

Common and conflicting objectives and practices of herders and conservation managers: the need for a conservation herder

Zsolt Molnár,^{1,8} József Kis,² Csaba Vadász,³ László Papp,⁴ István Sándor,⁵ Sándor Béres,⁶
Gábor Sinka,⁷ and Anna Varga¹

¹MTA Centre for Ecological Research, 2163, Vácrátót, Alkotmány u. 2-4., Hungary

²Freelance cattle herder, 4060, Balmazújváros, Kiskálló köz 3., Hungary

³Kiskunság National Park, 6001, Kecskemét, Liszt F. u. 19., Hungary

⁴Freelance cattle herder, 6794, Úllés, Rúzsai u. 4., Hungary

⁵Zoo Budapest, 1146, Budapest, Állatkerti krt.6-12., Hungary

⁶ELTE, Institute of Ethnography and Folklore, Department of Material Ethnography, 1088, Budapest, Múzeum krt. 6-8., Hungary

⁷Balaton Uplands National Park, 8229, Csopak, Kossuth u. 16., Hungary

Abstract. The mutual dependence of extensive land-use and conservation management has become apparent in Europe in the last 20–30 yr. Extensive land-use often survives in protected areas only, in the form of conservation management. Knowledge of extensive herding and that of conservation management are parts of two knowledge systems (traditional and scientific) which often leads to conflicts between locals and conservationists. We studied two herding/conservation systems (salt steppes and wood-pastures), and developed an inventory on the common/similar and conflicting/different objectives and pasture management practices of herders and conservationists. Data were collected by participatory knowledge co-production in teamwork of the co-authors (herders, conservation managers, and scientists). Data were analyzed and discussed in teamwork too. Herders and conservationists identified 23 objectives and 29 management practices. We found a number of common interests with respect to herding, the ideal state of pastures, legal provisions, and communication. Conflict resolution recommendations (e.g., on time and place of grazing, pasture improvements) were also developed. We argue that by co-production of knowledge, and establishment of a herder “school” the mitigation of the existing conflicts would be more effective. Our conclusion is that a new profession is needed: that of the *conservation herder*. The conservation herder shall be an individual knowledgeable about herding and pasture management, trained in conservation and ecology, able to design management experiments, and develop novel but tradition-based management practices. As such, he/she could facilitate adaptation of extensive herding in the changing socio-economic environment.

Key words: *agri-environment schemes; extensive grazing and herding; extensive land-use; Hungary; pasture management; salt steppe; Special Feature: Ecosystem Management in Transition in Central and Eastern Europe; traditional ecological knowledge; wood-pasture.*

Citation: Molnár, Z., J. Kis, C. Vadász, L. Papp, I. Sándor, S. Béres, G. Sinka, and A. Varga. 2016. Common and conflicting objectives and practices of herders and conservation managers: the need for a conservation herder. *Ecosystem Health and Sustainability* 2(4):e01215. doi: 10.1002/ehs2.1215

Introduction

Extensive land-use types (i.e., labor-intensive management practices with limited mechanization, no or low input of fertilizers and chemicals) play a key role in preserving natural values in habitats developed and

maintained by long-term extensive land management (Beaufoy 1998, Sheil and Lawrence 2004, Plieninger et al. 2006, Pe'er et al. 2014, Sutcliffe et al. 2015). Nature conservation therefore encourages and supports extensive land-use systems and a partial extensification of the more intensive systems (Batáry et al. 2015).

The mutual dependence of extensive land-use and nature conservation has become explicitly apparent in Europe in the past 20–30 yr (Beaufoy and Marsden 2010,

Manuscript received 15 June 2015; revised 5 February 2016; accepted 10 February 2016.

⁸E-mail: molnar.zsolt@okologia.mta.hu

Bunce et al. 2004, Haraszthy 2014, Poschlod and Wallis-DeVries 2002, Varga and Molnár 2014, cf. Berkes et al. 2000). Extensive grazing and/or mowing is required for maintaining a high number of species-rich habitats in Europe (Baur et al. 2006, Báldi et al. 2013, Csergő et al. 2013, Middleton 2013, Meuret and Provenza 2014). Meanwhile the focus of conservation is shifting from biodiversity conservation to conserving major ecosystem services and restoring natural resources while meeting the socio-economic, political, and cultural needs of current and future generations (cf. ecosystem management concept, Szaro et al. 1998).

Due to changing socio-economic environments, rural communities practicing extensive land management are aging and cultural landscapes have been desolated throughout Europe (MacDonald et al. 2000, Fischer et al. 2012). Young people have less and less desire and opportunities to undertake farming due to the low profits made. Far more skilled youth is needed with true competence to continue the kind of land use that has formed, maintained (and could possibly still maintain) the high nature value species-rich habitats.

Extensive land-use – including herding and extensive mowing – has vanished or is dramatically diminishing in a large portion of Europe (MacDonald et al. 2000, Bunce et al. 2004, Plieninger et al. 2006). Herd numbers declined even in East-Central Europe (Baur et al. 2006, Beaufoy and Marsden 2010, Fischer et al. 2012, Dahlström et al. 2013). Traditional and local ecological knowledge associated with these extensive land-use practices is being eroded and/or transformed (Oteros-Rozas et al. 2013, Bíró et al. 2014). In spite of this, in East-Central Europe there are still significant sections of high nature value grasslands that are still managed by farmers and herders using (semi)-traditional extensive land-use practices (Beaufoy et al. 2008, Csergő et al. 2013, Babai and Molnár 2014, Molnár 2014).

Abandoning extensive land-use may entail a number of negative ecological consequences (Niedrist et al. 2009, Middleton 2013). For instance, after the abandonment of grazing and mowing, certain butterfly species may disappear (Baur et al. 2006), invasive species may spread while a number of other plant species may be suppressed by the accumulation of litter (Csergő et al. 2013). Tall-growing species may spread in wetlands (such as *Phragmites*, *Typha* spp., bushes, and trees), while the overall diversity of marshes may decrease (Middleton et al. 2006, Molnár 2012). Abandoned wood-pastures may become reforested (Hartel et al. 2013, Bergmeier and Roellig 2014, Varga et al. 2015).

It is increasingly common that extensive land-use practices – specifically herding is a survivor or it is revived in high nature value habitats in Natura 2000 and other protected areas – mainly as a form of conservation management. On these grounds, nature conservation management and extensive herding are mutually interdependent.

Extensive land-use is supported by the European Union both in direct and indirect forms by establishing obligatory maintenance practices for Natura 2000 habitat types. As a promoter, compensation payments are distributed on the basis of the obligations met and the agri-environmental subsidies are paid for sustainable utilization of permanent grasslands. However, the impact of such subsidies is doubtful in many cases or may be counter-productive (Kleijn et al. 2006, Whittingham 2007). It is ever more obvious that novel approaches need to emerge in nature conservation with sustainable management solutions for high nature value areas requiring extensive land management (Batáry et al. 2015).

The meeting of two knowledge systems: conflicts and common interests

In conservation management, usually a number of stakeholder groups encounter and often conflict each other (Henle et al. 2008, Reed 2008). During herding, the two most characteristic stakeholder groups are herders and conservation managers. They daily develop a number of conflicts. Such conflicts typically concern differences in the respective world views and economic issues (Henle et al. 2008, Ween and Riseth 2011, Haraszthy 2014, Molnár 2014). The resolution of these issues, however, is possible, and there are a number of case studies from all over the world which report on building common understanding between various stakeholder groups and successful conflict management (e.g., Hunn et al. 2003, Olsson et al. 2008, Buijs and Elands 2013, Redpath et al. 2013).

The knowledge of herders and of conservation managers are parts of two distinct knowledge systems: the former is part of the traditional knowledge system, the latter is based on Western science (Molnár et al. 2008, Berkes 2012). Traditional and scientific knowledge systems differ from each other significantly (for instance, various pathways of knowledge generation, storing, and transmission, see Aikenhead and Ogawa 2007, Berkes 2012, Molnár et al. 2008). This makes the cooperation of these two knowledge systems difficult, albeit not impossible (Nadasdy 2003, Berkes 2009, Bohensky and Maru 2011, Hernández-Morcillo et al. 2014).

In spite of the fundamental differences, there are a number of common points between the two stakeholder groups (herders and conservation managers). More and more conservation managers recognize and admit the importance of extensive herding and the role herders' knowledge plays in properly managed herding. At the same time, herders are getting more self-confidence for their role and they open up to nature conservation. As a result, information exchange and cooperation takes place between the two knowledge systems: certain herders possess knowledge on nature conservation and certain conservation managers gathered traditional ecological knowledge and have experiences in extensive livestock management (Varga and Molnár 2014).

