Chapter 13
Suggested Management Measures for Natura 2000 Habitats in Körös-Maros National Park, Hungary

Ákos Malatinszky, Szilvia Ádám, Eszter Falusi, Dénes Saláta, and Károly Penksza

13.1 Introduction

Various effects of climate change are among the greatest challenges that Hungarian agriculture and nature conservation has to face, both currently and in the near future (Pullin et al. 2009). Considering annual precipitation in Hungary, there has been a 100 % difference between the two consecutive years of 2010 and 2011 (data of the National Meteorological Service). In Central Europe, wetlands are already seriously affected by weather extremes (Erwin 2009; George 2010; United Nations Economic Commission for Europe 2009) and, the challenge for agriculture and nature conservation is – besides assessing vulnerabilities and risks – to develop policies to adapt so as to achieve sustainability (Perdomo and Hussain 2011). Forty-six percent of the total grassland areas of Hungary are protected Natura 2000 sites. Over 90 % of these areas need specific forms of management, i.e. grazing, mowing, shrub removal, or combating weeds. This is why harmonising the aims of agriculture and nature conservation is highly important. This may be ensured either by national park directorates (management organised by them or renting state areas with restrictions) or private owners. Therefore, they are the stakeholders who play a crucial role in wetland maintenance by proper management. In favour of developing wetland resilience to climate change, there is an urgent need to develop adaptive management through stakeholder dialogue at an early stage (Sendzimir et al. 2007; Werners et al. 2010) to discover user known problems.

It is possible for conservation managers to proactively respond to probable influences of climate change which threaten habitat integrity and diversity. We have analysed the changes of habitats caused – with any possibility – by the climate

Á. Malatinszky (✉) • S. Ádám • E. Falusi • D. Saláta • K. Penksza
Department of Nature Conservation and Landscape Ecology, Faculty of Agricultural and Environmental Sciences, Institute of Environmental and Landscape Management, Szent István University, Páter K. 1., 2103 Gödöllő, Hungary
e-mail: malatinszky.akos@kti.szie.hu; sargabogar@gmail.com; falusi.eszter@kti.szie.hu; salata.denes@kti.szie.hu; penksza.karoly@kti.szie.hu

S. Rannow and M. Neubert (eds.), *Managing Protected Areas in Central and Eastern Europe Under Climate Change*, Advances in Global Change Research 58,
DOI 10.1007/978-94-007-7960-0_13,

change and simultaneously focused on the necessary changes in conservation management and land use in the designated protected areas. The main aim of our adaptation policies is to increase the resilience of agricultural systems. Our initiative aims at combining ecological aspects, nature conservation, and climatic adaptation with social and economic factors concentrating on the sustainability of this type of protected land management.

During the preparation of climate change adapted management plans, our main aim was to obtain a favourable conservation status and to improve resilience of habitats listed in the Habitats Directive of the EU (92/43/EEC) that is Natura 2000 habitat types comprising the ecological network of the European Union. To achieve these, goals and objectives, strategies and measures were defined, simultaneously identifying uncertainties while also integrating climate scenarios.

Included in the discussion are probable effects of climate change and suggested management measures for each conservation aim (beginning with the maintenance of the habitat type itself, focusing on each Natura 2000 species and protected species that was living in the habitat type or was reported within the sample areas), which are followed by an inclusion of other aspects to consider for each habitat type, except for the forested areas that usually require alternative management from non-forested habitat types.

13.2 Study Areas and Applied Methods

Habitat observations were done in the Körös–Maros National Park, which is located in South-Eastern Hungary among the rivers Tisza, Körös and Maros (Fig. 13.1). The landscape of the area is dominated by freshwater habitats, marshes, and grasslands of agricultural use. Considering the vegetation of the Hungarian Great Plain geographical macro-region, this territory belongs to the most diverse of landscapes; thanks to the complex effect of several natural factors. Among them, climatic and edaphic characteristics are the dominant ones. Investigation areas belong to the lowest located areas of the Hungarian Great Plain, having formerly been an extensive swamp area for several millennia. Areas which are constantly covered by water consist mainly of clay, while slightly higher, elevated patches, that only have temporary water coverage, entail appropriate conditions for different types of sodic (alkaline) habitats.

