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Wetland Ecosystems in Hungary's Nature Conservation Areas and Problems Relating to their Economic Utilization, from the Aspect of Nature Conservation

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If our current way of life is to be kept sustainable, particular attention must be paid to the management of the world around us – including our environmental conditions, natural resources and assets, and particularly the available water resources – and to the protection of natural elements that are, for whatever reason, of crucial importance for all of us. The aims and methods of the necessary protection are, however, not always compatible with farming activities and forms of land use that have been practiced, in some cases, for centuries. This article describes some of the incompatibilities and conflicts between various forms of farming and the relatively new domestic nature conservation activities, with a focus on Hungary's nature conservation areas and particularly its wetland ecosystems. This is followed by a discussion of problems associated with such conflicts and proposals for resolving them.

Keywords: *nature conservation, wetland ecosystems under protection, problems relating to modes of management*

Introduction

The management of groundwater and surface water resources has come to involve much more than distributing water among those using it for economic purposes: it comprises activities aimed at maintaining the circulation of water taking into account the relative proportions of the various elements of the circulation of water, the satisfaction of ecological requirements that are based on water resources, as well as river basin management, taking into account the widest possible range of natural and social interactions.

The second half of the 20th century saw a profound paradigm change in nature conservation. Rather than focusing on isolated areas, efforts came to be made to prevent damage to areas by altering the intensity of environment use over larger areas, not only by avoiding excessive but also insufficient cultivation, and by terminating or altering other activities causing anthropogenic damage. To this end, efforts are being made to harmonize nature conservation with the upkeep of biodiversity, the economic and social embeddedness of areas, the promotion of their development and bringing about changes in the existing segregational attitude. Based on this new approach nature conservation is opening up towards society, turning to

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scientists and other professionals for new methods, and offering new solutions for "users" of the environment (e.g. the necessary information and knowledge are being brought closer to people by way of offering education programs, creating educational trails and operating forest schools).

The Concept and Tasks of Nature Conservation and an Overview of the Relevant International Agreements

The Tasks and Objectives of Nature Conservation

Whatever is of value to us – however subjectively the term "value" may be interpreted – needs to be protected. Nature is valuable because we cannot live without it; it is something unique, without any alternative, and it is the basis of our survival. Natural values include animate (botanical, zoological) and inanimate (geological, hydrological, landscape) as well as culture-historical values along with their habitats and sites whose preservation and maintenance are important from scientific, cultural or economic aspects, along with species and things that are valuable on account of being rare or unique or threatened by transformation, destruction or extinction. [1] Water, soil and air are inseparably combined in a single whole in an ecosystem. Once man interferes in the natural processes or changes the composition of any one of these three factors, or upsets their natural processes, the ecosystem itself is bound to be damaged and transformed. [2]

Our natural resources are public property, therefore they must be protected. This is the basis of the principle of *nature preservation*. Nature preservation involves general protection of nature as a whole, the exploring, identification and preservation of our animate and inanimate resources, the maintenance and enabling of its processes, the preservation, protection, management and controlled presentation as well as utilization of the natural resources that are of importance from both scientific and cultural aspects. Some of these natural elements have "a mere" intangible value but others have actual economic value as resources for business, science or in the protection of human health or from an aesthetic or emotional perspective.

At the level of individual countries nature conservation is a centrally organized, regulated and controlled activity aimed at preserving, restoring, maintaining and – to the extent possible – presenting such values and systems.

The aim of nature conservation is to preserve and present the above mentioned values in a natural or as nearly natural state as possible, providing the conditions and requisites required for maintaining them, keeping up biodiversity [25] – that may also be viewed as the genetic resources of wildlife as evolved to date – partly in an indicator function (even if this is considered by some scientists as a gross interference with natural processes), enabling scientific research. Other important objectives include the promotion and popularization of nature conservation itself, bringing it closer to people, raising awareness of its crucial importance and its integration in the day-to-day life and functioning of society. The possible means to achieve these include making it possible for people to spend their spare time in a natural environment, as well as preserving, maintaining and presenting areas and facilities supporting traditional ways of life and farming methods.

The tasks of nature conservation may be grouped in a variety of categories, such as (a) official/state administration tasks comprising primarily regulatory functions ranging from

licensing, authorization and permission, supervision and sanctioning, along with (b) management tasks and (c) service provision functions.

Other concrete tasks include the identification, taking account of and listing natural values in need of protection (compiling Red Lists[2]), as well as the declaring of natural resources as resources under protection. To prevent conflicts of interest and provide for the most efficient and effective level of protection, values under protection in the framework of nature conservation need to be expropriated and brought under state management. Further concrete tasks include the exploring and identification of phenomena and factors threatening natural values under protection and the underlying causes, prevention of damage and once damage has occurred, the assessment of its extent and the preparation and implementation of recovery (recultivation, revitalization, reconstruction etc.), maintenance, management and development plans. Further tasks belonging to the scope of nature conservation include the development of areas designated for protection and areas already under protection, the development, construction and equipping of infrastructure for visitor centers and making arrangements for their protection (guarding). [3]

International Agreements, Treaties and Conventions Relating to Water and Wetland Habitats

The European Union's most important piece of legislation concerning water management and water resources is a regulation determining the Union's water policy, referred to as *Water Frame Directive* (WFD). [19] A series of rules and regulations were introduced in Europe from the 1970s on to improve the status of water bodies, however, those efforts failed to bring about the desired improvements. Policy makers therefore set about implementing a new water policy, one of the results of which was the adoption of the Water Frame Directive that entered into force on 22nd December, 2000. Pursuant to the rules laid down in the Directive Member States must improve their groundwater and surface water bodies so that they conform to the criteria of what the legislation refers to as a "good status" by 2015 – provided they can still be improved to that extent – and such good status must be rendered sustainable. Moreover, any further deterioration in the status of water bodies must be prevented. The WFD applies to all human activities that may have a significant negative impact on the status of waters thereby impeding the attainment and/or preserving of good water status. To make it easier for the Member States to comply with the WFD, Member States are allowed to set out less exacting environmental goals and/or longer time frames in cases where the desired water body status cannot be attained or it can only be attained in unreasonably expensive ways. (Such softer targets or longer time frames must, however, be properly justified.) Other objectives besides achieving good water body status include reducing the quantity of pollutants discharged into waters or terminating such discharges, along with the alleviation of the effects of floods and droughts.