All these considerations could give reasons for hope, yet the number of knowledgeable herders is diminishing even in East-Central Europe (Molnár 2012, Varga and Molnár 2014). Lack of appreciation and hence, the lack of a future in sight for this occupation, strongly contribute to the disruption of the intergenerational knowledge transmission of herding-related skills (Molnár 2012). Recognition of herders and their knowledge could also be facilitated by policy instruments to a greater extent than it is currently being done. Yet no comprehensive or even locally conducted inventory has been reported, to our knowledge, on the common and conflicting interests and management practices of herders and of conservation managers. Such an inventory could provide the basis for resolving some of the conflicts and help the long-term maintenance of extensive herding in East-Central Europe.

Two typical, but distinctly contrasting herding and conservation management systems were studied and are described in the present paper. Both these systems have been established in high nature value areas: salt steppes that are tens of thousands years old (Molnár and Borhidi 2003, Molnár 2014) and wood-pastures developed from forested land that are a couple thousand or a couple hundred years old (Hartel and Plieninger 2014, Varga and Molnár 2014).

In this study, we address the following four topics:

1. Comparison of the perspectives of herders and conservation managers regarding the management goals of salt steppes and wood-pastures;
2. Comparison of the management practices applied by herders and conservation managers;
3. Potential conflicts while applying management interventions (and cases where no conflict emerges) and
4. How conflicts could be resolved.

One of the main conclusions of this study is that a new profession may help the effective conservation management of these landscapes: that of the *conservation herder*. These herders shall be knowledgeable in both extensive herding and nature conservation. Such a person would be able to prevent or resolve a great part of the problems identified in the study and to find a compromise that could be satisfactory to both parties and thereby facilitating the adaptation of extensive herding practices to the rapidly changing socio-economic environment of East-Central Europe.

Study area and methods

Pastures, herding, herders, and conservation managers

We studied two characteristic herding and conservation management systems of Central Europe. The pasture type with the largest extent in the Pannonian biogeographic region (ca. the central part of the Carpathian

basin) is represented by the salt steppe (approximately 190 000 hectares). It is a typical lowland habitat with the largest spot on the Hortobágy steppe (Hortobágy National Park) in Hungary (Molnár and Borhidi 2003). The area was covered mainly by herbaceous vegetation (different types of steppes, forest-steppes, and wetlands) throughout the Holocene; the main soil type is the saline meadow solonetz; the landscape is very flat (local extremes in elevation range between 1.7 and 2.3 m). During the Holocene the area was grazed initially by large native grazers (e.g., aurochs, wild horse) and later on by domesticated cattle, horse, and sheep. Typical old breeds include Hungarian gray cattle and the Racka sheep. About a third of the steppe area is wetland habitat, some parts were regularly inundated by floods before river regulations and drainage of the 19th century. For the most part, however, the marshes are still rain fed. Average annual precipitation is approximately 550 mm, while annual mean temperature is 10°C. Snow covers the area for about 35 d a year. Groundwater is rich in soda (Na_2HCO_3) and the groundwater table is shallow (about 0.5–2.5 m). The vegetation (determined primarily by the soil type) is a multiscale mosaic. There are three to eight distinct vegetation types on the hectares scale on average that form the mosaic. Dominant habitats include short-grass *Artemisia* and *Achillea* steppes and salt meadows. Typical species of the pastures are *Festuca pseudovina*, *Alopecurus pratensis*, *Agrostis stolonifera*, *Lolium perenne*, *Elymus repens*, *Eleocharis palustris*, *Artemisia santonicum*, *Trifolium angulatum*, *Hordeum murinum*, *H. hystrix*, *Calamagrostis epigeios*, *Cirsium arvense*, *C. vulgare*, *Carduus acanthoides*, on stubble fields *Convolvulus arvensis*, *Polygonum aviculare*, and in the marshes *Typha angustifolia*, *T. latifolia*, *Phragmites australis*, and *Bolboschoenus maritimus*.

The extensive (semi)natural steppe pastures could only survive because the area cannot be profitably used for arable agriculture. Most salt steppe pastures were designated as protected areas and frequently integrated into a national park. The main goals of nature conservation are fourfold. One goal is the conservation of the characteristic bird fauna (including the great bustard, common crane, birds of prey, stone-curlew, migratory species). The second goal is the conservation of the salt habitat mosaic with endemic and continental plant and animal species. The third goal is the protection of the unique treeless scenery (with Fata Morgana) and finally the maintenance of traditional herding practices and its associated pastoral culture. Currently, approximately 300 herders are herding on the steppe, most of who have been born to multigenerational herder families (even though it is increasingly common that the livestock is accompanied by someone who is not a herder by “training”). The herders’ mentality is characterized by thriftiness, pride and respect for the ancestors. The herders are usually distant with foreigners, e.g., people coming from urban areas with a different culture and knowledge base

(Kunkovacs 2013). Most herders have a detailed knowledge of plants, habitats, and vegetation dynamics of the steppe (Molnar 2012, 2014). The area has been and it still is characterized by both transhumant and sedentary herding (Bellon 1996), however, transhumance herding distances are reduced to 5–30 km distances. The steppe is divided into pasture parcels with approximately 90–150 hectares available to a flock of sheep and 500–800 hectares to a cattle herd. As a rule, a flock and a herd consists of 500–800 sheep and 250–300 heads of cattle, respectively. Herding dogs are still crucial in directing the herds. Grazing season lasts from March/April to November/December (Molnar 2012). Due to its unique pastoral culture, the Hortobagy National Park is a Cultural World Heritage Site.

In the more wooded parts of the Pannonian biogeographic region, the traditional herding often takes place on wood-pastures. Most wood-pastures were developed from closed canopy forests hundreds or maybe thousands of years ago. The current total area of wood-pastures in Hungary is ca. 5500 hectares (Boloni et al. 2008). The climate is moderate. Annual average precipitation is approximately 600–850 mm, while annual mean temperature is 8.5–10°C. Typical tree species on wood-pastures include *Quercus robur*, *Q. cerris*, *Carpinus betulus*, *Fagus sylvatica*, *Pyrus pyraeaster*, *Salix fragilis*, *Populus* spp., shrubs include *Crataegus monogyna*, *Prunus spinosa*, *Rosa canina*, etc., in the grass layer grasses (such as *Festuca rubra*, *F. rupicola*, *Agrostis* spp.), and *Trifolium repens*, *T. pratense* are found, while seasonal grazing land is provided at some place by *Ambrosia artemisiifolia*. The non-native *Robinia pseudoacacia* is spreading on many pastures. Trees are frequently big, with wide canopies (Boloni et al. 2008, Varga and Molnar 2014).

Selective cutting and selective regeneration of the trees is an important aspect in the process of developing and maintaining wood-pastures. The goal of the herders was to replace the former forest herb layer with nourishing pastureland, while retaining occasional woodlots and shrublands. Key grazing species of livestock include cattle, sheep, horses, goats, and pigs. In the 19th century, wood-pastures and grazed forests represented the most important grazing land in the Pannonian landscape (Varga et al. 2015). Forestry management gradually pushed out livestock from the forests starting with the end of the 19th century. Starting in 1961 and onwards, forest grazing is absolutely forbidden (Salata et al. 2009). Key natural values of wood-pastures include veteran trees, the characteristic landscape with old trees and groves and the traditional husbandry practices (Hartel et al. 2013). The area of most wood-pastures has diminished dramatically in the last century as a consequence of the forest encroachment on grassy areas. The most important management issue for conservation managers is to restore and sustain the former dynamic open patchy structure. The low number of active, extensive herders is a huge concern in this respect. In the wood-pastures, the grazing

season lasts from April through November, but winter grazing was a more common practice earlier than it is now.

After sporadic initiatives, modern Hungarian nature conservation administration started with the Nature Conservation Act of 1935. In the 1950s, the institutional landscape has been further developed and the first national parks were established in the mid-seventies. A special feature in Hungarian nature conservation administration is that the entire territory of the country is divided up into ranger districts and approximately 3000–50 000 hectares of land are in the charge of a single conservation ranger. The duty of rangers in their respective areas is to protect natural values which were formally declared as protected. Rangers interact with farmers and herders not only in the national parks and in the strictly protected areas, but also in areas with lower protection grade or in nonprotected land. This allows a lot more direct interactions with people pursuing farming than it is the case in other parts of Europe. Up to accession to the European Union, Hungarian nature conservation administration worked mainly with restrictions and prohibitions, with virtually no consideration of local people and their local knowledge. Since the accession to the EU (2004) the Community and Hungary shall pay compensation for the economic losses caused by nature conservation measures. This system intended to achieve conservation goals by incentives instead of prohibitions. This has been a positive change in itself, but the rapid introduction of the system resulted in a number of conflicts in attitudes, in both political and economic issues. Subsidies account for a substantial part of the total income the farmers earn. Distribution of the funding takes place basically through the European Union payment agencies and not by the local nature conservation administration system. As a result, a number of dissonant details make it difficult for farmers to understand, why exactly they receive support.