The sample areas designated for investigations are the Kisgyanté swamp, the Kisvátyon swamp and the Sző-rét meadow, all of which carry natural values of high environmental importance, and are located in the geographical micro-region called Kis-Sárrét, in close vicinity to the Romanian border. These areas are located within the Kis-Sárrét operational part of the Körös-Maros National Park, belonging to the so-called “A zone” of the park (strictly protected areas). Complex studies on the effects of management on vegetation and forage value of wetlands in these sample areas has already been carried out by Nagy et al. (2007) and Kiss et al. (2008).

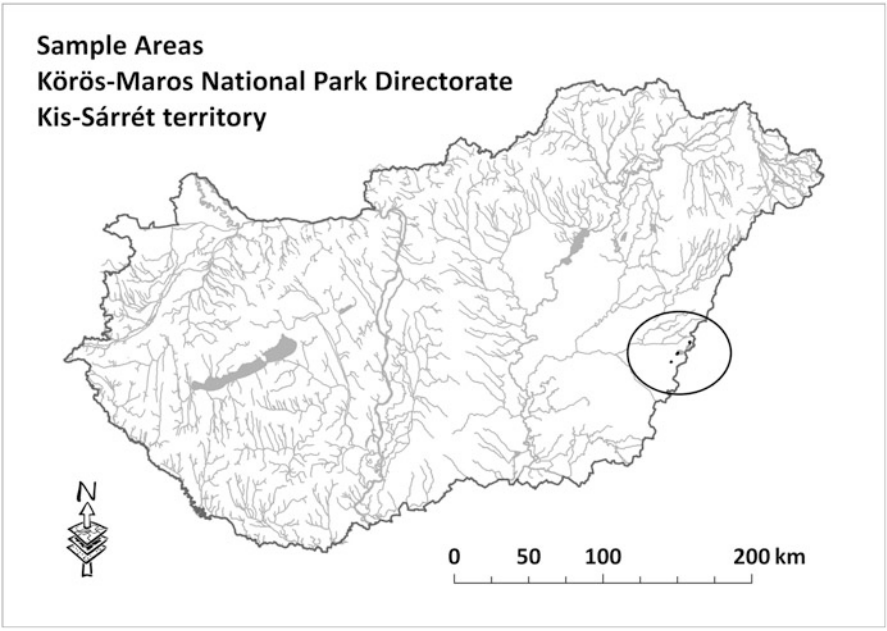

Fig. 13.1 Geographical situation of the sample areas

The sample areas host five types of habitats that are under protection within the Natura 2000 programme of the European Union: Pannonic salt steppes and salt marshes (Habitat Directive code 1530), Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation (3150), Pannonic loess steppic grasslands (6250), Alluvial meadows of river valleys of the *Cnidion dubii* (6440) and Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (91E0). This is why, on top of being a national park area, those habitats have been also designated as Natura 2000 sites (both Special Protection Areas (SPA) and Special Areas of Conservation (SAC)). They are especially important as preservers of salt steppes and salt marshes. Due to the high ecological values, these habitats are in focus of adaptive management planning.

Arable lands cover a larger portion of the Kis-Sárrét SAC and SPA areas. However, the national park's directorate supports their conversion of grasslands. The rate of inhabitants living in the investigation area and working in agriculture is higher than the national average. However, most of them own less than 5 ha. Some former agricultural cooperatives have been converted to economic enterprises. The national park's directorate primarily uses those areas which benefit from habitat reconstruction or restoration. Other state-owned protected areas are worked by farmers, with certain restrictions from to the national park's directorate. The main crops grown in these areas are autumn wheat, autumn barley, oat, corn, sunflower, alfalfa. Alternative crops are oil pumpkin, oil rape, and oil radish. Rice had been produced between the 1930s and 1960s around Mezőgyán, Geszt and Biharugra villages, resulting in artificially created wet areas that were later inhabited by native species.

The number of grazing livestock has increased during the past couple of years after a massive fall in the 1990s. Next to the area of research, the second largest artificial fishpond system of Hungary (about 1,600 ha water surface) is operating. Most of the forested areas are state owned and managed by a state forestry service. Only 12 % of the forested areas are covered by indigenous species, of which 33 % remains oak. Touristic activities are dominated by the bird-watching (mainly on the fishponds). To promote environmental conservation, a 7 km long educational trail was developed along the edge of the Kisvátyon swamp area.