The first task in Hungary in relation to the WFD was to work out a typology of waters on the basis of which the system of criteria required for the categorization of water quality can be elaborated. This will be the basis for identifying the various water bodies, establish their reference statuses, and ultimately for their evaluation and monitoring.

2 Red List, a collection of species threatened with extinction, the most comprehensive inventory of taxa under protection in the framework of nature conservation, compiled for the first time in 1948 by the former World Conservation Union, today known as International Union for Conservation of Nature and Natural Resources.

Natura 2000 is an ecological network established by the EU with the aim of contributing to the maintenance of biodiversity through the protection of habitat types as well as animal and plant species of Community importance, and to the maintenance of values already under protection in the framework of nature conservation and the possible recovery processes. The Natura 2000 network is based on the 1979 Birds Directive and the 1992 Habitats Directive. The Natura 2000 network covers some 17% of the total area of Europe. One of its key objectives is to protect bird species and special bird protection areas, which are, wetland habitats. The primary goals of the habitat protection directive include protection of biodiversity and ensuring the long-term survival of species and habitat types. The relevant areas in Hungary are listed in Decree 14/2010 Ministry for Environmental Protection and Water Management. [20] All of the areas that had already been under protection became parts of this network, as a result of which some 21% of the total area of Hungary is now covered by this new type of protection. As the Natura 2000 network is made up not only of nature conservation areas, the scheme involves farmlands and forests as well. Accordingly, the applicable regulation provides for the coordination of the various forms of economic utilization with the interests of nature conservation. [4]

The *Ramsar Convention*, [5] that is the "Convention on Wetlands of International Importance, especially as Waterfowl Habitat", is the oldest intergovernmental agreement on nature conservation, signed in response to the growing speed of the transformation and the destruction of wetland habitats. The Convention has been developing dynamically since its inception and the range of activities carried out within its scope has been growing wider and wider. The Convention has been signed by 168 countries to date and it cooperates with a variety of international organizations (BirdLife International, WWF,[3] IUCN[4]), enabling global action. Initially, the Convention was aimed at affording protection to dramatically decreasing waterfowl populations but in view of experience that accumulated over time emphasis was shifted from the protection of habitats to that of ecological systems. Hungary joined the Convention in 1979, and today there are 29 "Ramsar sites" in Hungary – of a total area of 204,000 hectares – including every one of the wetland habitat types that are characteristic of the Carpathian Basin. The topographical lot numbers of all of the areas qualifying as Ramsar sites in Hungary are announced in a ministerial decree by the Minister of Rural Development in office at the time of such announcement. At an international level Ramsar sites are categorized in 40 different wetland habitat types and/or combinations but in practice the following five large groups are distinguished: marine, river delta, lake, riparian and bog habitats. Man-made wetland habitats – such as fish ponds, crayfish ponds, agricultural ponds, salt ponds, water reservoirs, quarry ponds, sewage settling ponds and canals – are dealt with as a separate category. The most important objective of the Convention is to preserve wetland habitats and to sustainably utilize their resources in ways that do not interfere with their ecological nature. The signatory countries are required to fulfil basic obligations, the most important of which is to designate at least one wetland habitat to be added to the Ramsar List. At present the list contains nearly 2200 wetland habitats of a total area exceeding 208 million hectares. [5]

3 World Wide Fund for Nature
4 International Union for Conversation of Nature and Natural Resources

Nature Conservation in Hungary

According to the IUCN's definition a national park is an area whose ecological integrity must be preserved, an area that needs to be protected from any form of agricultural or industrial utilization, where educational and recreational activities must also be enabled to the extent possible, in addition to scientific research. It was in the United States of America that an area – the Yosemite Valley – was placed under state protection for the first time in the world but the first "real" national park was created by establishing the Yellowstone National Park in 1872. The first national parks in Europe were established in the early 20th century. The European Day of National Parks is celebrated every year on 24th May. In Hungary the Hortobágy National Park was established with effect from 1st January, 1973, by the No. 1850/1972 [21] and 1851/1972 resolutions of the National Nature Conservation Agency [22] (Hungarian acronym: Országos Természetvédelmi Hivatal – OTvH). Since then, the number of our national parks has increased to ten. The last one established so far is the Őrség National Park. Hungary's national parks are managed by Directorates whose operations are regulated by Government Decree 347/2006 (XII. 23.) on the designation of bodies performing tasks of authorities and administrative tasks relating to environmental protection, nature conservation, water management. [23] The areas covered by the competence of the various Directorates comprise not only national parks but also other landscape protection areas which are also managed by the Directorates. Hungary's national parks are summed up in brief in Table 1 below.