Data collection and analysis

Data were collected and analyzed by all the authors in coordinated teamwork. Three of the authors (JK, LP, SB) are active herders (all three having conservation management experiences as well), three are conservation managers (CsV, IS, GS, all three having livestock farming experiences as well), and two ethnoecologists (AV, ZsM, both are botanists studying traditional ecological knowledge of herders, landscape history, and vegetation dynamics). Management objectives set and management practices used by herders and conservation managers were collected and analyzed (discussed) in three different ways. First, participatory observations were carried out by ZsM and AV between 2012 and 2015 with 24 salt steppe herders and 16 wood-pasture herders (124 and 45 d of field research, respectively). Second, semistructured interviews were made with herders and conservation

managers (26 Hortobágy herders and 25 Hortobágy conservation rangers and other conservation managers; 12 herders grazing on wood-pastures and 24 conservation rangers and other conservation managers mostly from Somogy, Bakony, and Bereg regions of Hungary) – which provided the base for the first version of Tables 1, 2, and 3 and Box 1. Third, the co-author herders and conservation managers completed and clarified the contents of the tables in two rounds. It was sometimes difficult to separate, and properly classify objectives and management practices. Some were more, some less complex, some were partly overlapping. The list in Table 1 was the best consensus we could reach.

Joint discussions and participatory data evaluation were important tools in the cooperation efforts of writing the article. Tables included only the opinions of “good” herders and “good” conservation managers (i.e., who are perceived as knowledgeable by their peers in their community). Outlier data and extreme cases not validated by knowledgeable herders and conservation managers and by the co-authors were excluded. Only the topics of pastures, herding, and pasture management were covered and animal welfare, marketability of products or the funding scheme were not addressed by this work.

The basic idea of the paper emerged from a herder (JK) and an ethnoecologist (ZsM) 4 yr ago. Based on the aforementioned circumstances, the paper corresponds to the multiple-evidence-base concept by Tengö et al. (2014) and the IPBES recommendations (UNESCO-IPBES 2013), since all the concepts regarding research design, data collection, data analysis, and publication have been the results of the common will and work of people coming from two different knowledge systems.

Results

Herders and conservation managers (including conservation rangers) identified a total of 23 different objectives (Table 1) and 29 different management practices (Table 2) with respect to pasture management.

The majority (20/23) objectives set out by herders herding on salt steppes and wood-pastures were identical or similar (Fig. 1). The objectives of conservation managers managing salt steppes and wood-pastures concurred in 19/23 cases. Objectives set by herders and conservation managers were common/similar in 11 points of those working on salt steppes and in 13 cases of those working on wood-pastures. There were also conflicting/different objectives between herders and conservation managers: 12 in case of those working on salt steppes and 10 in case of those working on wood-pastures.

Management practices of herders herding on salt steppes and herders of wood-pastures were identical in 23 points and they were different in six cases, respectively. Management practices of conservation manag-

ers managing salt steppes and wood-pastures had 21 identical points and eight differing issues. Management practices used by herders and conservation managers were mainly conflicting/different (20 of those from salt steppes and 19 of those of wood-pastures) as summarized in Table 2. However, some of management practices were common/similar (nine from steppes and 10 from wood-pastures).

The most important conflicts between herders and conservation managers are summarized in Table 3, and the most important common interests and shared values in Box 1. The key findings are that appropriate compromises can be found in most conflicts, while other conflicts could be mitigated by mutual tolerance agreements or new regulations as summarized in Table 3.

Discussion

Common and conflicting management objectives and practices

A high number (122) of common/similar management objectives and practices and about two-thirds (82) of conflicting/different objectives and practices were found between the four groups (herders and conservation managers managing salt steppes and wood-pastures) (see Tables 1 and 2). Both herders and conservation managers shared common points within their respective vocations (i.e., herders vs. herders) and that amounted to be over 80% of the objectives and over 70% of the management practices (see Fig. 1). About equal common/similar and different/conflicting objectives have been found between herders and conservation managers. The proportion of conflicting/different elements was the highest in the case of management practices (66% for salt steppes and 69% for wood-pastures).

Table 1 and 2 shows that for the herders, the pastures are the foundations of the livelihood. The key for them was to see the grass growing well which could be grazed by livestock effectively, since the goal is the fast weight gain of the animals. In the hierarchy of values, herders embraced utilitarianism and stability as important factors in addition to the wellbeing of the livestock.

The main objective of the conservation managers (as emerged from this work) has been to protect species and habitats of local and/or global (regional) importance. However, it should be noted here that conservation and management needs provide their livelihood. In the value system of conservation managers, nature (i.e., diversity, rare and protected plants and birds), wilderness/naturalness and the preservation of natural processes were of the highest priority. The ideal state as described by them was often (quite arguably) the nondisturbed ecosystem and wilderness without the presence of humans.

Table 1. Main objectives of herders and conservation managers in pasture management (SS: specific for salt steppes, WP: specific for wood-pastures, respectively).

Objectives	Herders' objectives	Conservation managers' objectives
Total area	The size of grazing land should not be reduced in a landscape, pastures should not be plowed over, should not be afforested; need for grazing outside of dedicated pastures (e.g., on stubble fields, in forests); SS: do not transform it into wilderness, WP: prevent forest encroachment	Pastures should not be plowed over, should not be afforested, left in larger parcels and not fragmented; limit development (building); SS: increase the size of the area by abandonment of cropland, enhance connectivity; WP: do not requalify as a forest; increase pasture land by shrub clearing
Property structure	There should be sufficient amount of grazing land for a herd (frequently holdings are very fragmented), and sometimes local infrastructure is missing (such as paved road, electric power supply)	SS: often you need larger than current pasture parcels for optimum management of large steppe areas; WP: the individual wood-pastures to be managed are sometimes too small, do not sustain a herd
State of the pasture	The pasture should be such that livestock grew fat on it, the quality of the pasture improved year to year, with relatively tall grass, high-yield, nutritious, many Trifolium and other legumes species, clean, if possible, not grazed barren, not trampled; SS: large amount of Festuca; WP: there should be trees, woodlots, shrubs (for midday rest, reserve pasture)	Sustain the naturalness, species richness of the area (increase if possible), should not be weedy, invasive species should not propagate, natural species be dominant, it should have a closure and height appropriate for the site conditions; SS: be mosaic structures from barren overgrazed ground up to untreated spots; WP: trees be old and mixed in species, native
Utilization	Biomass be exploited the best possible way	This is not a consideration directly, but grasslands should be used somehow (grazed or mown), should not be littered at the end of the season; WP: no overgrazing, no bare soil, but no shrub encroachment, either
Water regime	SS: "it should be water falling from the sky", flooding does no good, "superfluous" spring waters need draining; WP: sometimes you needed more water (for regeneration of oaks), watering in streamlets, but avoiding waterlogging is important	The more natural is the water regime, the better, abolish ditches; SS: flooding to restore habitats is welcome (mainly for purposes of bird protection), WP: reconstruction of floodplains of rivers and streamlets, controlling the regulation of water courses
Wild spots, wilderness	Pastures need management, growing "wild" (abandonment) should be prevented; SS: it should be possible to graze wetlands and forests as well; WP: regular cleaning is a must, otherwise it grows bushy (encroachment of shrubs and trees; the number of wild boars grows), at the same time wild places are important reserve pastures	SS: in many places dynamics need to be left to nature, such as wilderness with wild horses and Heck cattle (a reconstruction of aurochs); marshes should not grow wild too much, should be grazed properly; WP: it should be managed to become beautiful like a park..., abandonment, growing wild is harmful
Mosaic pattern	Mosaicity is necessary on a pasture, but not too much unproductive places should be kept; marshes are important reserve pastures in times of drought; WP: trees and groves are a natural phenomenon on the pastures	SS: sustain or restore mosaicity of habitats as natural as possible; WP: a key value of wooded pastures is their mosaic physiognomical pattern
Stability	The yield of the pastureland should be stable, but accepting the natural fluctuations caused by weather, summer drought should be survived (many kinds of pastures may provide a higher level of stability in yields)	SS: climax communities are preferred, although dynamic fluctuations and the presence of pioneer associations is also natural in this landscape; WP: dynamically stable plant and animal communities are desirable; old trees should be left for the future continuously
Biodiversity	SS: multispecies pasture, multispecies hay is of better quality, but biodiversity per se is not an issue; WP: pasture vegetation and wildlife diversity is good (for instance, edible and medicinal plants can be gathered)	Biodiversity is in the focus of management, sometimes only birds as a priority or a single species, or naturalness as such; WP: old trees and their inhabitants
Trees	You should have trees for midday rest of livestock, beside the hut, for rubbing poles and wind shelter; WP: for acorns, wild fruits, firewood	SS: there should be the least trees possible, but individuals with a high-nature value should be retained; WP: there should be sufficient amount of tree for the landscape, exclusively native ones, for habitat, nesting place, landscape
Shrubs	SS: not a criterion (there is almost no bush); encroachment of bushes is usually not really welcome; WP: scattered shrubs are desirable (for fruits, sticks, pasture in drought), but surplus must be cleared	SS: shrubbery is rare (to be protected on mixed-grass loess steppes), the goal is to suppress alien species; WP: mosaic pattern of shrubs such as nesting place for birds

