucegi mountains, a total of 177 vascular plant and 19 gastropod species was recorded. Twelve plant species (6.8 percent) and three gastropod species (15.8 percent) were endemic to the Carpathians. Grazed sites had lower plant and gastropod species richness than ungrazed sites. Furthermore, grazed sites harboured fewer gastropod species endemic to the Carpathians than ungrazed sites. On acid soils in the Fagaras mountains, a total of 96 vascular plant and nine gastropod species was found. In this mountain area, however, grazed and ungrazed sites did not differ in species richness, abundance and number of endemic plant and gastropod species.

### Implications for conservation and management

Our study shows that in the Bucegi mountains plant and gastropod diversity and abundance are significantly reduced by sheep grazing on formerly ungrazed, steep slopes (Baur et al. 2007). This is of particular concern because the plateau of the Bucegi mountains is already heavily overgrazed, which has resulted in the local extinction of numerous indigenous plant species (Coldea 2003). The grasslands investigated in our study belong to the last remaining refuges for several endemic and relic plant and gastropod species. If overgrazing by sheep should further extend into these particularly valuable grassland remnants, their diverse flora and fauna would be at risk. Thus, an appropriate management should aim to protect these last refuges on steep slopes from overgrazing. Most of these grasslands are part of the 13 nature reserves of the Bucegi Nature Park ([www.bucegipark.ro](http://www.bucegipark.ro)). The findings of our study indicate that there is an urgent need to implement the protective aims of the existing nature reserve. Furthermore, the restoration of overgrazed grasslands should be promoted. At present, the situation in the Fagaras mountains appears to be less critical, but should also be observed with attention.

Our study confirms the high biodiversity value of grasslands on steep slopes, not only for endemic and relic plant and gastropod species, but also for more widespread species in the Carpathian mountains. It also shows the detrimental effects of intensified sheep grazing on these so far unthreatened grasslands, which were only occasionally grazed by wildlife. Other taxonomic groups such as butterflies and moths may also suffer under the increasing grazing pressure.

### References

- Baur, B et al. (2006) *Effects of abandonment of subalpine hay meadows on plant and invertebrate diversity in Transylvania, Romania*. *Biological Conservation*, 132: 261-273
- Baur, B et al. (2007) *Intensified grazing affects endemic plant and gastropod diversity in alpine grasslands of the Southern Carpathians, Romania*. *Biologia*, 62: 438-445
- Coldea, G (2003) *The alpine flora and vegetation of the south-eastern Carpathians*, pp. 65-73 In: Nagy, L; Grabherr, G; Körner, C; Thompson, D B A (eds), *Alpine Biodiversity in Europe*, Springer, Berlin



Extensively grazed slopes of the Bucegi mountains, Southern Carpathians, Romania, harbour a high number of endemic and relic species. Photo: Bruno Baur.

Cremene, C et al. (2005) *Alterations of steppe-like grasslands in eastern Europe: a threat to regional biodiversity hotspots*. *Conservation Biology*, 19: 1606-1618

Ioras, F (2003) *Trends in Romanian biodiversity conservation policy*. *Biodiversity and Conservation*, 12: 9-23

Nagy, L et al. (eds) (2003) *Alpine Biodiversity in Europe*. Springer, Berlin, 477 pp.

Bruno Baur [bruno.baur@unibas.ch](mailto:bruno.baur@unibas.ch), a member of GMBA and MRI, is Professor of Conservation Biology in the Department of Environmental Sciences, University of Basel, Switzerland. His research is focused on different aspects of maintaining and supporting biodiversity, the impact of invasive species on native biodiversity and on the biology of rare and endangered species.



Sheep grazing in the Fagaras mountains, Southern Carpathians, Romania. Photo: Bruno Baur.