Table 1. National parks in Hungary. [6]

Name (year of foundation)	Area	Location	Other	Wetland ecosystems
Hortobágy National Park (1972)	80,549 ha, of which 1285 ha is strictly protected	Great Plain – Trans-Tiszania	The first and largest national park in Hungary. The largest salt area in Central Europe. An area of 75,000 hectares is part of the UNESCO World Heritage since 1999.	Hortobágy Fish Pond and Lake Tisza, a number of marshland areas Ramsar site 22,000 ha
Kiskunság National Park (1974)	56,761 ha, of which 12,457 ha is strictly protected	Great Plain – Duna-Tisza interfluve	Comprising 9 separate units, the whole area is a biosphere reserve	Lake Kolon, Tisza valley. Their wetland ecosystems and Ramsar sites

Name (year of foundation)	Area	Location	Other	Wetland ecosystems
Bükk National Park (1976)	43,130 ha, of which 3774 ha is strictly protected	North Hungary Mountains		Szalajka-valley and its region.
Aggtelek National Park (1985)	19,892 ha, of which 3922 ha is strictly protected	North Hungary Mountains	Part of the UNESCO World Heritage since 1995	Bodrogzug – a Ramsar site as well
Fertő-Hanság National Park (1991)	23,588 ha, 7492 ha of which is strictly protected	West Transdanubia – Small Plain		The whole area of Lake Fertő, Hanság
Duna-Dráva National Park (1996)	49,473 ha, of which 14,123 ha is strictly protected	South Transdanubia – along the rivers Danube and Dráva		Gemenc floodplain, Duna-Dráva riparian area
Balaton Uplands National Park (1997)	56,998 ha, of which 11,134 ha is strictly protected	Central and West Transdanubia, north of Lake Balaton and Lake Kis-Balaton		Balaton Uplands karst formations, Lake Balaton and the Kis-Balaton wetland habitat, canals
Duna-Ipoly National Park (1997)	60,314 ha, of which 16,119 ha is strictly protected	North of Budapest between the rivers Danube and Ipoly, Pilis and Börzsöny mountains, Danube Bend and the Szentendre Island	One of Hungary's national parks with the richest wildlife	Rivers, Lake Velence
Körös-Maros National Park (1997)	50,134 ha, of which 6411 ha is strictly protected	Great Plain – between the rivers Körös, Maros and Tisza		Rivers, flood plains, canals
Őrség National Park (2002)	43,933 ha	West Transdanubia – Vas county		Smaller rivers, lakes, fens/bogs

The Various Types of Wetland Ecosystems

Rivers' Active Floodplains, Protected Floodplains and Riverbank Strips

The territory of Hungary is very rich in rivers; however, about 95% of our rivers come from outside Hungary's borders. Owing to its climate and the topography of the neighboring countries, floods are a common occurrence in Hungary. Flood protection practices date back centuries, while the history of accessing and using rivers is as old as humanity. Accordingly, most of our larger watercourses are accompanied by active floodplains (the area exposed to floods even with the protective structures in place) and protected floodplains (the areas that would be flooded without protective structures in place). The whole of the territory of Hungary is part of the Danube basin. The database produced by the Ministry of Environment Protection in 2002 lists 10 rivers in the Danube valley and 18 in the Tisza valley with sections along which flood protection embankments have been constructed. The most extensive active flood plains are to be found along the rivers Tisza (45,882 ha; 36%) and Danube (36,764 ha; 29%), i.e. some 65% of the total active floodplain area is formed along these two rivers. The rest of Hungary's rivers are accompanied by active floodplains of significantly smaller areas, e.g. about 5% of the total active floodplain area is to be found along each of the rivers Hármas-Körös and Bodrog, while 4% of the same is located along the river Dráva. This however, does not mean that they have a less important ecological value. [7]

Riverside strips and active floodplains – partly as a result of the sediment deposited by the rivers and more or less frequent inundations year after year – have come to be temporary or permanent homes to special flora and fauna. Such areas show unique topographic and hydrological features, providing breeding, feeding, migrating and resting ground for wildlife. Protected and active floodplains are also important in that they play a key role in the material exchange processes along the rivers (between the body of water and the gravel bed). The zone along the river functions as a kind of a nutrient trap, this strip can reduce the load of contaminants coming from the river basin and this is where the process of the river's self-purification takes place through organic materials' decomposition and plants' nutrient uptake. [7] These areas are typically exposed to little human activity, therefore they often provide near-natural habitats for wildlife. This relatively pristine condition and the nearly permanent presence of water contribute to the appearance and development of a succession of biocoenoses. Active floodplains are therefore extremely valuable from an ecological aspect and for the purposes of nature conservation. Indeed, some of them are actually under nature conservation protection. Active floodplains are characterized by high degrees of biodiversity. The importance of active floodplains from the aspect of nature conservation has been growing steadily during recent years because wetland habitats of former open floodplains have been significantly reduced by the regulation of watercourses, as a consequence of which their roles have actually been taken over by the active floodplains, as areas in which similar wildlife can evolve. Active floodplains are home to practically all biocoenoses, ranging from forests, through meadows to peat and marshland type areas. Consequently, they are very important not only for nature conservation but also as areas used for agricultural production or forest farming. On the other hand, it should also be noted that the primary function of active floodplains is to provide for flood protection by safely channeling increased amounts of water down when rivers rise.

Hungary has an outstanding number of protected areas in active floodplains. In the territory of the Körös-Maros National Park nearly the entire floodplain of the river Maros – right from where it enters the territory of Hungary to where it flows into the river Tisza – is under some degree of protection. At the same time, it also has a section under cross-border – that is, international – protection, such as the area called Maros Naturpark at the town of Pécska, one of the most important parts of which is the Makó-Landor Forest. The active floodplain along the river Körös, that is also to be found in this area, is different from the aforementioned sites in that its current appearance is more of a result of human activities. The Tiszatelek-Tiszabercel Floodplain Nature Reserve was declared protected as early as in 1973. Through the integration of an area near Gávavencsellő its size was increased later on to 1263 hectares. The Tiszadob Floodplain area – also over 1000 hectares – was also among the first sites to be brought under protection.

Some rivers also have sections referred to as continental deltas. Such areas appear where rivers reach a plain area and break up into a varied and complicated system of branches, depositing their load and then after a while the branches reunite in the main river bed. [7] Such a continental delta is formed by the river Danube in Hungary in the regions called Szigetköz and Csallóköz, as well as at Gemenc, where it has built gravel layers up to 7 meters deep in some places. In addition to extremely widely varied habitats such a thick gravel bed in these continental deltas enhances the river's "self-purification" function and it also contributes to the cleaning of the water to be extracted from aquifers along the river.

