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PhD thesis

CHANGES IN ECOLOGICAL STATE OF WETLANDS OF INTERNATIONAL IMPORTANCE OF HUNGARY

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SUBJECT JUSTIFICATION

The oldest modern international treaty, the Convention on Wetlands of International Importance especially as Waterfowl Habitat, was signed four decades ago. The treaty imposes a number of obligations for parties which – if implemented – could ensure the sustainability of biological diversity connected to wetland ecosystems and, eventually, for human populations, too. At the time of their adoption, these provisions were ahead of their time in terms of the wise use concept.

Due to the accelerated landscape conversions in the mid-20th-century, as well as the effects of global climate change, wetlands became the most threatened ecosystems in the world. This is even more valid for the Carpathian Basin, where local precipitation and water inflow are more and more unpredictable creating huge areas which may be covered by water on one occasion while later becoming semiarid.

PROBLEM DESCRIPTION

Through its 40 years of history, there has been a significant change in the general scope, operation and objectives of the convention. This was created partly by the newly emerging and developing science of conservation biology, as well as by the accelerating degradation of biological diversity. Recognizing the alarming rate of biodiversity loss, during the 1970s and 1980s countries around the world began to draw up and sign a series of international conventions. In 1992, the convention on biological diversity was accepted as the widest legal instrument in international legislation. However, it was quickly concluded that the ambitious commitments were rarely implemented. This led to demands for a system of indicators and reporting mechanisms which make it possible to measure the compliance of the various obligations engaged by each of the countries.

The overall aim of the dissertation is to review the changes in the ecological characters of wetlands of international importance in relation to the effectiveness of implemented measures.

GOALS

The author asked the following questions in the dissertation.

1. How could the designation of a site of the list of wetlands of international importance contribute to conserve its natural assets and ecological state? Does the designation of a site have a positive or negative impact on its ecological state? What management measures should be implemented in light of the occurred or ongoing changes?

2. What type of changes occurred in the ecological state? What are the reasons behind the ecological changes?

3. What is the situation regarding the state of naturalness and nature conservation of the wetlands of international importance? How do these relate to other wetlands not designated as being of international importance? Is there a relationship between the criteria of designation and the naturalness of the sites?

4. How and to what extent are wetlands of international importance used in Hungary? What are the influences of such use on the ecological character of wetlands?

MATERIAL AND METHODS

The author has done the following analysis for answering the above-mentioned questions:
Basic characteristics (geographical, typological, biotic and non-biotic factors) of wetland sites have been defined, and a national overview is provided. Changes of waterbird populations of wetlands of international importance between 1996 and 2009 were determined and analysed based on data from the Hungarian Waterfowl Monitoring. To supplement this database, archive data of waterbird populations between 1984 and 2009 was collected and analysed from the Kardoskúti Fehértó Ramsar Site. An evaluation system was developed to rank the naturalness and nature conservation status of wetlands of international importance based on biotic and non-biotic data. Present threats to wetlands were identified and compared to those at the date of designation.

RESULTS

The significant waterbird population trends, changes in threats and land use and the position in the naturalness ranking system have been evaluated jointly for each wetland site.

Lake Balaton
Though waterbird monitoring has been carried out in the two bays of the site that are important for waterbird migration, three significant decreases of waterbird populations were detected, while only the population of Great Cormorants increased. The number of waterbird species increased, but the total population decreased in the period analysed. The lake has had Ramsar status for 20 years, and although it is fully state owned, threats almost doubled between 1999 and 2009. Designated originally as a temporary Ramsar site (between Oct. 1 and Apr. 30) along with the Tata lakes, it was later concluded that the temporary designation was senseless. The whole site was designated as a Natura 2000 site in 2004, which made its temporary Ramsar status pointless. Because of its economic potential, the lake is considered a national treasure, but the strengthening of the legal status of nature conservation is an utmost priority because the lake's economic development is done at the expense of its natural assets. The lake was ranked in 15th place in the naturalness ranking system, a surprising result taking into account the complex and intense uses of the site. It was ranked in last place in the ranking according to habitat type group, which is more reasonable result. The ecological state of the lake has not changed and no processes took place which could have a negative effect on the site. Water quality of the site has improved, while water quantity is balanced. On the other hand, threats have increased and there is a growing demand to use the lake more intensively. Without nature conservation management, Ramsar status is an outstanding tool to halt overriding intentions for overuse.
Recommendations: The development of shore areas disrupted the connections to former marshy bays; therefore the restoration of these areas is a requisite for the improvement of the ecological state.