Table 1. Continued

Objectives	Herders' objectives	Conservation managers' objectives
Herbaceous plants	SS: the most valuable species are <i>Festuca</i> , <i>Alopecurus</i> , <i>Lolium</i> , legumes, <i>Phragmites</i> , on stubbles: <i>Convolvulus</i> and <i>Polygonum</i> ; pasture weeds to be suppressed; WP: the most valuable species are legumes (especially <i>Trifolium</i> spp.), in winter the sour grasses; pasture weeds to be suppressed	Endemic, specialist and/or protected species are important; SS: especially species of the unique salt habitats, loess steppes and forests; WP: orchids; suppress invasive species
Animal species	Suppress/wipe out harmful species, "let the others live"	There should be a rich wildlife community, intensive protection to special (for instance, endemic, rare and/or protected) species, suppress invasive species
Meadow hay	Protect meadows (i.e., do not graze until cut); they need management to have enough hay; second growth (aftermath) is important on meadows for grazing	Mowing (since it is exclusively machine clipping) should not be encouraged (mainly to protect birds and amphibians); WP: when not grazed, grasslands can only be maintained by mowing (or mulching)
Landscape view	SS: it is usually not an issue, but the open landscape is nice; WP: "a pasture is nice when trees are on it!"	SS: the internationally unique main landscape element, the "unbroken horizon" should be maintained; WP: the main landscape value is the grove-like, park nature
Livestock density	More livestock than today ought to be on the pastures	More livestock than today ought to be on the pastures
Type of breed	No substantial preference for traditional breeds (maybe gray cattle, cigája sheep, Hungarian Pied cattle (Hungarian Simmental) are in a higher esteem)	Survival of ancient breeds is an important goal; graze cattle and horses rather than sheep, because the former are native; livestock should be appropriate to the habitats managed (for instance, no sheep should graze in wetlands)
State of livestock	Livestock should fatten, no disease, many calves and lambs, should eat good food, does not have the runs (diarrhea), should not get lost, should not go astray from unfenced resting places, be not stolen	In general no direct purpose with the livestock (animal husbandry should comply with the law)
Convenience, mechanization	The more reasonable, the more convenient is the work, the better (livestock should know its daily routine, the borders of the pasturing range); mechanization when expedient and feasible	Herders, farmers should carry out nature conservation management the more the better, so that no special management and costs be involved; mechanization is opposed as a rule...
Electric fencing	Sometime useful (mainly on the midday and night resting places, and in the neighborhood of main roads or railway), but cannot replace herders, instead it "wipes out" the herder	Cheap and sometime more reliable than a contemporary average "herder", but even the best electric fencing system is still a far cry from a medium skilled herder; it "wipes out" the herder; better for mixed stock grazing (i.e., horses, cattle, sheep, donkeys, etc.), as grazing livestock can graze wherever it likes; it is easier to partition the pasture
Waste	There should be no waste, garbage on the pasture	There should be no waste, garbage on the pasture, WP: illegal dumping is a problem
Legislation	SS: laws and regulations should conform the conditions of the region, support herders, herding and pasture management; WP: regulations are key impediments for the use of wood-pastures, e.g., tree cover is limited, Natura 2000 areas are difficult to graze in wintertime, grazing in forests and burning are completely forbidden, driving of livestock on roads is limited	SS: laws should be adapted to the conditions of the geographic region; current regulations be adhered to; WP: laws and regulations are the key impediments for the use of wood-pastures, e.g., tree cover is limited, Natura 2000 sites are difficult to graze in winter and grazing in forests is banned altogether
Touristic presentation	Too many tourists disturb peaceful grazing, but touristic demonstration is sometimes important	Demonstration is a goal, but only in a limited manner in terms of time and space, man should not disturb the area, in particular not "unnecessarily"; SS: certain sites can receive great masses of people, WP: a favorite target area for demonstration, but large-scale tourism must be limited

Table 2. Practices of pasture management on salt steppes and wood-pastures according to herders and conservation managers (SS: specific for salt steppes, WP: specific wood-pastures, respectively).

Practice	Herders' practices	Conservation managers' practices
Grazed parts, grazing time	Daily, weekly, monthly, and annual grazing courses (routes on the pasture) be adapted to the needs of the livestock and the state of the pasture	Timing and places are bound to nesting of birds and flowering of plants; more recently rotation is also attempted (leaving areas set aside for regeneration)
Annual schedule	SS: in the springtime dry parts, later on salty places, in wetland during drought, to the stubble fields after harvest, second growth on meadows at the end of summer and in autumn; today's pastures are sometime too small for this; WP: hillsides in springtime, under the woods, and fresh places in summer, stubble fields, then second growth on meadows, alfalfa, shrubberies; today's pastures are sometime too small for this	The sequence is influenced by nesting birds and sometime flowering plants; needs of the livestock and optimum exploitation of pastures is seen less important
Partitioning, rotation	Rotational grazing is made as a function of the grassland area; it is important to keep certain spots temporary banned from grazing, SS: such as around the barn/shed for "dining place" or pastures sheltered from wind; grazing parts one by one in marshes to decrease trampling; let enough time for <i>Festuca</i> and <i>Trifolium</i> to regenerate in summer	It is worth partitioning, mainly to avoid overgrazing or to secure blossoming of protected plants or nesting of birds
Livestock density	Neither too many, nor too little livestock, which unfortunately cannot be measured by the official livestock units; quantity of young animals and actual pasture quality and its species composition need to be taken into account	Less animals than in intensive farming but more than the current stock should be grazed (0.2–1 livestock unit/ha); SS: have overgrazed parts for steppe birds, WP: do not leave it undergrazed, because it encourages forest encroachment
"Let them graze well spread"	Do not trample, do not run, have its customary courses on the pasture, graze in a spread out pattern; graze on dew in morning, when grass is not broken by the feet of livestock; WP: better keep together when the wood, the gardens or crop fields are too close, or when it is a delivery season	No unnecessary trampling on the grass, no unnecessary driving of the herd; pasturing should cause no harm to nature
Let them graze in due time and evenly	SS: let's have it grazed now, because livestock will not eat it later on (when it is withered) (for instance, <i>Hordeum</i> , <i>Festuca</i> , <i>Elymus</i>); in order to have strong new growth after summer rains; let the grass grazed evenly, even those which the livestock does not like so much; WP: it depends on the year and winter pasturing as well, what is worth get grazed and left over (e.g., <i>Carex</i> and <i>Urtica</i> patches, <i>Ambrosia</i> , <i>Robinia</i>)	SS: this is usually not an issue; more recently: the structure (physiognomy) of the grassland should be diverse at the end of grazing season; WP: livestock should cover the pasture as a whole (no ungrazed parts should be left)
Trampling	SS: "let's have it trampled now, new growth after rains will be eaten in summer, in drought" (for instance, <i>Agrostis</i> will grow in marshes instead of the unedible <i>Eleocharis</i>); WP: where it has not been grazed for a long time, it will have a stronger new growth after trampling; wet winter pasture is best get trampled in springtime	Usually not an issue; SS: sometime "opening up" of closed marshes on sheep pastures by cattle grazing; WP: sometime management is trampling: opening of gaps to promote germination of rare species, and suppressing invasive species
Spring drive-out, autumn drive-in	Drive out in due time in springtime, because winter fodder may be saved by it, but not too early because the livestock will have the runs (from the too fresh grass), and will not grow fat; drive in due time (not too late)	Drive out when the ground is not too wet anymore and is not trampled too much, protect the grass; for Natura 2000 sites dates are specified by law; it would be better to adapt to the weather conditions of the year
Winter pasturing	Pasturing in winter is done to get the livestock moving and save fodder (a less common practice than it was in the past)	Not an issue as a rule; it may be worth grazing, e.g., for breaking up of the thick litter (dried leaf) layer
Pasture rotation by type of livestock	In autumn sheep and cattle visit each other's pastures (sheep is able to nibble stalks shorter, cattle penetrates in deeper marshes)	Not an issue, most of the time there is no possibility to do it anyway