Stagnant Waters, Bogs, Marshlands and Areas Covered by Reeds

Stagnant waters are water bodies with little or no natural discharge. Most of the waters belonging to this category are lakes and ponds. Their characteristics and status are determined by the purity and sediment load of the waters discharging into them. Depending on the degree to which it has filled up with sediment such a water body may be a lake, a morass, a marsh or a bog. Some have evolved naturally, others are man-made. [8] Such water bodies include, among others: Lake Héviz, the Tapolca Lake Cave, Lake Kis-Balaton in the Balaton Uplands National Park, Rétszilas Lakes in the territory of the Duna-Ipoly National Park, Lake Vaja and Lake Mohos of Kállósemjén in the Hortobágy National Park, Lake Baláta (which is also a Ramsar site) and Lakes Pacsmag in the Duna-Dráva National Park, Lake Szelíd in the Kiskunsági National Park. In the Aggtelek National Park – owing to the karstic surface – there are primarily dolines (sinkholes) and artificial lakes that are not under protection in themselves. In the Bükk National Park, despite its name, Lake Nyírjes is more of a bog; therefore it is listed in that category. The Hungarian part of the morass called Lake Fertő, taking up much of the area of the Fertő-Hanság National Park, has little open water surface, yet it needs to be listed here at this point.

Mention should also be made of what are referred to as "wetlands" since they can be regarded as clearly distinct water bodies. The Ramsar definition of a wetland is as follows "*areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters.*" [5] This definition applies to fresh, brackish and salt waters, indeed, even coral reefs (since the Ramsar Convention was aimed primarily at identifying waterfowl habitats). [5] For this reason, for practical applica-

tion in Hungary wetlands are defined as natural units in which the average depth of water relative to the surface does not – at times of "medium" water level – exceed two meters. (Where the average water depth is over 2 meters, those parts of the given water body in which at least a third of the surface is covered or accompanied by macro-vegetation – pondweed, and/or marshland and/or specifically foreshore vegetation [standing – in part or in full – in water] qualify as wetlands.) [5] This category also comprises natural units with such hydromorphic soils whose top layer is saturated by water permanently or for much of the time and which are therefore characterized by vegetation typically comprising plants of high water requirements or those tolerating the presence of abundant water (reed beds, rich fens, marsh meadows, marsh plant communities, mud vegetation, sand/gravel bar vegetation, vegetations of wet alkaline areas and those of dry salty patches, moor forests and marsh woodlands, willow shrubs, soft and hardwood gallery woods, ash-alder woodlands), and/or their clearly recognizable residues. Wetlands appear in a wide variety of forms, not only in along and near rivers, lakes and seas but also at greater distances, in areas identified as subsiding depressions. In terms of their positions in the landscape, the following four categories of such areas are distinguished:

- bogs,
- marshlands,
- protected/active floodplains,
- the associated wetland habitats.

Bogs are permanent shallow stagnant endorheic water bodies (without discharge), dominated by oxygen scarcity or anaerobic conditions. Such areas are characterized by the build-up of peat because dead parts of plants can only decompose through rotting. The decomposition of organic materials entails the production of reduced compounds (e.g. methane, Sulphur-hydrogen, in some cases phosphine. [9] Bogs are an indication of an advanced stage in the process whereby stagnant waters fill up with sediments, in which higher order aquatic plants have occupied a large part of the surface. Bogs and fens appear in a variety of different forms (e.g. spring bogs, rich fens, raised bogs, floating bogs). A nationwide survey carried out in 2000 by the Ministry of Environmental Protection registered nearly as many as 1000 bogs and fens in the areas of nine national park directorates (including those registered earlier). The most extensive bog and fen areas are to be found in the Transdanubia Region, near and south of Lake Balaton, on the western edge of the sand ridge between the rivers Danube and Tisza as well as in the Nyírség region. Bogs and fens show a heterogeneous distribution in Hungary. Unfortunately, more than a third of them are already in the form of moor forests and mire shrubs, which is a sign of an advanced age. Moreover, the increasingly frequent drought occurrences have been causing quality degradation as well, as a consequence of which signs of a decrease in their effectiveness in their filtering function have been appearing. [10]

Rich fens are supplied with water from groundwater and precipitation. In its final status in the process of filling up with sediments a rich fen may turn into a forest bog. One typical representative of this type is the one near the town of Dabas that is home to the Dabasi-Halász Arboretum, or the bog at the town of Ócsa with the Selyem-rét nature trail. In areas with a cooler climate peat-moss bogs (raised bogs) may build up, where more organic material is produced than is decomposed. Such bogs are also characterized by an accumulation of peat. This type is represented by Lake Nyírjes at the village of Sirok as well, but its most important example in Hungary is the fen meadow near the village of Szőce in the Őrség National Park.