Béda-Karapancsa
The number of observed waterbird species has significantly increased, despite an overall decrease in the waterbird populations. The population of the Bean Goose fell drastically, similarly to that of the Tufted Duck. The site has had Ramsar status for 16 years and the magnitude of the threats has decreased. The floodplain was ranked 7th in naturalness and 2nd according to habitat type group. The wetland is mostly state owned but managed by a forestry company and nature conservation management is in place in just a small part of the site. This poses a risk for its conservation. Together with the Gemenc Ramsar site, a significant reconstruction project was launched. All in all, the ecological state of the lake has improved.

Recommendations: one of the main problems is that the Ramsar site is managed by a forestry company, which creates conflicts with the national park. The substitution of present land uses (forestry, hunting) for more prosperous uses (e.g. ecotourism) would also be very important.

Biharugrai-halastavak

Evaluating the wetland's waterbird stocks, we observed that the populations of six species are expanding. The number of species observed has also increased, while the total number of waterbirds is stagnant. The area was designated a Ramsar site 12 years ago and the magnitude of risk factors is unchanged since then. The floodplain was ranked 27th in naturalness and 3rd in its habitat group. The site is mostly state-owned and parts of the fish pond are managed by one of the largest civic organizations, which is a guarantee of conservation efforts. The rising waterbird stocks may be a consequence of the site's nature-friendly management. The ecological quality of the wetland has improved.

Recommendations: The ponds and their infrastructure are in need of thorough renovation. This endangers the effectiveness of the nature conservation factors. The increase of habitat mosaic patterns could significantly improve the diversity of the area.

Dinnyés-Fertő és Velencei Madárrezervátum

Populations of three waterbirds are expanding, while two species are decreasing. The number of species observed is expanding, while the total number of species is decreasing. The site was designated a Ramsar site 30 years ago and the magnitude of risk factors is rising mainly because of infrastructure development connected to more intensive touristic use. The floodplain was ranked 31st in naturalness and 10th in its habitat group (saline pools and grasslands). The site is mostly state-owned and managed by the national park, which implemented a 300-hectare wetland reconstruction project. The ecological state of the wetland is stagnant, thanks to legislation and nature conservation management. Without conservation efforts, it is likely that the ecosystem of the site could have undergone a degradation process because of the high economic potential of the wetland.

Recommendations: raising awareness of the natural values of the wetland is vital for decision-makers at local and regional levels. Livestock should be used more intensively to manage grasslands and reedbeds to increase diversity and to create more feeding and resting areas for waterbirds.

Fertő

The population of Whitefronts is expanding, while one species is decreasing. The number of species observed is expanding, while the total number of species is decreasing. The site was designated a Ramsar site 20 years ago and the magnitude of risk factors is decreasing, perhaps because of the peripheral location of the site and strong nature conservation traditions. The site is mostly state-owned and managed by the national park. The floodplain was ranked 32nd in naturalness and 11th in its habitat group (saline pools and grasslands). The reasons behind this may be the site's homogenous and dominant reedbeds. The ecological state of the wetland is improving, which is a result of active nature conservation management and restoration measures (e.g. fishing is supervised by the national park).

Recommendations: the eradication of invasive species is a priority. Reed harvesting should be controlled more effectively by the national park. More mosaic habitats could increase the diversity of ecosystems.

Felső-Kiskunsági alkaline lakes

Based on long-term monitoring, the author observed expanding waterbird populations, although this can be probably traced back to the fact that water-related species from disappearing wetlands in the area seek refuge in the remaining, protected wetlands, which provide excellent habitats. The site was designated a Ramsar site 20 years ago and the risk factors of the site are decreasing.