Considering historical development of the landscape, the Kis-Sárrét territory, once called Sárrét of the Körös river, has undergone severe landscape changes during the past 200 years. Extended marshes and fens used to dominate the area before the landscape was converted resulting in very diverse landscape attributes and therefore different management types that were adapted to the ecological conditions. The original state of the land had started to change in the mid-nineteenth century due to severe water regulation activities between 1856 and 1879. As many areas under constant or temporal water cover disappeared, the traditional management changed and a significant portion of local inhabitants were forced to give up traditional way of living. Dried-out areas were converted to arable lands, while wet parts have started to serve as pastures or hayfields, preserving the high importance of raising livestock in the region.

There were significant landscape changes in the twentieth century. The creation of the fishponds near Biharugra village started in 1910, which currently provide sanctuary for rare bird species. There was extended forestation in 1930s, resulting in several new wood patches. Despite landscape conversions, some wetlands remained in a favourable conservation state, remaining today as the last remnants of the once extended marshes and marshy patches. As a consequence of inland water regulatory works, the area of marshes has decreased, but their state can be still considered as almost natural.

The research conducted as a part of this study was based on vegetation mapping, climate data collection, analysis of former and present management, botanical and zoological review, and the analysis of soil and water characteristics. In order to obtain feedback from stakeholders, semi-structured interviews based on open ended questions according to Leech (2002) were prepared, focusing on management and the problems that had been experienced that either directly or indirectly connected to the effects of climate change. The interviews were usually done on the spot with individual responses given in person.

13.3 Determining Priority of Conservation Aims

Problems reported by stakeholders, as well as drivers and pressures delivered from sensitivity maps prepared during the HABIT-CHANGE project, focus on those phenomena that are directly or indirectly connected to climate change and draw attention to future changes on habitat status and their consequences for land

management. As different plant and animal species living within the same habitat type have different requirements, the management of habitats should vary according to the specific conservation aim. This is why at the beginning of the process of adaptive management preparation, a priority order of conservation aims should be determined (e.g. which species, species groups, habitats, or habitat patches should be preserved first and foremost). These could be nesting or feeding birds, butterflies and their feeding plants, orchids, other plant species, or landscape view (see also http1 and http2). In the case of other taxa (mammals, reptiles, amphibians, fishes, and invertebrates not mentioned), management that creates optimal conditions for the appropriate habitat type itself is usually sufficient. Besides basing on scientific research, the process of setting conservation aims requires more insight from stakeholders. Therefore, they should be involved to integrate their interests and needs into the management plans and it has already been recognised in biodiversity conservation that most of them really wish to take part (Idle and Bines 2005).

The landscape scale for planning a unit of management (habitat patches or their mosaics or whole habitat types or protected area level, administrative unit etc.) should also be determined in prior to management planning.

The setup of conservation aims should be based both on scientific research on the area in question and the insight from stakeholders about the possibility of practical implementation. Literature sources draw attention to the fact that, despite of the general assumption that farmer decisions are mostly driven by economic rationality costs are not the most important factor (Sattler and Nagel 2010).

13.4 Suggested Management Measures for Natura 2000 Habitat Types Occurring in the Sample Areas

13.4.1 Pannonic Salt Steppes and Salt Marshes (HD Code 1530)

A special problem emerges when planning adaptive management of this Natura 2000 habitat, as it unites every sodic habitat from the driest steppes to the wettest marshes. Thus, we discuss this habitat referring to the Hungarian habitat classification system (ÁNÉR), which divides this HD code towards six habitat types (*Artemisia* salt steppes and *Achillea* steppes on meadow solonetz, Salt meadows, Tall herb salt meadow steppes, Dense and tall *Puccinellia* swards, Annual salt pioneer swards of steppes and lakes, and Salt marshes). A special feature of these habitats is that they change, even just within a few centimetres of elevation, due to different water conditions (Fig. 13.2).

Maintenance of the *Artemisia* salt steppes and *Achillea* steppes on meadow solonetz only allow open sheep grazing with medium intensity, and taking care to regulate the distance from each other and intensive mobility of animal. In addition,