Floating bogs can evolve in shallow lakes, meanders and oxbows, slowly flowing side-branches of rivers through a process whereby the reedbed spreading towards the water creates a complicated mesh, which – with the settling dust, pieces of vegetation and the like – comes to form a mat floating on the water after a while. This mat grows thicker over time and it is acidified by precipitation, turning into a habitat for rare and valuable species of narrow tolerance ranges. Such floating bogs are to be found on Lake Velence and the Ráckeve Danube branch. Floating bogs are crucially important since they can absorb and retain a large amount of pollutants and contaminants, as large amounts of water flow across and get filtered by the floating bog mats. Their very highly intensive metabolic processes render such floating bog mats suitable even for the treatment of certain types of wastewater. [7]

Marshes are distinguished from bogs by the flow/exchange of water and the absence of peat accumulation. A marsh is characterized by a typically unstable balance of water, sometimes going dry, or it may be a shallow stagnant body of water that is regularly flushed through, densely populated by higher order plants with open water surfaces of various sizes in between. The bottom of a marsh accumulates organic sediments going through what is a partly anaerobic decomposition process, producing reduced compounds (marsh gas: carbon-dioxide, methane, and hydrogen-sulphide). Marshes are significantly more sensitive than bogs and are easily destroyed by water pollution. Hungary's most important protected marsh is called Vörös-mocsár (Red Marsh) near the village of Császártöltés in the Kiskunság National Park. Lake Kolon is also located nearby, the most extensive marshland area in the Danube-Tisza Interfluve region. [11] Lake Kék near the town of Szeghalom in the area of the Körös-Maros National Park is, despite its name, in fact a marsh and after nearly 20 years of local protection it was brought under national protection in 2006.

Oxbows

Thanks to their favorable characteristics and conditions oxbows enable a variety of different landscape uses, therefore in addition to their importance from the aspect of nature conservation and landscape ecology they also play a key role in water management and recreation. From the perspective of water management oxbows perform an important role as flood reserves, drinking water basis reserves and surface water recipients. Areas to be found within active floodplains also contribute to channeling floodwaters downstream. The total amount of water stored in oxbows in Hungary is about 119.4 million m^3, 87.2 million m^3 of which is stored in oxbows in protected floodplains and 32.2 million m^3 is stored in oxbows in active floodplains. [12] Besides recreation and tourism, oxbows have recently been coming to be used for a variety of commercial purposes (fishing, waterfowl production, reed harvesting). Active floodplain and former floodplain areas along oxbows are highly productive areas also utilized by forestry and agriculture. The various forms of utilization and use are, however, causing a variety of problems for landscape protection and landscape use. As a consequence of the various forms of use and the resulting organic matter loads the processes of the silting up, ageing and contamination/pollution of oxbows have been accelerating. [12] Owing to eutrophication[5] and drying out they are listed among heavily endangered water bodies.

5 Water blooming. Eutrophication entails an accumulation of nutrients, leading to primary productive organisms, including phytoplankton, pondweeds anchored by roots along with marshland plant species. [26]

There are many oxbows in the territory of Hungary as a result of the natural shifts of riverbeds and the regulation of watercourses. Besides the term oxbow they are also referred to in Hungarian in terms translating into English as dead river beds, lakes etc. Some smaller river branches may turn into oxbows temporarily when at times of low water levels one end is or both ends get temporarily blocked. Oxbows are of importance primarily for direct use of water – such as irrigation – in areas along the former river banks, but they are also useful in storing water drained from waterlogged areas or as recipients of other water discharges. Direct use of the water surface (swimming, and other forms of recreational use) is also important and such forms of use also entail contamination. They are also highly important in temporarily storing and channeling off surplus water during floods. On the other hand, as they have been created by the large amount of sediments carried and deposited by rivers, water filtered through the layers of sediments may also be relied on as a reserve drinking water resource. Reedbeds along the shore also play an important filtering role in the case of older oxbows.

Hungary's most important protected oxbows: [13]

The oxbow called "*Verőce-szigeti Holt-Duna*" was created on the right side of the river Danube, in the upper end of Szentendre Island as a result of the watercourse regulation works carried out in 1952. The oxbow is 1.6 km in length, its average width is 100 meters, its total area is 16 hectares, its average depth is 1.5 m and its volume of water is 240,000 m^3. It has been under nature conservation protection since 1968. It has been significantly filled up and a coppice forest is now flourishing around it. It plays an important landscape forming role and it is also important from the aspect of nature conservation. A significant number of drinking water wells are also located near the oxbow, therefore no form or type of utilization is permitted in this area in order to protect the wells.

The lake called "*Morotva-tó*" near the village of Lipót in the Fertő-Hanság National Park is one of Hungary's strictly protected oxbows. It is heavily filled up with mud; its water level is regularly monitored and when necessary, it is topped up with water from the Danube. Since there is a thermal spa nearby, sport fishing in the lake and reed harvesting on its shores are permitted under certain restrictions.

There are a number of protected oxbows in the territory of the Duna-Dráva National Park, including those called "*Böki holtág*", "*Belső-Béda* and *Külső-Béda holtág*", "*Nyéki Holt-Duna*", "*Csertai Holt-Duna*", "*Kadia Ó-Duna*", "*Klágya Holt-Duna*", "*Kishobogyi-tó*" (making up, with a number of other lakes, the oxbow system called "*Cún-Szaporcai holtágrendszer*"). Some of these have been isolated from the river through natural processes; others were produced by watercourse regulation works. Most of them have been heavily filled up with mud and are overgrown with vegetation, but none of these affect the drinking water aquifers, therefore they can be utilized for a variety of purposes. Based on permits issued by the water management authorities concerned they are used for storing water drained from waterlogged areas, and for sport fishing. They also play a significant role in landscape forming and nature conservation. The quality of the water in these lakes deteriorates heavily during dry spells. This is accompanied by drops in the levels of dissolved oxygen, decimating their fish populations. The rehabilitation of these lakes got underway in the 1990s after being brought under protection and their water retention is now controlled by weirs and locks.