Table 2. Continued

Practice	Herders' practices	Conservation managers' practices
Protection and plantation of plant species	SS: species level plant protection is not common (except maybe <i>Festuca</i>); WP: special species of shrubs and trees (for instance, acorn bearing and wild fruit) are protected, grown	It is important that grazing should do no harm to protected plant species; SS: introduction of target species, e.g., on abandoned arable land; WP: protection of old trees, planting and nursing trees is necessary
Protection and reintroduction of animal species	Protection of certain bird species (e.g., hoopoe, barn swallow) is a folk tradition	Protecting protected animal species, in particular birds is important; SS: e.g., great bustard, birds of prey, WP: e.g., black stork, hoopoe, insects living in dead wood
Plant collection	SS: collecting mushrooms and wild chamomile for own purposes; WP: collecting mushrooms, wild pear, wood for stick, wild edible plants and medicinal herbs	The law restricts gathering in large volumes; collection practices doing harm to nature must be discouraged
Hunting	Do not hunt or only seldom (but they would frequently use traditional hunting tools, had it been allowed to do so)	Hunting is regulated by the law
Eradication and suppression of plant species	SS: eradication of spiny species (<i>Cirsium</i> and <i>Carduus</i> spp.), local burning of <i>Hordeum</i> and <i>Calamagrostis</i> , trampling of <i>Typha</i> stands; WP: eradication of unnecessary shrubs and trees, clearing of pastures, cutting low grown twigs, suppressing poisonous species (e.g., <i>Datura</i>) and <i>Robinia</i>	SS: removal of all unnecessary shrub and tree for open scenery; suppressing invasive species; WP: removal of unnecessary shrubs, trees and invasive species off vegetation and breeding seasons
Eradication and suppression of animal species	SS: suppressing rook, rodents, wild boar, killing off fleas, rats, stray dogs would be important; WP: suppressing stray dogs, golden jackal, fox, rodents, dormouse would be important	SS: suppression of invasive species and certain nest predators (e.g., fox, hooded crow, wild boar); WP: suppressing of game to the game carrying capacity of the area
Traffic on the pasture	Utilitarian traffic: do not trample the grass if possible, but livestock and comfort are frequently more important	The goal is to prevent and suppress trampling damages, ban unnecessary pedestrian and machine traffic; regulated by law in protected areas
Hay cutting	Meadow hay must be cut enough for winter fodder; meadows must be spared until mowing, but be cut in due time	SS: proportion of mown areas should be reduced in face of grazed areas; delayed date is important; WP: wood-pastures and hay fields separate; many pastures are in fact mown because there is not enough livestock
Cleaning by mowing/mulching	Since manual removal of spiny species is less common, mulching by machines for pasture cleaning became more important	Machine cutting for cleaning is important, but harmful in certain cases (because, e.g., the grassland structure is homogenized, <i>Bombus fragrans</i> needs large patches of nectar-producing species for habitat)
Manuring	Manuring by resting livestock during midday and night rest on grassland, and scattering manure on grassland is necessary for a good quality ("rich") grass; synthetic fertilizers are no good and not necessary; WP: manuring by resting suppresses sedges in wetlands	Synthetic fertilizers are to be banned, manuring is harmful (introduction of alien weed seeds, unnecessary surplus nutrients); some conservationists would endorse manuring in degraded places because it would increase biomass
Turf loosening	Harrowing and loosening of the turf would be important in certain parts of the pasture (opening up the grass cover, to reduce moss and crush hard stalk weeds), but it is not allowed in Natura 2000 sites and protected areas	Banned because it is harmful to sensitive species, and increases weed cover; some conservationists would endorse it in degraded places because it would facilitate the renewal of the grass
Burning	SS: marshes not grazed need to be burnt and it would be better for littered places (the pasture is improved and the habitat for foxes is diminished), but burning is not always good; WP: burnt parts grow sooner in spring, pasture is more healthy, cleaning, garbage collection is easier, but it is not allowed in Natura 2000 sites and protected areas	SS: littered, reedy places ought to be burnt, but only to a limited extent and carefully; WP: burning is needed only rarely and is dangerous for veteran trees
Scattering of hayseed	SS: it was done infrequently, this activity is not practiced anymore; WP: no data available	Scattering of hayseed is an issue raised recently on species-poor old-fields to introduce and promote native target species
Oversowing by commercial seeds	SS: no data; WP: it is worth to do it with <i>Trifolium</i>	Forbidden, regulated by law

Table 2. Continued

Practice	Herders' practices	Conservation managers' practices
Drainage	Stagnant water is usually no good (needs draining), but marshes and margins of marshes are important pastures in times of drought ("this gives life in summer")	Drainage is almost never supported
Abolishing of drainage ditches/floodplain reconstruction	SS: sometimes good, in certain places it is harmful; on some pastures ditches are crucial for watering livestock; WP: it is good to cascade streamlet water to have a place for watering in summer	SS: at the time being abolishing of ditches is one of the main interventions for nature conservation (>1000 km); WP: wherever there is a ditch, it would be abolished, streamlet floodplains restored
Watering, wells	There should be several active wells in the pasture, you should not get back to the resting place for watering, unnecessary extra movement does no good to the livestock; WP: water should not be carried in water-carts, let livestock drink from streams and lakes	This is not an issue, but trampling damage should be avoided; the traditional sweep-pole well is an important landscape element
Collecting garbage	Collects garbage, especially those pieces dangerous for the livestock (such as wires, glasses, tin cans)	Collects garbage
Abolishing of power transmission lines	Not an issue	SS: high priority activity for open scenery and bird conservation purposes; WP: not a priority

We have found a number of common interests of herders and conservation managers with respect to herding, the state of pastures, legal provisions, and communication. The main reason for the high proportion of common interests may be that pastures which are rich in natural values have often been formed and are maintained by extensive grazing in this region (Poschlod and WallisDeVries 2002, Molnár and Borhidi 2003, Bunce et al. 2004, Hartel and Plieninger 2014, Molnár 2014). In addition, many elements of conservation management were developed from traditional pasturing practices (Haraszthy 2014, Molnár 2014, Varga and Molnár 2014). Common interests may have been enhanced by European Union subsidies which have become more and more important factors in the last decade, and which play a reconciliation role between the two stakeholder groups; even if it is "instinctively happening". It needs to be mentioned here that herders' income is originated partly from selling livestock, but a growing portion is coming from subsidies. Therefore, nature protection and conservation management needs are crucial also from the herder's perspective.

One cause of conflicts is that many conservation managers insist on nature conservation too vehemently as they possess the powers conferred to them by the law but lack an appropriate level of pasturing experience. This could result in making it impossible for extensive herding to continue. There are conservation managers, for instance, who believe that livestock should be kept in a "less than average physical conditions" because in that case the animals will graze "less selectively" and that is being perceived to be "better" from the nature conservation perspective. Such an approach, however, is unacceptable for a herder on both ethical and emotional grounds since in this case the grazing livestock

is degraded to a mere management tool. Conservation managers frequently believe that they were superior to herders because they have been scientifically trained and they had a more realistic understanding of their environment. However, this "fight for supremacy" is a mutual attitude. Conservation managers think: "we are on the top", while herders maintain: "you will never notice what we do" (cf. Scott 1985, Stepanova 2015). This power struggle is harmful because it prevents mutual understanding and joint learning.

Conflict resolution in pasture management could be greatly assisted by a compiled international inventory of locally established solutions (cf. conservation evidence, Sutherland et al. 2004). People with several different types of qualifications work in nature conservation (research biologists, agricultural engineers, forest engineers, etc.) and they handle problems and conflicts with different attitudes and experiences based on their past training. The diverse experience from the multitude of nature conservation workers of all trades together with the suggested inventories may help to find adequate solutions to deal with management conflicts and they may also be crucial in addressing two key topics:

1. Establishing that what part of the pasture in which season is important for the herder and for the conservation manager and the reason behind that. Spatio-temporal clashes could be avoided by a proper partitioning of grazing land based on our experience during this work.
2. Low nature value grasslands in protected areas can provide two important services (among many others): a) they may substantially increase profitability of extensive farming since there are more opportunities on such land to obtain higher level and nutritionally better quality biomass by extensive

Table 3. Conflicts between herders and conservation managers on management and their potential resolution.

Conflict	Herders' opinions	Conservation managers' opinions	Possible compromises and resolutions
State of the pasture	The key interest of a good herder is to ensure the well-being of livestock; nutritious and mixed pastures, managed, not growing wild, enough grass to eat throughout the year, some bushes and trees pending on the site conditions, pasture weeds should be suppressed	Pastures should be kept in natural state (or be assisted in regeneration), should be species rich; community dynamics and hydrology should be spontaneous, natural; spots may grow wild; many protected, few alien species; SS: there should be not too many trees, WP: many veteran trees and groves including new growth	It is easier to handle restrictions in space and time when the herder and the ranger can see, understand and accept the other's interest; if the nature conservation target state can be shown on an actual place ("I'd like you to reach this target by grazing"); protection of certain species is easier to explain (e.g., birds of prey, great bustard), others more difficult (such as rooks, insects, plants, dead wood and its inhabitants); key pasturing interests can easily be taken into account in most cases
Time and place of grazing	Grass should be exploited to the maximum, grazing sequence is determined by forage distribution, so that enough could be left for summer and new growth in summer could be guaranteed; when livestock can be grazed, it should be allowed to do so (early spring and late autumn, or even in wintertime), local "transhumance" to forests and stubble fields should be allowed	No damage to nature by grazing, but the area should be managed; no overgrazing (except for creating/maintaining short-grass bird habitats), and certain nesting grounds or flowering populations should be protected from grazing periodically	It is mutually difficult to understand the other's interest well; no need to oversized securities if the herder and ranger clearly understand and approve each other's interests
Electric fence	Some electric fencing should be allowed	Some places need less, some more electric fencing	Set up electric fencing only where it is appropriate and necessary
Type of livestock	The breed should be profitable (or which is already there), easy to pasture, and in the case of new breeds those are welcome which were bred under a similar climate	Old breeds if possible (but more important to have livestock on the pasture in the first place; cattle and horse rather than sheep)	A compromise is in the making (for instance, because traditional breeds are subsidized)
Hay, hay cutting	There should be sufficient amount of hay for wintertime; mowing in due time should be allowed where grass is good for the purpose	Mowing is not supported, restricted in space and delayed; in some cases it is already acknowledged that "it is difficult to keep livestock without good winter fodder"	Where no ground nesting bird is present either half of the hay field could be cut in time or other local compromises are needed; more and more frequently fodder is produced outside the grassland area (on arable fields)
Manuring, turf loosening, burning, etc.	Let be manuring (e.g., by corralling and resting), turf loosening wherever necessary; at some places burning and draining is necessary	Avoid any kind of human disturbance to the extent possible	A lot more local compromises could be achieved by participatory planning, e.g., burning of Calamagrostis-spots, manuring around sheep pens, turf loosening on degraded grassland
Traffic, mechanization	Let us move around and use machinery as reasonable and necessary	Disturbance should be minimized	Such conflicts may be minimized by an appropriate holding structure and localization of infrastructure (wintering barn with paved road, electric power supply)
Good farming practices	A good herder usually adheres to them but the interest of the livestock is more important...	It is sometimes fit for the nature conservation goals; on more degraded places so much "management" would be enough	It should not be the ranger to enforce such practices; a good herder is worth the trust in many cases, (s)he knows the practices appropriate for the long term