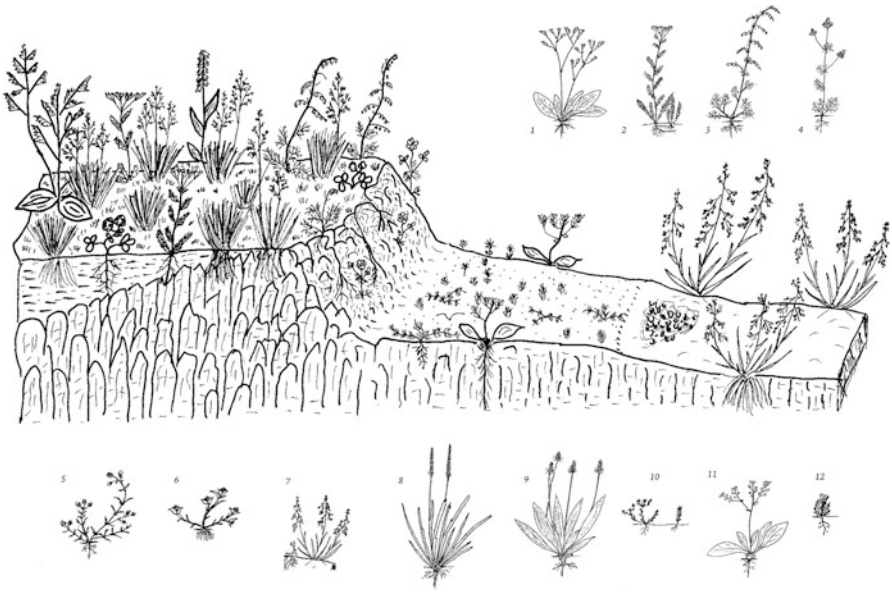

Fig. 13.2 Geographical situation and species composition of three habitat types (*Artemisia* salt steppes and shoulders, Annual salt pioneer swards and *Puccinellia* swards) belonging the Pannonic salt steppes and salt marshes (HD code 1530) habitat category. 1 *Limonium gmelini* subsp. *hungaricum*, 2 *Achillea* spp., 3 *Artemisia santonicum*, 4 *Matricaria recutita*, 5 *Spergularia maritima*, 6 *Crypsis* spp., 7 *Puccinellia* spp., 8 *Plantago maritima*, 9 *Plantago schwarzenbergiana*, 10 *Sedum caespitosum*, 11 *Lepidium cartilagineum*, 12 *Camphorosma annua*

selective weed control (or winter burning) may be necessary (Nagy et al. 2008). Spring inundation may last only for a short period (national park rangers I. Bíró and I. Tóth ex verb.). Erosion by overgrazing may lead to the generation of shoulders (a special landscape form), being another habitat type. Probable effects of climate change, such as excess rainfall or some months of longer spring inundation may reduce salt characteristics, and thus, degrade the habitat. This can be avoided by temporal overgrazing and trampling, which increase open soil surfaces and transpiration. Hotter and less rainy summers strengthen habitat condition. Other aspects to consider are the need to protect against farmers ploughing into these protected habitats from adjacent arable lands by creating hedges of shrubs. *Eleagnus angustifolia* may thrive on upper areas, providing shade for livestock and nesting places for raptor birds; however, it may invade the pasture. Normally there are neither invasive species nor scrub encroachment. Another conservation aim is to protect *Aster tripolium* that thrives on the saltiest parts and needs grazing and tolerates trampling. *Aster sedifolius* occurs on less sodic parts and benefits from mowing or grazing by horse or cattle. *Plantago schwarzenbergiana* and *Orchis morio* thriving on this habitat type also tolerate sheep grazing. *Spermophilus citellus* needs constantly low grass, which can be attained through grazing or mowing. It is important to control grazing during nesting period of birds.

Maintenance of the Salt meadows habitat requires an adequate water supply with temporary inundation, usually between autumn and early summer (at least May). The optimal time for mowing would be the second half of May in order to gain quality hay and pasture for the summer. However, this may destroy bird's nests. Therefore, mowing is advised to be done in late June. Intensive grazing and trampling are harmful. Livestock hooves may harm the soil surface among the sedges as they graze on top of soils filled with water during early spring, thus creating optimal surface for other species to appear (Mann and Tischew 2010). However, usually weed species (from the edges and adjacent arable lands) settle onto these harmed surfaces. Hence, mowing in late June may be advised. This also helps the grassland to close which allows the grass species to thrive, and the grazing livestock can be lead onto the area after drying up. Pykälä (2005) draws attention to the fact that species benefitting from mowing may appear on pastures as well. Slight grazing creates more mosaics (open water patches) and limits the invasive species, reed and *Typha* spp., and prevents scrub encroachment. Decreasing rainfall, as a probable effect of climate change, leads to early drying out, while excess summer rainfall may result in soil leaching and a reduction of salt content which causes soil degradation. Another aspect to consider is to abolish the effects of historical water management initiatives (construction of canals and ditches). No invasive species have had an effect on the habitat, except for *Eleagnus angustifolia*. Occasional burning (in sections) may help to control the weed expansion. To cut back *Typha* stands, the habitat needs to dry up for the late summer. If the conservation aims at protecting the nesting birds, the area should be mowed annually after the 15th of June, leaving un-mown strips (changing their exact place every year), and use wildlife alarming chain. Grazing should be avoided during nesting periods. Milder winters and warmer springs caused by changing climate may lead to earlier blooming of vegetation. This requires earlier mowing, which is harmful for nesting birds. High water levels can also be harmful for birds. However, draining may threaten privately owned arable lands and lowers the groundwater table below adjacent loess steppes. In favour of conserving amphibians and reptiles, alternating scythe should be used instead of bung scythe during mowing.