Canals and the Land along their Banks

Canals are artificial structures, constructed for purposes of hydraulic engineering and/or water regulation, including the drainage of waterlogged areas, supply of water for irrigation or for industrial purposes, controlling water levels in other water bodies, or, less frequently, for wastewater removal or enabling inland navigation. They play an indirect role in the maintenance of the quality of water since their purposes include – among others – the removal of water that could have an adverse impact on water aquifers or other water resources. Canals that are sometimes referred to as "cut-through", connect rivers or river sections. The importance of canals lies primarily in the vegetation thriving alongside their banks. The original flora and fauna managed to survive in some places along canals constructed in order to drain marshlands or bogs. Although there are protected canals as well in Hungary, in most cases rather than a complete canal it is only a short section or the area alongside a canal that is under protection. In some cases the canal concerned marks the boundary of a given nature conservation area. Nádor canal in the area of the Balaton Uplands National Park, for instance, comprises a number of such areas. Its 37–88 river km section is home to the "Sárvíz-völgye" Landscape Protection District and the "Rétszilasi-tavak" Nature Conservation Area. There are strictly protected Ramsar sites along both sides of the Dinnyés-Kajtor Canal that removes the surplus water from Lake Velence. [14] One part of the boundaries of the nature conservation area south of Lake Tisza is also marked by a canal (Canal V or Aranyosi). Zádor-bridge and its neighborhood in the area of the Hortobágy National Park is crossed by numerous canals that are not under protection in themselves but are the habitats and nesting places of a variety of protected water fowls and other birds, including the great white egret *(Egretta alba)*, the grey heron *(Ardea cinerea)* and the collared pratincole *(Glareola pratincola)* among others, while in years of more abundant precipitation the canal called Karcagi I is home to the European pond turtle *(Emys orbicularis)*.

Possibilities for Economic Utilization of Wetland Habitats and the Associated Problems in the Light of Nature Conservation

Wetland habitats are among the most effective and efficient ecosystems in the East-Central European region. Our ancestors used these areas as hayfields and pastures, they harvested reeds, willow sprouts and wood. Wetlands were also excellent for hunting and fishing. Nature conservationists argue that these areas were drained and converted into agricultural land exclusively in order to boost agricultural output, but in some areas water levels subsided as a consequence of water management interventions. This negative trend is still apparent even today, despite the availability of techniques supporting wetland habitats besides enabling their utilization for economic purposes in suitable ways.

Reedbed Management

Water Quality Improved by Reedbeds' Filtering Function

The reed zone – or littoral zone – is one of the most important vegetation zones in various wetland habitats, forming a transition between dry land and water, functioning as a buffer

zone protecting surface water resources from certain contaminants and pollutants, external stress and anthropogenic impacts in general, coming from the dry land. Its complex fauna and flora is a venue of complicated feeding processes where all sorts of material flows and exchanges take place, ranging from the production to the consumption and from the decomposition to the accumulation of organic matter. [15] With a view to the role played by reeds, legislation had already been adopted even before the introduction of the WFD, to regulate the surveying, assessment and rating of reed lands. Government Decree 120/1999. (VIII. 6.) [24] on tasks relating to the maintenance of water bodies and public water facilities prescribes that owners of water bodies and river or lake beds must provide for the rating of reed beds to be found in their areas on the basis of water quality protection and shore/bank protection considerations, for the categorization of the areas concerned on the basis of such rating, as well as for the repeated performance of such rating and categorization once every five years. In addition to their water filtering function, reeds also play a major role in shaping the landscape, as well as in nature conservation, as they are home to a wide range of wetland and aquatic biocoenoses including animals ranging from invertebrate to vertebrate species.

The largest single reed-covered area in Central Europe is to be found in and around Lake Fertő, taking up some 7000 hectares of land in the Fertő-Hanság National Park. Large areas covered by reeds are also to be found along the northern shoreline of Lake Balaton in the Balaton Uplands National Park, around Lake Kis-Balaton and Lake Velence and in the Hortobágy National Park, for example in the Kisköre water reservoir. The total area of reed lands under protection is some 12,500 hectares, accounting for 2 percent of the total area of land under protection in Hungary.

Complications Relating to Reed Harvesting

Reedbeds are aquatic communities in a certain stage of the natural process called succession,[6] therefore their survival requires human intervention. [16] Careful management contributes to the maintenance of heterogeneous mosaic-like reed-covered areas. Adequately planned intervention may ensure the maintenance of a heterogeneous pattern in a given reed-covered area, including wet and dry patches, resembling a natural status to support wildlife and water-borne organizations, along with areas of homogeneous reed populations where reeds can be harvested in line with economic interests.

Reed scything used to be a traditional branch of farming in watery areas in Hungary. In winters when the soil froze over, reeds used for thatching roofs and for putting up fences were broken off manually. The utilization of reed-covered areas, that is reed harvesting, is one of the least intensive forms of land use.[7] In terms of land use categories Hungary has about 40,000 hectares of reed lands [17] but together with reed-covered parts of uncultivated natural water bodies the total area of reed lands in Hungary is about twice as large. Since it is indispensable that efforts be made to decelerate the process of the ageing of reed populations and eutrophication of water bodies, reeds should be harvested wherever possible. In

6 An ecological process whereby biocoenoses go through a series of transformations in space and time. Its result is a decrease in the likelihood of the survival of the given biocoenoses, facilitating the transit into the next stage. The direction of the series of changes is determined, from pioneer plant communities towards a climax community through various steps. [27]

7 A form of land use based on existing conditions and resources, without the application of fertilizers, without sowing seeds etc. In the case of reeds this involves only the cutting of the latest growth.

addition to its environmental advantages, reed harvesting also yields economic benefits. The removal of ageing reeds – i.e. part of the biomass output – contributes to the creation of more heterogeneous reed communities that are more favorable habitats for a variety of species (even if homogeneous reed lands are more favorable for reed harvesting). Heterogeneous reed communities are broken by canals, inlets and clearings in which newly sprouting reeds can develop vigorously.

Cutting reeds is that particular method of reed treatment whereby the plant's upper part over the water surface – stalk and seeds/flower – is removed. [18] There are two distinct harvesting times: summer and winter. Winter harvest is more advantageous for both wildlife and the quality of reed that is to be used for various purposes, while cutting reeds in the summer makes the vegetation of a reed-covered area more widely varied. Winter harvest removes the reeds' already dead, dry parts, which is favorable for the plant itself since it removes dead foliage, slowing down the process of succession, enabling also the maintenance of the dominance of reeds in the area concerned. Cutting in the summer removes fresh green reed stalks, giving room for plant species that do not grow that tall, enabling the growth of vegetation of a more varied composition and contributing to the maintenance of open water surfaces as well.