Box 1

Management-related common interests of herders and conservation managers (conflict-free situations)

- let the agricultural and agri-environment system be predictable
- by-passing rules and restrictions which are impeding day-to-day operations, are alien to the region, unnecessary for or contradictory to the objectives (noncompliance by herders, nonenforcement by rangers)
- pastures should not be plowed over, afforested, no buildings built on them
- be more livestock (higher livestock density) on the pastures
- be more knowledgeable herders
- work should be the most convenient possible (livestock should graze “by itself”, without management, area be managed for conservation “by itself”, by simple herding, without extra costs)
- the livestock should graze calmly, no unnecessary walking and trampling
- there should be more active wells on the pasture to reduce unnecessary walking and trampling
- reducing weeds on pastures (though differences exist in methods)
- fox, stray dog, hooded crow, wild boar under control
- no/less garbage, waste on the pasture
- no tourist beyond the demonstration areas
- facilitation of direct communication between herder and ranger, getting to know and explain each other’s objectives right at the beginning of the common work
- there should be mediators present between herders and rangers in order to avoid mismatch in communication and resolve disputes

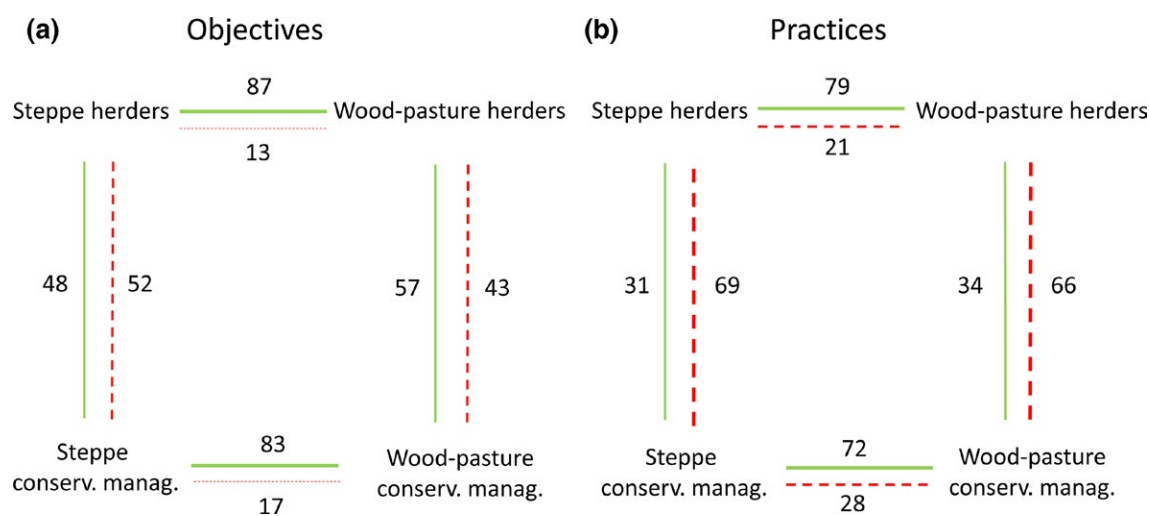


Fig. 1. Proportion (in percentage) of common/similar (in green) and conflicting/different (in red) objectives (a) and practices (b) of salt steppe and wood-pasture herders and conservation managers (including rangers), respectively.

grassland improvements (e.g., manuring, harrowing, and burning restricted both in time and space) (Babai et al. 2015); b) over time, they may develop into high nature value grasslands, improve landscape connectivity, and function as a buffer zone around existing high nature value grasslands.

We argue that by increasing common “thinking”, communication and reciprocal learning between herders and conservation managers, it will be possible to effectively mitigate most of the conflicts between extensive herding and nature conservation.

The need for more cooperation between knowledge systems

Successful and unsuccessful cooperation efforts between local (traditional, indigenous) communities and nature conservation management have been most frequently reported from the postcolonial settings (see e.g., Lewis 1989, Mapinduzi et al. 2003, Roba and Oba 2009). One of the most common causes of unsuccessful cooperation is the fundamentally different world view of local people and conservationists (Hunn et al. 2003, Nadasdy 2003). In Europe, the situation is different for a number

of reasons: the basic world views behind local (rural) knowledge and science/nature conservation are less differentiated as in other continents since both are rooted primarily in the Jewish-Christian world view, and their interactions root back to several thousands of years (Molnár et al. 2008, Svanberg and Łuczaj 2014). Yet, even in Europe, the conflicts between extensively farming/herding locals and conservationists are fairly common (Henle et al. 2008, Ween and Riseth 2011, Babai and Molnár 2014).

East-Central Europe is in a specific situation from the herding/nature conservation perspective. In Central Asia and in Africa the suppression of the traditional, extensive, but more and more over-exploiting pasturing practices are in the focus of nature conservation efforts (Hilker et al. 2014, Petz et al. 2014), while in a large part of Western Europe there are simply no extensive/traditional herders. Mutual interdependence is of paramount importance in the East-Central European region: there is a need for extensive land-use by herding and extensive herders are still present.

Varga and Molnár (2014) has drawn attention to the fact that the key depositories of relations between the traditional and the scientific/conservationist knowledge systems are locally engaged conservation rangers who are interested in extensive animal husbandry and traditional ecological knowledge or the herders who are interested in state-of-the-art conservation attitudes. These people may be able to unite the two knowledge systems. For the cooperation of herders and conservation managers, the mutual understanding and tolerance are essential values and these should be complemented by looking for local compromises instead of adherence to EU-level or national rules (Gugič 2009). Alternatively, the development of region- and culture-specific funding schemes motivating the farmers may also be effective (de Snoo et al. 2013, Babai and Molnár 2014, Batáry et al. 2015).

We argue that the seemingly diverging interests of the herders and of the conservation managers is not a true reflection of reality. This misconception may be originating from the misinterpretation of the spirit and significance of nature conservation. Protected species are indicators of operational and functional ecosystems and should be regarded only as indicators and not as the main (or sole) subjects of protection. Conservationists assume that as long as rare species are present, no problems will be encountered with the populations of more abundant species (compositional indication), and the ecosystem as a whole functions well (functional indication) (cf. Noss 1990). The species composition of grasslands in East-Central Europe has been formed by extensive herding lasting through centuries and millennia. We argue that extensive herding is basically the way by which these systems can and should be sustained in the future (cf. Middleton 2013).

For a more efficient cooperation between the knowledge systems, conservation managers should better

understand the underlying mechanisms of the local ecological states deemed to be desirable, such as the “intermediate disturbance” maintained by extensive grazing (see Poschod and WallisDeVries 2002, Middleton et al. 2006). It should also be noted that wilderness concepts can only be implemented in large areas and not in cultural landscapes with fine-scale land-use. In other words, conservationists must understand the importance of extensive land-use practices in maintaining species-rich habitats and habitat-rich landscapes (Middleton 2013, Babai and Molnár 2014).

It has to be made clear for the representatives of both knowledge systems that there is a key factor bringing their respective activities to a common denominator in spite of any short-term conflicts. The maintenance of high nature value grasslands and the funding available for the maintenance of this and only this high nature value state are key factors. High-yielding grasslands with relatively low biomass fluctuations are usually species-rich grasslands (excluding high-input grasslands). This in fact is a practical manifestation of sustainability. The grass yields of grasslands can be substantially improved by intensive technologies (e.g., sowing of high-yield grass varieties, fertilization, and irrigation) temporarily and in the short run, but this entails the disappearance of both extensive herding and species richness. Under poor site conditions, intensive systems are economically unsustainable even on the short run. This marks the space where extensive herding has a chance for survival and also, where extensively managed species-rich grasslands have a chance to survive: in regions dominated by grasslands on poor quality soil.