Tall herb salt meadow steppes require regular spring inundation and drying up in summer. In order to preserve environmental conditions of the habitat, mowing should be done after the 15th of June. Decreasing rainfall leads to early dry-up (a regular trend of drying was already observed in historical times (Saláta 2011)). No invasive species were recorded within our study habitat area. Temporal scrub encroachment does not underpin the degradation of this habitat; however, this process needs to be monitored. Sheep grazing degrades the habitat if they graze too much, or they do not manage to graze tall herb vegetation because of its height. If the conservation aim is to preserve *Peucedanum officinale* – the foodplant of the Natura 2000 butterfly species *Gortyna borelii lunata* – mowing is necessary, but only needs to be done every second year. In favour of preserving this invertebrate, it is imperative to conserve the landscape mosaic. This can be done by leaving un-mown strips of land and switching around the areas that are mowed from year

to year. Early mowing (before the mid-July) kills the larvae of *Gortyna borelii lunata*, which remain in the stem of the food plant at this time. Also the hatching of the *imago* out from the *pupae* form is blocked by the use of heavy mowing machines. Therefore, hand mowing should be preferred. Natura 2000 tall herb species *Cirsium brachycephalum* needs spring rains and late summer drying; mowing harms the tall herb physiognomy. Nesting birds benefit from late mowing (after 15 June), leaving un-mown strips to be mowed in the late summer, and use wildlife alarming chain. If the habitat is grazed, it should be limited for the nesting period.

Dense and tall *Puccinellia* swards thrive if they get regular precipitation, (not necessarily constantly between autumn and spring, but for several shorter periods) and then dry up for summer. This habitat presents strong sodic characteristics. Mowing is required after nesting period. Pasture grazing should not be allowed during wet periods. Hotter and less rainy summers will probably strengthen the condition of this habitat; however, short-term inundation also remains important. Excess rainfall or longer spring inundation reduces salt characteristics. This process can be avoided by temporal overgrazing and trampling which increases open soil surfaces and transpiration. Unbalanced circumstances caused by climate change are beneficial for this habitat. Moderate sheep grazing is not harmful. Erosion by overgrazing may lead to the generation of shoulders; this being a new habitat type. If the priority is to preserve *Aster tripolium*, constant inundation by rain should not be allowed and the area could be covered with water just for several shorter periods of year.

Annual salt pioneer swards of steppes and lakes are sensitive to trampling, especially in wetter periods, but they tolerate moderate grazing. Long lasting water inundation and intensive transpiration is beneficial for the habitat, and hotter, less rainy summers may also strengthen their condition. Climate extremes are favourable for this habitat. Intensive trampling assists its generation, but may also destroy the shoulders.

Salt marshes should experience excessive rain between late autumn and summer. Its vegetation mainly consists of tall and rigid species unpalatable for most livestock species and breeds. Therefore, only the robust Hungarian Grey Cattle breed (or water buffalo) is optimal for their grazing. This breed is also more resistant to the effect of heat waves increasing especially on the Central European plain areas (Twardosz and Batko 2012). Long water inundation and intensive transpiration is beneficial. This habitat regenerates easily in rainy periods after drying up in dry years, thus making the area sensitive to the climate extremities. Abolishing the effects of past water management works (canals, ditches) may be necessary. Occasional mowing or grazing (Hungarian Grey Cattle or water buffalo) may prevent the expansion of this habitat type onto other ones. No invasive species were recorded in this habitat within our study area. If the main aim is to preserve *Eleocharis uniglumis*, no special management measures need to be implemented besides the monitoring and sustaining of ample precipitation between late autumn and summer.