Reed is harvested in Hungary with special machines, for the most part in winter. Nature conservationists tend to heavily criticize the use of such machines, since even the machines themselves pollute the environment and when harvesting is carried out when the ground is not frozen, the machines damage the plants, preventing their re-growth. Mechanized harvesting facilitates the development of homogeneous reed populations, whereas heterogeneous plant communities are more favorable for the purposes of nature conservation, therefore manual harvesting would be more favorable from this aspect. Another problem is that the harvesting of reeds of lower quality is not economically profitable but neglecting such reeds leads to further deterioration of its quality. Fortunately, lower quality reed is suitable for use in facilities generating energy from biomass. High quality reed is used for thatching roofs and for producing reed panels.

Delayed harvesting entails a variety of problems from the aspect of nature conservation: late harvest destroys the buds from which the next year's shoots should sprout out in the spring and this practice also threatens the young of animal species living in such habitats. When the reed is not harvested in time, it is often burned down instead, which can also cause severe damage. While reed farmers argue that reed may be harvested even until the appearance of several inch-long reed shoots, conservationists hold that from the aspect of animal species whose reproduction takes place early in the year (e.g. greylag goose *[Answer anser]*) harvesting should be stopped in the middle of February already. This would be particularly important partly in order to prevent the destruction of the actual habitats and nesting places as well as to avoid scaring animals and birds away even from adjacent areas by the disturbance in the area being harvested. For this reason, one basic principle laid down by nature conservationists is that no reed farming activities (harvesting or burning) should be carried out in areas of reed management after the 15th of February. [18]

In addition to the timing of reed harvesting problems are caused for nature conservation by its frequency, the sizes of the areas concerned and the techniques of reed management. Homogeneous reed areas that are favorable for economical reed harvests require one-year – but not more than two-year – harvest cycles, because such reeds do not need to go through a thorough selection process. Such short harvest cycles are, however, favorable only for

highly tolerant animal species, therefore they are objected to by nature conservation. The least expensive method for the rejuvenation of aged and fully heterogeneous reed communities is burning. One additional problem with burning is that neither the edges, nor smaller reed-covered patches of land are treated at the same time, i.e. such areas tend to be neglected. Moreover, the chemicals applied to control weeds and pathogens are also unwelcome from the aspect of nature conservation.

The most important factors for reed-covered areas include hydrological conditions, which however, are nearly always ignored in planning reed harvesting activities. Local water management authorities should be involved in the planning of the management of larger reed-covered areas (over 1 hectare or so), because they can provide information on the prevailing water supply possibilities in order to determine the required balance. Reed management practices, that provide for sustainability and that are aligned to environmental considerations as well, should be developed in order to preserve natural values, heterogeneity, and the diversity of species and the complexity of habitats.

Fish Management

The Importance of Fish Management

The history of fishing is as long as that of humankind. Selective fishing of a reasonable intensity could be compensated for in early times by the extremely vigorous reproduction potential of fish species. To provide food supplies and to improve living standards man tends to overuse the land on which he lives, often disregarding the effects of man-made changes on diversity and habitats. The same applies to wetland habitats. Pollution, and the increase in the nutrient contents of water bodies, together with waterbed regulation, are among the most severe human interventions as a consequence of which the productivity of certain types of water bodies may grow to extreme levels, having negative impacts on more sensitive fish species (in contrast to which less exacting species proliferate).

Until the middle of the 19th century more than two million hectares of land was – permanently or periodically – covered by water in Hungary. Water was removed from most of those areas by land drainage or watercourse regulation, eliminating much of the wildlife that is dependent on water bodies or wetland habitats, while several species (such as the pelican) disappeared altogether. Hungary's rivers are characterized by a relatively high level of heterogeneity in terms of species, in contrast to natural lakes that are more homogeneous in this regard. [18] The construction of artificial fish ponds could and can only partly balance this process by creating favorable conditions for certain endangered species. Many of the existing fish ponds were created in the place of natural lakes or marshlands or in areas of wet and dry grasslands, which facilitated their population with a wide variety of species. Man-made fish ponds are also important in that economic activities provide for the survival of the wetland habitats often concentrating far larger amounts of biomass than in natural water bodies, particularly because most of these fish farms comprise not one pond but entire systems of ponds, including extensive canal and/or embankment systems. Reeds and typha communities and marshland vegetation along the edges of ponds are of importance not only for biodiversity but they also contribute to filtering and thereby to improving the quality of the waters concerned. [18]

Fish Management and Nature Conservation

Fishing and fish management is an economic segment almost without any conflict between the interests of economic participants and nature conservation, since the creation and maintenance of a suitable habitat entails water quality protection, the maintenance and improvement of the status of wetland habitats, the creation of near-natural conditions and the prevention of the shrinking of biodiversity. Fish pond management and fishing enable the settlement and presence of certain natural values in fish ponds. Therefore, while the operation of fish ponds is a source of livelihood for some people, fish ponds also help conservationists in their efforts aimed at maintaining aquatic habitats, as the key principle is that fish are the most important and most advanced water-borne animals, playing a key regulatory role in the aquatic habitat. The maintenance of the diversity of species is also in the interest of both fish farmers and conservationists.

One of the negative features of fish farming results from fish production practices. Before the productive season pond owners can boost the natural productivity of their ponds with farmyard manure [16] or some diluted form of manure. In some intensive fish farming systems even chemical fertilizers are added in small (100–200 kg/ha) doses. Though the quality of water in fish ponds has been found by certain tests and measurements 1–2 months after the termination of the addition of manure or fertilizers to be better than the original quality of the water – owing to nutrient management processes (through intensive hydro-biological processes nearly 100% of the added nutrients is utilized) – conservationists still have reservations concerning such practices.