There are local knowledge-intensive systems with extensive operations and an almost perfect adaptation to local socio-ecological conditions. On the other hand, there are global (i.e., nonlocal) knowledge-intensive systems with intensive operations using external input technologies. In the first case, sustainability has been proven over centuries or even millennia of use (Meuret and Provenza 2014, Molnár 2014, cf. Berkes et al. 2000). Consequently, they ought to be acknowledged and preserved for preventing the irreversible loss of this adaptive knowledge (Molnár et al. 2008, Hernández-Morcillo et al. 2014).

The need for a new profession

We argue that successful cooperation, knowledge exchange, co-production, and joint learning of herders and conservation managers would be facilitated to a great extent by the development of a new profession, preferably named the *conservation herder*.

Earlier on, herders were paid for the meat and milk produced. Currently, this could be supplemented by benefits awarded for managing biodiversity and ecosystem services (cf. Fischer et al. 2012, Heikkinen et al. 2012, Babai et al. 2014, Meuret and Provenza 2014).

The challenge is the reconsideration of pasture management knowledge and practices of extensive herders along the new values of nature conservation (cf. Gugič 2009, Middleton 2013). The man of the new profession, the *conservation herder* should 1) be able to apply and adapt the traditional knowledge of herders, 2) know the needs and behavior of livestock, 3) the plants and vegetation on the pasture, 4) the spatio-temporal heterogeneity of the pasture and the management possibilities thereof, and 5) be trained in basic nature conservation issues and ecology. This training would allow the *conservation herder* to become familiar with the priority protected species locally, to know about the needs of the hidden world of animals (such as insects), and to have an insight into the global relations of local wildlife (e.g., migratory birds, the value of endemic species). Most importantly the *conservation herder* shall be able to reconcile and harmonize nature conservation management and herding as well as to design management experiments in which the *conservation herders* are involved as their routine task. The *conservation herder* shall be able to develop novel but tradition-based management practices at high nature value areas (cf. the “ecological doctor” concept of Meuret and Provenza 2014).

In order to accelerate the process of training quality *conservation herders*, it is worth considering the establishment of a herder school for practicing herders and for those who want to become herders, but also for those who are interested in nature conservation and are also interested in learning about conservation management by extensive herding. Joint learning and co-production of new knowledge would be one priority in these schools (for practical details of possible curricula and training and knowledge co-production methods see e.g., Meuret and Provenza 2014).

The recognition of and the training itself dedicated for *conservation herders* would greatly facilitate the adaptation of extensive herding in the rapidly changing socio-economic environment. This way, extensive herding may be sustained and even be revived while economic profitability is also retained while preservation of natural values, proper management of ecosystem services and the use of subsidies would also become more efficient concomitantly.

Acknowledgments

We are extremely grateful to the herders and the conservation managers for sharing their thoughts and ideas with us and to Béla Borsos, Katinka Stecina for the English version of the article. This research was partly supported by the project “Sustainable Conservation on Hungarian Natura 2000 Sites (SH/4/8)” within the framework of the Swiss Contribution Program and by the project “Silvopastoral systems of the Duna-Tisza köze region” supported by the Kiskunság National Park.

Literature Cited

- Aikenhead, G. S., and M. Ogawa. 2007. Indigenous knowledge and science revisited. *Cultural Studies of Science Education* 2:539–620.
- Babai, D., and Z. Molnár. 2014. Small-scale traditional management of highly species-rich grasslands in the Carpathians. *Agriculture, Ecosystems & Environment* 182:123–130.
- Babai, D., Á. Molnár and Z. Molnár. 2014. Traditional ecological knowledge and land use in Gyimes (Eastern Carpathians). MTA Centre for the Humanities and MTA Centre for Ecological Research, Budapest, Vácrátót, Hungary.
- Babai, D., et al. 2015. Do conservation and agri-environmental regulations effectively support traditional small-scale farming in East-Central European cultural landscapes? *Biodiversity and Conservation* 24:3305–3327.
- Báldi, A., P. Batáry, and D. Kleijn. 2013. Effects of grazing and biogeographic regions on grassland biodiversity in Hungary - analysing assemblages of 1200 species. *Agriculture Ecosystems & Environment* 166:28–34.
- Batáry, P., L. V. Dicks, D. Kleijn, and W. J. Sutherland. 2015. The role of agri-environment schemes in conservation and environmental management. *Conservation Biology* 29:1006–1016.
- Baur, B., C. Cremene, G. Groza, L. Rakosy, A. A. Schilekyo, A. Baur, P. Stoll, and K. Erhardt. 2006. Effects of abandonment of subalpine hay meadows on plant and invertebrate diversity in Transylvania, Romania. *Biological Conservation* 132:261–273.
- Beaufoy, G. 1998. The EU Habitats Directive in Spain: can it contribute effectively to the conservation of extensive agroecosystems? *Journal of Applied Ecology* 35:974–978.
- Beaufoy, G., K. Marsden. 2010. CAP Reform 2013: Last chance to stop the decline of Europe’s High Nature Value farming? Joint position paper by EFNCP, BirdLife, Butterfly Conservation Europe and WWF Europe. <http://www.efncp.org/download/policy-cap-reform-2013.pdf>
- Beaufoy, G., G. Jones, deRijck K. and Y. Kazakova. 2008. High Nature Value farmlands: Recognising the importance of South East European Landscapes. Final Summary Report (Bulgaria & Romania). WWF Danube-Carpathian Programme and European Forum on Nature Conservation and Pastoralism (EFNCP). http://www.efncp.org/download/blg_rom/FinalReport_HNVfarming_BulgariaRomania_EFNCP-WWFDCP.pdf
- Bellon, T. 1996. Beklen. Animal husbandry of the cities in Nagyunság in the 18–19th centuries (in Hungarian). Karcag város önkormányzata, Karcag, Hungary.
- Bergmeier, E. and M. Roellig. 2014. Diversity, threats and conservation of European wood-pastures. Pages 19–38 in T. Hartel, and T. Plieninger, editors. *European Wood-pastures in Transition*. Routledge, London, UK.
- Berkes, F. 2009. Evolution of co-management: role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management* 90:1692–1702.
- Berkes, F. 2012. *Sacred Ecology*, Third edition. Routledge, New York, USA.
- Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications* 10:1251–1262.
- Bíró, É., D. Babai, J. Bódis, and Z. Molnár. 2014. Lack of knowledge or loss of knowledge? Traditional ecological knowledge of population dynamics of threatened plant species in East-Central Europe. *Journal for Nature Conservation* 22:318–325.
- Bohensky, E. L. and Y. Maru. 2011. Indigenous knowledge, science, and resilience: what have we learned from a decade