The site is mostly state-owned and managed by the national park. The floodplain was ranked 12th in naturalness and 4th in its habitat group (saline pools and grasslands). The ecological state of the wetland is improving, due to strong and active nature conservation measures, and the implementation of various reconstruction projects.
Recommendations: Securing quality and quantity in the water supply is an essential issue for the site. Extensive grassland management by sheep and cattle should be maintained.

Gemenc
Based on data from long-term wild geese monitoring, two geese species with expanding populations were observed. The site was designated 12 years ago and the risk factors have been increasing since. Although the site is state owned, it is managed by a state-owned, profit-oriented forestry company. The floodplain was ranked 1st in naturalness and in its habitat group (floodplains), too. The reason for this is likely that the site is still a large, untouched remnant of the riverine floodplains habitat-complex hosting a significant number of rare species. Nevertheless, the ecological state of the wetland is stagnant, due to the ongoing large-scale wetland reconstruction projects and conservation efforts done by the national park.
Recommendations: A significant improvement of the ecological state could be achieved if the majority of the woodlands were managed in line with nature conservation guidelines. The large poplar plantations should be replaced by mixed native woods, creating a more diverse age structure and composition of the woodlands. To revitalise disconnected parts of the floodplain, more emphasis should be placed on gaining water supply from the Danube River.

Hortobágy
Based on the results of the waterbird monitoring project, we observed four increasing waterbird populations and one species with a decreasing population. The site was designated a Ramsar site 30 years ago and the risk factors have decreased significantly. The wetland is overwhelmingly state-owned and managed mainly by the national park. Conditions for waterbird population improved due to the implementation of reconstruction projects and because of active conservation management. The Kunkápolnás marsh (part of Hortobágy Ramsar site) was ranked 2nd in naturalness and 1st in its habitat group (saline pools and grasslands). The marsh system has the third largest untouched reedbed in Hungary and was part of a military field until 2004 with no other use. Based on the water depth, it has a mosaic of various habitats hosting a remarkable amount of threatened species. The saline grasslands of Hortobágy were ranked 5th in naturalness and 2nd in their habitat group. The Egyek-Pusztakócs marshes were ranked 8th (3rd in habitat group), while Hortobágy Halastó was ranked 19th (1st in its habitat group). In the past, the fishpond was used for commercial fish production, which was later adjusted according to conservation priorities. The overall ecological state of the Hortobágy is improving due to strong and active nature conservation measures.
Recommendations: Remnants of former intensive uses (agriculture, etc.) should be removed to increase water-retention, especially in spring. This could increase the number of species hosted by the site.

Kardoskúti Fehértó
Based on the results of the waterbird monitoring project, the author observed two increasing waterbird populations, in line with the trend of waterbird species in Central Hungary (Duna-Tisza köze) and Eastern Europe. Besides the fact that waterbird stocks expanded across Europe, it is likely that local conditions, such as increased spring precipitation between 1994 and 2001, also influenced the rise of waterbird populations (especially for Shoveler and Teal). The site was designated a Ramsar site 30 years ago and the risk factors have since been stagnant. The wetland is mostly state owned, managed mainly by the national park. However, areas outside the wetland suffered from significant human-induced factors (intensification of use, disturbance). Surprisingly, the site was ranked 20th (5th in habitat group) in naturalness, which can be explained

by the unpredictability of water levels due to dry periods. The ecological state of the wetland has improved due to the implementation of reconstruction projects and because of active conservation management efforts.
Recommendations: The provision of sufficient water in dry periods and increasing traditional grazing could significantly improve the ecosystem.