13.4.2 Natural Eutrophic Lakes with Magnopotamion or Hydrocharition-Type Vegetation (HD Code 3150)

This habitat requires constant water supply. Decreasing rainfall may harm hydrophyte vegetation as its levels will simplify. *Ceratophylloide*-type submersed floating life forms may fall and *Lemnoid*-type emersed floating life forms (with smaller space claim) may gain space. Species number may fall as species with limited ecological tolerance disappear. Species requiring a high naturalness state of habitat (*Myriophyllum verticillatum, Ceratophyllum demersum, C. submersum, Utricularia australis, Salvinia natans*) may disappear. Increase of less sensitive *Lemna minor* and *Trapa natans* is expected. Protected species such as *Salvinia natans, Misgurnus fossilis, Emys orbicularis, Triturus cristatus* etc. need constant water supply in this habitat type, and it appears that no special measure is required to be applied.

13.4.3 Pannonic Loess Steppic Grasslands (HD Code 6250)

Maintenance of this habitat is possible with slight section grazing, which should be limited within the wetter spots. Mowing once a year (June) and/or autumn grazing by sheep, cattle, or horse are also a possible management measures. Keeping mown buffer zone on the edges helps to prevent expansion of weeds. Mosaic landscape should also be retained. Species composition alters depending on annual rainfall; this may be augmented with stronger changes in climate. Continuous attention is needed to prevent overgrazing. Deflating water from wet areas during summer threatens the habitat by the groundwater table decline. If nature conservation aims at protecting the *Spermophilus citellus,* low cut grass should be maintained which can be obtained as a result of grazing and/or mowing. Converting arable lands into alfalfa production in parallel with cutback of shrubs (e.g. *Prunus spinosa*) is beneficial for *Otis tarda*. *Cirsium furiens* does not require intervention, only cutback of shrubs.

13.4.4 Alluvial Meadows of River Valleys of the Cnidion Dubii (HD Code 6440)

Mowing in June and autumn grazing by sheep, cattle, or horses on the young grassland is beneficial. As a consequence of lowering groundwater table these habitats may evolve towards drying out and in parallel, become weedier. *Cirsium brachycephalum* requires spring inundation of the area with a dry climate in late summer. Late mowing harms its tall herb physiognomy. In favour of conserving amphibians and reptiles, alternating scythe should be used instead of bung scythe during mowing. *Orchis laxiflora* ssp. *elegans* needs late June mowing, after the ripening of its seeds. A rare remnant of ancient marshlands, *Carex divisa,* requires water cover between autumn and June as drying threatens its proliferation.

13.5 Further Insights

We experienced various management methods even within the same habitat type on our relatively small sample areas. A favourable conservation status of protected habitats is not only threatened by pressures and impacts driven by climate change, but also by those emerging from land use and its changes. Therefore, planning climate adapted management requires the intense involvement of stakeholders and amongst them, land users. Preparing a compilation of problems with the stakeholders, focusing on problems that are connected with climate change helps to identify the most important questions that should be answered during the planning of adaptive management. Conflicts between stakeholders concerning the management of the protected area should also be explored. It should be decided in each case which factors are of the highest importance (e.g. species-oriented or habitat requirements) and which climatic effects might affect the natural values (both species and habitats) at the highest level. Thus, management cannot be uniformed or standardised.

Several ecologists and other officers working at Hungarian national park directorates underlined that a high flexibility of the authorities is needed when ordering certain management restrictions for farmers on protected areas; the regulations should be revised every year or even within a year (e.g. time of mowing should be tied to vegetation phenophase instead of exact date). They also reported that currently there is a lack of such flexibility due to strict legal regulations. A general guideline is that management planning should be based on current, exact, relevant ecological and social circumstances, and historical land uses. Therefore, this process cannot be simplified into following a planning scheme. This especially applies on the Natura 2000 habitat type Pannonic salt steppes and salt marshes (HD code 1530) as it unites every sodic habitat from the driest steppes to the wettest marshes. The scale of planning its management should be based on the Hungarian habitat classification system (ÁNÉR), which divides it towards six habitat types. This scale should be refined onto administrative management units according to national park officers.