More serious conflicts are caused by the treatment of the reed patches along the edges of the ponds. Although reedbeds also protect fish spawning grounds, fish pond owners – based on considerations of economic efficiency – make efforts to reduce the areas covered by reed, endangering the habitats of birds nesting there. Both sides agree, however, that in combating eutrophication there is a need for removing some of the reed, even if not in the form of reed harvesting. Fish pond management also involves draining and refilling the ponds, which is another practice endangering bird nesting places. Once drained, the pond's bed is often treated with lime, partly to eliminate unwanted fish species – often referred to as "garbage fish"[8] – remaining after the harvesting of the fish being produced and partly in order to disinfect the pond bed and improve the productivity of the water. [16] This technique is hardly justifiable from the aspect of nature conservation because the water remaining in the pond after it is drained is also home to a large quantity of protected fish species *(Cobitidae)* besides garbage fish, while other animal species that are dependent on water also seek shelter in the water remaining in the pond, and the application of lime causes severe damage to such animals as well.

Another set of problems for nature conservation is associated with fish species introduced to waters in Hungary from abroad. Such species are regarded as biological "contaminants" of ecosystems and they threaten indigenous biocoenoses because they reduce their reproductive potential or cause genetic degradation and in some cases they simply compete with and defeat indigenous species. [18] Even conservationists do not, however, dispute the advantages of the introduction of certain carefully chosen species. The fish called grass carp (Cteno-

8 Inferior species of fish that are too sensitive and difficult to transport, containing too many fish bones, fish that are not very tasty or those that cause a lot of damage, i.e. fish of little or no economic value, e.g. crucian carp. [28]

pharyngodon idella) for instance, is not indigenous in Hungary but it feeds on vegetation (macrophytes and pondweed), thereby slowing down the eutrophication process. Another such example is the introduction of the eel (Anguilla anguilla) (which is, by the way, indigenous in Hungary), as eels feed on bentic[9] organisms whereby they have a positive impact just like grass carps. Its over-population however, may also cause problems as it starts competing for food with other fish species.

Floodplain Farming

The meaning of the term floodplain farming (management) has still not been fully clarified. This term is applied in this paper to landscape use in floodplains and the utilization of floodplains. Even the origins and the history of floodplain farming are unclear, since it means not only agricultural production on millions of hectares of arable land created by the regulation of watercourses. Natural processes in rivers enabled certain fish species to find spawning grounds in flooded areas, so floodplains were important fishing areas. Floodplain forests also played an important role in water management. They were also used grazing lands and were important sites of fruit breeding. [18] Accordingly, floodplains gave rise to a wide variety of farming systems. Since however, by the turn of the 18th–19th century watercourses in Hungary had undergone regulatory interventions to let floodwaters pass downstream as quickly as possible, riverbeds became shorter, their water was trapped between embankments, floodplains were reduced and traditional floodplain farming and management techniques disappeared. Today a variety of efforts are being made to restore floodplain farming practices. Activities the like of the traditional floodplain farming techniques that prevailed for centuries are being carried out at present only in the Gemenc region of the Danube-Dráva National Park, the reason for which is that the area that used to belong to the Archbishopric of Kalocsa did not join the association set up to eliminate floods therefore the village was not protected by embankments.

The National Agro-environment Protection Programme is aimed at determining in a variety of ways – based on the Vásárhelyi Plan – where and how floodplain farming could be reintroduced in Hungary. Nature conservationists have serious reservations about the reintroduction of floodplain farming because quite a number of floodplain areas have been designated as nature conservation areas of national significance or as sensitive natural areas, therefore any economic use of such areas requires extensive and thorough prior consultations in regard to economic, development and utilization considerations. [17] Indeed, owing to the heavily regulated rivers an entirely new type of landscape and system of values should be developed. Since land use is aligned to inundation, only cropping without the use of chemicals may be permitted not only in sensitive areas but in all such areas. Also, in the case of utilization as grazing land, excessive quantities of manure must be prevented from being washed into water bodies. Another fact that must not be disregarded is what proportion of the floodplains will be used for emergency water storage, as that will be incompatible with any farming activity and may even cause serious damage in protected areas. Accordingly, only such options may be feasible when it comes to floodplain farming that are worked out with a view to considerations of national security, flood protection, farming, nature conservation and regional employment, social and welfare.

9 Living on the bottom of the water body.

Conclusion

It is not only within the scope of nature conservation and particularly in the areas of wetland ecosystems that professional and commercial considerations, viewpoints and local interests – in the case of wetlands and floodplains: business vs. nature conservation considerations – are contrary to one another and stakeholders pursue different and in many cases conflicting objectives. Centuries of farming and other economic activities based on water resources and the experience built up in the meantime, along with the problems caused by watercourse regulation that are still being faced, as well as the relatively new efforts aimed at protecting natural values and results already achieved, show that there is a need for a much more thorough and much closer coordination and harmonization of different areas, and for a more detailed elaboration of different points of view. As a possible solution I suggest that although representatives of different sectors strive to have their own requirements met, a number of points should be identified, in which justified restrictive and protective measures need to be enforced in order to protect the most crucial interests for the purposes of nature conservation and water resource protection and ultimately our own sustainable existence. As for conflicts between farming and other forms of economic utilization as well as nature conservation, it should be noted that economic considerations may appear to be more profitable in the short run, intensive interventions may cause serious damage to wetland ecosystems which will lead to a need for even more costly interventions in a longer run. Although a number of farmers have already recognized that sustainable farming and development is not possible without the coordination of certain farming methods with the prevailing environmental elements, practical implementation is still causing a variety of conflicts.

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