Kis-Balaton
Based on the results of the waterbird monitoring project, the author observed three increasing and four decreasing waterbird populations, while total number of waterbird stocks has also fallen. The site was designated a Ramsar site 30 years ago and the risk factors have decreased for several reasons. The site was ranked 3rd in naturalness and 1st in its habitat group. It was primarily managed by the water management agency and conservation priorities were enhanced only in the last decade. Drastic habitat degradation was observed between 1992 and 1996 when nutrient-rich water from the Zala River eradicated parts of the reedbed, which would have justified nomination to the Montreux Record. Since the continuous modifications due to the water purification project, nature conservation priorities have gained a firm hold and the change of the ecological state is slightly positive, but it cannot be evaluated since the project has not yet been completed.
Recommendations: The former mosaic of marsh-reedbed-sedge should be saved and expanded during the final stage of the water purification project.

Pusztaszer
Based on the results of the waterbird monitoring project, six decreasing and three increasing waterbird populations were observed. The number of observed waterbird species increased while total number of waterbird stocks has decreased. The site was designated a Ramsar site 30 years ago and it is predominantly privately-owned. Risk factors have increased especially in fishponds. The fishponds were ranked 23rd in naturalness and 28th in their habitat group, while the saline grasslands were ranked 25th (8th in its habitat group) and the floodplain part was ranked 39th (10th in its habitat group). Waterbird stocks became more diverse but have shrunk in the study period. The ecological state of the wetland has changed adversely. This could be explained by the lack of partnership between the national park and the land owners and users. Fishpond owners did not recognize the potential of the ponds' multiple possible uses, creating conflicts with nature conservation.
Recommendations: A change of management in fishponds and the increase of grazing livestock would improve the ecosystems.

Rétszilas Fishponds
Based on the results of the waterbird monitoring project, we observed five increasing and two decreasing waterbird populations, while the total number of waterbird species increased. The site was designated a Ramsar site 20 years ago and private ownership is dominant. The risk factors have been stagnant since then. The water level is a source of occasional conflict between the owners and the national park. The ponds are used not only for fish production but also for recreation (ecotourism, fishing), which are significant in terms of sustainability. The site was ranked 33rd in naturalness and 5th in its habitat group. The ecological state of the wetland has improved.
Recommendations: creating flooded areas where waterbirds can feed on less valuable fish would be a good solution for both the owners and the ecosystem.

Lakes by Tata
Based on the results of the waterbird monitoring project, we observed two increasing waterbird populations. The site is in a unique situation, because it was designated a nature reserve only at

the local, but not national, level, and designated a Ramsar site 20 years ago. The town almost completely surrounds the lake and there is a growing demand for various uses of the wetland. However, conservation of the wetland seems to be guaranteed by the community. The wetland is privately owned and the risk factors have decreased due to several reasons. The site was ranked 37th in naturalness and 5th in its habitat group, which can be explained by the proximity of the settlement. The ecological state of the wetland has improved.
Recommendations: More wetland reconstruction projects and the eradication of the adverse impact of fishing could significantly improve the ecosystem. Raising awareness is also a priority task.

Changes in the ecological state of the following sites cannot be evaluated because of the lack of long-term monitoring programmes, as such studies about waterbird populations or other indicator species would be needed for this purpose. Instead, the surveys carried out by the National Biodiversity Monitoring System could be used.

Baradla cave and related wetland
The subterranean wetland was designated a Ramsar site eight years ago. The risk factors increased, but the site is predominantly state-owned and managed actively by the national park. The site was ranked 6th, which can be attributed to its species richness. Due to the remote location, there is a low risk of large-scale development (industry, infrastructure), which is positive for the natural values. Tourism is likely to expand, but under the national park management policy.

Bodrog-zug
The site was designated a Ramsar site 20 years ago. Nature conservation management is dominant but risk factors have increased. It was ranked 18th in naturalness and 7th in its habitat group. Among the risk factors, the most important are those which either affect the management of natural habitats, like declining livestock grazing, or cause significant disturbances, like watersports. The replacement of poplar and other commercial woodlands with native forests is also a priority.

Borsodi Mezőség
The site was designated a Ramsar site 3 years ago. As a former floodplain of the Tisza River, the site is a mosaic of grasslands, marshes and ploughlands, owned mainly by the national park. It was ranked 35th in naturalness and was also near last place in its habitat group. The reconstruction of oxbows and marshes, as well as an increase in livestock (cattle and sheep) would improve the ecological state.