Acknowledgments We are grateful for the key informants for this study, especially the managers of the Körös-Maros National Park Directorate and the land owners and farmers who gave their knowledge and time. Our study was supported by the HABIT-CHANGE project, implemented through the CENTRAL EUROPE programme co-financed by the ERDF. Authors are also greatful for the support of Research Centre of Excellence - 17586-4/2013/TUDPOL.

References

Erwin, K. L. (2009). Wetlands and global climate change: The role of wetland restoration in a changing world. *Wetlands Ecology and Management, 17*, 71–84.

George, G. (Ed.). (2010). The impact of climate change on European Lakes. *Aquatic Ecology Series 4,* 1–13.

http1: http://www.env.gov.bc.ca/conservationframework/documents/CF_Primer.pdf
http2: http://www.nature.org/media/asia-pacific/east-mongolia-grasslands-ecoregional-assessment.pdf
Idle, E. T., & Bines, T. J. H. (2005). *Management planning for protected areas, a guide for practitioners and their bosses*. Eurosite. Available at: http://www.eurosite.org/files/Eurosite_management_planning_guidance.pdf
Kiss, T., Nagy, A., Malatinszky, Á., Balogh, Á., & Penksza, K. (2008). Habitat mapping and map presentation of characteristic habitats in the Körös–Maros National Park, Kis-Sárrét territory. *Lucrări Ştiinţifice Management Agricol, 10*, 357–364.
Leech, B. (2002). Asking questions: Techniques for semistructured interviews. *Political Science and Politics, 35*, 665–668.
Mann, S., & Tischew, S. (2010). Role of megaherbivores in restoration of species-rich grasslands on former arable land in floodplains. *Waldökologie, Landschaftsforschung und Naturschutz, 10*, 7–15.
Nagy, A., Malatinszky, Á., Pándi, I., Kristóf, D., & Penksza, K. (2007). Élőhelycsoportok kialakítása táji szintű összehasonlításhoz I [Development of habitat groups for comparisons at landscape level I.]. *Tájökológiai Lapok (Hung. J. Landscape Ecology) 5*, 363–369.
Nagy, G. G., Déri, S., & Lengyel, S. (2008). *Guidelines to the reconstruction and conservation management of Pannonic dry loess and sodic grasslands* (pp. 1–57). Debrecen: Hortobágy National Park Directorate.
Perdomo, A., & Hussain, O. (2011). A multisystem climate change adaptation approach for water sustainability in regional Australia. *International Journal of Global Warming, 3*, 39–54.
Pullin, A. S., Báldi, A., Can, O. E., Dieterich, M., Kati, V., Livoreil, B., Lövei, G., Mihók, B., Nevin, O., Selva, N., & Sousa-Pinto, I. (2009). Conservation focus on Europe: Major conservation policy issues that need to be informed by conservation science. *Conservation Biology, 23*, 818–824.
Pykälä, J. (2005). Plant species responses to cattle grazing in mesic semi-natural grassland. *Agriculture, Ecosystems and Environment, 108*, 109–117.
Saláta, D. (2011). Landscape changes on 3 areas of the Kis-Sárrét part of Körös-Maros National Park: Kisgyanté, Kisvátyon and Sző meadow. *Crisicum, 7*, 129–152.
Sattler, C., & Nagel, U. J. (2010). Factors affecting farmers' acceptance of conservation measures – A case study from north-eastern Germany. *Land Use Policy, 27*, 70–77.
Sendzimir, J., Magnuszewski, P., Flachner, Z., Balogh, P., Molnar, G., Sarvari, A., & Nagy, Z. (2007). Assessing the resilience of a river management regime: Informal learning in a shadow network in the Tisza River Basin. *Ecology and Society, 13*, 11. Available at: http://www.ecologyandsociety.org/vol13/iss1/art11/
Twardosz, R., & Batko, A. (2012). Heat waves in Central Europe (1991–2006). *International Journal of Global Warming, 4*, 261–272.
United Nations Economic Commission for Europe. (2009). *Guidance on water and adaptation to climate change*. Available at: http://www.unece.org/env/documents/2009/Wat/mp_wat/ECE_MP.WAT_30_E.pdf
Werners, S. E., Matczak, P., & Flachner, Z. (2010). Individuals matter: Exploring strategies of individuals to change the water policy for the Tisza River in Hungary. *Ecology and Society, 15*, 24. Available at: http://www.ecologyandsociety.org/vol15/iss2/art24/