- of international literature on “integration”. *Ecology and Society* 16: 6. <http://www.ecologyandsociety.org/vol16/iss4/art6/>.
- Bölöni, J., Z. Molnár, M. Biró, and F. Horváth. 2008. Distribution of the (semi-) natural habitats in Hungary II. Woodlands and shrublands. *Acta Botanica Hungarica* 50:107–148.
- Buijs, A. E., and B. H. Elands. 2013. Does expertise matter? An in-depth understanding of people’s structure of thoughts on nature and its management implications. *Biological Conservation* 168:184–191.
- Bunce, R. G. H., M. Pérez-Soba, R. H. G. Jongman, A. Gómez Sal, F. Herzog, I. Austad. 2004. Transhumance and biodiversity in European mountains. Report from the EU-FP5 Project ‘Transhumount’, IALE Publication Series No. 1, Alterra, Wageningen, The Netherlands.
- Csergő, A. M., L. Demeter, and R. Turkington. 2013. Declining diversity in abandoned grasslands of the carpathian mountains: do dominant species matter? *PloSOne* 8:e73533.
- Dahlström, A., A. Iuga, and T. Lennartsson. 2013. Managing biodiversity rich hay meadows in the EU: a comparison of Swedish and Romanian grasslands. *Environmental Conservation* 40:194–205.
- de Snoo, G. R., et al. 2013. Toward effective nature conservation on farmland: making farmers matter. *Conservation Letters* 6:66–72.
- Fischer, J., T. Hartel, and T. Kuemmerle. 2012. Conservation policy in traditional farming landscapes. *Conservation Letters* 5:167–175.
- Gugič, G. 2009. Managing Sustainability in conditions of Change and Unpredictability - The Living Landscape and Floodplain Ecosystem of the Central Sava River Basin. Lonjsko Polje Nature Park Public Service, Krapje, Croatia.
- Haraszthy, L., editor. 2014. *Natura 2000 fajok és élőhelyek Magyarországon*. Pro Vértes Természetvédelmi Közalapítvány, Csákvár, Hungary.
- Hartel, T., and T. Plieninger. 2014. *European wood-pastures in transition: A social-ecological approach*. Routledge, London and New York, USA.
- Hartel, T., I. Dorresteijn, C. Klein, O. Máthé, C. I. Moga, K. Öllerer, M. Roellig, H. von Wehrden, and J. Fischer. 2013. Wood-pastures in a traditional rural region of Eastern Europe: Characteristics, management and status. *Biological Conservation* 166:267–275.
- Heikkinen, H. I., S. Sarkki, and M. Nuttall. 2012. Users or producers of ecosystem services? A scenario exercise for integrating conservation and reindeer herding in northeast Finland. *Pastoralism* 2:1–24.
- Henle, K., et al. 2008. Identifying and managing the conflicts between agriculture and biodiversity conservation in Europe—A review. *Agriculture, Ecosystems & Environment* 124:60–71.
- Hernández-Morcillo, M., J. Hoberg, E. Oteros-Rozas, T. Plieninger, E. Gómez-Baggethun, and V. Reyes-García. 2014. Traditional ecological knowledge in Europe: status quo and insights for the environmental policy agenda. *Environment: Science and Policy for Sustainable Development* 56:3–17.
- Hilker, T., E. Natsagdorj, R. H. Waring, A. Lyapustin, and Y. Wang. 2014. Satellite observed widespread decline in Mongolian grasslands largely due to overgrazing. *Global Change Biology* 20:418–428.
- Hunn, E., D. Johnson, P. Russell, and T. Thornton. 2003. Huna Tlingit Traditional Environmental Knowledge, Conservation, and the Management of a “Wilderness” Park. *Current Anthropology* 44:79–103.
- Kleijn, D., et al. 2006. Mixed biodiversity benefits of agri-environment schemes in five European countries. *Ecology Letters* 9:243–254.
- Kunkovác, L. 2013. *Shepherds* (in Hungarian). Cser Kiadó, Budapest, Hungary.
- Lewis, H. T. 1989. Ecological and technological knowledge of fire: Aborigines versus park rangers in northern Australia. *American Anthropologist* 91:940–961.
- MacDonald, D., J. R. Crabtree, G. Wiesinger, T. Dax, N. Stamou, P. Fleury, L. J. Gutierrez Lazpita, and A. Gibon. 2000. Agricultural abandonment in mountain areas of Europe: Environmental consequences and policy response. *Journal of Environmental Management* 59:47–69.
- Mapinduzi, A. L., G. Oba, R. B. Weladji, and J. E. Colman. 2003. Use of indigenous ecological knowledge of the Maasai pastoralists for assessing rangeland biodiversity in Tanzania. *African Journal of Ecology* 41:329–336.
- Meuret, M., and F. D. Provenza. 2014. *The Art & Science of Shepherding. Tapping the Wisdom of French Herders*. ACRES, Austin, Texas, USA.
- Middleton, B. A. 2013. Rediscovering traditional vegetation management in preserves: Trading experiences between cultures and continents. *Biological Conservation* 158:271–279.
- Middleton, B. A., B. Holsten, and R. Diggelen. 2006. Biodiversity management of fens and fen meadows by grazing, cutting and burning. *Applied Vegetation Science* 9:307–316.
- Molnár, Z. 2012. Traditional ecological knowledge of herders on the flora and vegetation of the Hortobágy. *Hortobágy Természetvédelmi Közalapítvány, Debrecen*.
- Molnár, Z. 2014. Perception and Management of Spatio-Temporal Pasture Heterogeneity by Hungarian Herders. *Rangeland Ecology and Management* 67:107–118.
- Molnár, Z., and A. Borhidi. 2003. Continental alkali vegetation in Hungary: syntaxonomy, landscape history, vegetation dynamics, and conservation. *Phytocoenologia* 21:235–245.
- Molnár, Z., S. Bartha, and D. Babai. 2008. Traditional ecological knowledge as a concept and data source for historical ecology, vegetation science and conservation biology: a Hungarian perspective. Pages 14–27 in P. Szabó and R. Hédl, editors. *Human Nature: Studies in Historical Ecology and Environmental History*. Institute of Botany of the ASCR, Brno, Czech Republic.
- Nadasdy, P. 2003. Reevaluating the Co-Management Success Story. *Arctic* 56:367–380.
- Niedrist, G., E. Tasser, C. Lüth, J. Dalla Via, and U. Tappeiner. 2009. Plant diversity declines with recent land use changes in European Alps. *Plant Ecology* 202:195–210.
- Noss, R. F. 1990. Indicators for monitoring biodiversity: a hierarchical approach. *Conservation Biology* 4:355–364.
- Olsson, P., C. Folke, and T. P. Hughes. 2008. Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. *Proceedings of the National Academy of Sciences USA* 105:9489–9494.
- Oteros-Rozas, E., R. Ontillera-Sánchez, P. Sanosa, E. Gómez-Baggethun, V. Reyes-García and J. A. González. 2013. Traditional ecological knowledge among transhumant pastoralists in Mediterranean Spain. *Ecology and Society* 18:33 <http://www.ecologyandsociety.org/vol18/iss3/art33/>.
- Pe’er, G., et al. 2014. EU agricultural reform fails on biodiversity. *Science* 344:1090–1092.
- Petz, K., J. Glenday, and R. Alkemade. 2014. Land management implications for ecosystem services in a South African rangeland. *Ecological Indicators* 45:692–703.
- Plieninger, T., F. Höchtl, and T. Spek. 2006. Traditional land-use and nature conservation in European rural landscapes. *Environmental Science & Policy* 9:317–321.
- Poschod, P., and M. F. WallisDeVries. 2002. The historical and socioeconomic perspective of calcareous grasslands – lessons from the distant and recent past. *Biological Conservation* 104:361–376.
- Redpath, S. M., et al. 2013. Understanding and managing conservation conflicts. *Trends in Ecology & Evolution* 28:100–109.

- Reed, M. S. 2008. Stakeholder participation for environmental management: a literature review. *Biological Conservation* 141:2417–2431.
- Roba, H. G., and G. Oba. 2009. Efficacy of integrating herder knowledge and ecological methods for monitoring rangeland degradation in Northern Kenya. *Human Ecology* 37:589–612.
- Saláta, D., S. Horváth, and A. Varga. 2009. Az erdei legeltetésre, a fás legelők és legelőerdők használatára vonatkozó 1791 és 1961 közötti törvények [Laws regulating grazing in forests, use of grazed forests and wood pastures in Hungary between 1791 and 1961]. *Tájékológiai Lapok* 7:387–401.
- Scott, J. C. 1985. *Weapons of the Weak: Everyday Forms of Peasant Resistance*. Yale University Press, New Haven, USA.
- Sheil, D., and A. Lawrence. 2004. Tropical biologists, local people and conservation: new opportunities for collaboration. *Trends in Ecology & Evolution* 19:634–638.
- Stepanova, O. 2015. Conflict resolution in coastal resource management: Comparative analysis of case studies from four European countries. *Ocean & Coastal Management* 103:109–122.
- Sutcliffe, L. M. E., et al. 2015. Harnessing the biodiversity value of Central and Eastern European farmland. *Diversity and Distribution* 21:722–773.
- Sutherland, W. J., A. S. Pullin, P. M. Dolman, and T. M. Knight. 2004. The need for evidence-based conservation. *Trends in Ecology & Evolution* 19:305–308.
- Svanberg, I., and Ł. Łuczaj, editors. 2014. *Pioneers in European Ethnobiology*. Uppsala Universitet, Elanders Sverige, Sweden.
- Szaro, R. C., W. T. Sexton, and C. R. Malone. 1998. The emergence of ecosystem management as a tool for meeting people's needs and sustaining ecosystems. *Landscape and Urban Planning* 40:1–7.
- Tengö, M., E. S. Brondizio, T. Elmqvist, P. Malmer, and M. Spierenburg. 2014. Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach. *Ambio* 43:579–591.
- UNESCO-IPBES. 2013. *The Contribution of Indigenous and Local Knowledge Systems to IPBES: Building Synergies with Science*. Report of International Expert Workshop, Tokyo, 9-11.06.2013. Towards principles and procedures for working with Indigenous and Local Knowledge systems. <http://unesdoc.unesco.org/images/0022/002252/225242e.pdf>
- Varga, A. and Z. Molnár. 2014. The Role of Traditional Ecological Knowledge in Managing Wood-pastures. Pages 187–202 *in* T. Hartel, and T. Plieninger, editors, *European Wood-pastures in Transition*. Routledge, London, UK.
- Varga, A., P. Ódor, Z. Molnár and J. Bölöni. 2015. The history and natural regeneration of a secondary oak-beech woodland on a former wood-pasture in Hungary. *Acta Societatis Botanicorum Poloniae* 84:215–225.
- Ween, G. B., and J. Å. Riseth. 2011. Doing is learning: analysis of an unsuccessful attempt to adapt TEK/IK methodology to Norwegian Sámi circumstances. *Acta Borealia* 28:228–242.
- Whittingham, M. J. 2007. Will agri-environment schemes deliver substantial biodiversity gain, and if not why not? *Journal of Applied Ecology* 44:1–5.

Copyright: © 2016 Molnár et al. This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.