Csongrád-Bokrosi Sós-tó
The saline pools were designated a Ramsar site 6 years ago. The privately-owned wetland's ecological state is since unchanged. It was ranked 36th in naturalness. Ensuring the wetland's water supply is of heightened importance and should be resolved in the near future.

Felső-Kiskunság Alkaline Steppes
The saline grasslands were designated a Ramsar site 3 years ago and are owned and managed predominantly by the national park. It was ranked 9th in naturalness and 4th in its habitat group. Active nature conservation management, in addition to the proactive conservation efforts (e.g. restoration of grasslands, marshes) of some landowners resulted in the favourable conservation state of the wetland.

Felső-Tisza
The site was designated a Ramsar site 6 years ago and along with its Slovakian sector it became a trans-boundary wetland of international significance. The designation of the Ukrainian and Romanian sections of the Tisza River as a Ramsar site is under preparation. The wetland is predominantly privately owned and nature conservation management is present only in some areas. It was ranked 17th in naturalness and 6th in its habitat group. The risk factors have increased since the designation. Maintaining of the ecological state is a priority task of nature conservation. Because of its shared water catchment area, it is also an international obligation to improve the ecological state of the wetland.

Ipoly
The Hungarian section of the river was designated a Ramsar site 10 years ago. Together with the Slovakian sector (Poiplie), it is a trans-boundary wetland of international importance. It was ranked 26th in naturalness and last in its habitat group. This could be explained by 13 dams used to regulate the watercourse. The risk factors have decreased since the national park actively manages most of the site. Joint management could improve the ecological state of the wetland.

Lake Kolon
The site was designated a Ramsar site 12 years ago. The national park manages most of the wetland, expanding open water surfaces in the extensive marsh system. It was ranked 4th in naturalness and 2nd in its habitat group. Its naturalness, nature conservation management and the implementation of reconstruction projects make it possible to maintain the ecological state of the wetland. If dominance of reedbed could be reduced, the diversity of the site could be increased.

Mártély
The site was designated a Ramsar site 30 years ago. The wetland is predominantly state owned, but only a third of the total area is managed by the national park. Risk factors of the site have decreased. It was ranked 11th in naturalness and 4th in its habitat group. In line with the aims of the Ramsar Convention, the floodplain and oxbows are used for numerous purposes. Active nature conservation measures, however, are needed to maintain the ecological state.

Montág-puszta
A recently-designated Ramsar site, managed by the national park. It was ranked 22nd in naturalness and 7th in habitat group. Water retention in spring could significantly improve the ecological state of the wetland.

Nyirkai-Hany
As part of the Hanság marsh system, the area was reconstructed by the national park. It was ranked 13th in naturalness and 4th in habitat group. As vegetation and wildlife re-occupy the wetland, nature conservation measures should be applied accordingly.

Ócsa
The wooded marsh system was designated a Ramsar site 22 years ago. Managed by the national park, it was ranked 21st in naturalness and in last place in its habitat group. The surrounding region suffered from intensive gravel exploitation and peat extraction, resulting in the fall of underground water levels and the increase of risk factors. Because of this and the lack of reconstruction projects, there is a risk of negative changes to the ecological character.

Szaporcai Ó-Dráva meder
One of the oldest wetland sites, it was designated a Ramsar site 32 years ago. It is predominantly state-owned and managed by the national park. It was ranked 24th in naturalness and was last in

its habitat group. The main river has lost its direct connection to the oxbow, the ecosystem has changed and the heronry has disappeared. Risk factors have not changed since its designation. The state of the ecosystem can be improved by implementing a complex reconstruction project.

Pacsmag fishponds
The fishponds were designated a Ramsar site 12 years ago. It is partly privately-owned. Risk factors have decreased, but it was ranked 34th in naturalness and last in its habitat group. The fishponds are in need of reconstruction, when new habitat types could be created for improving ecological conditions.

Rába valley
One of the youngest Ramsar sites, it was designated three years ago. The site is predominantly privately owned and the national park manages just a few small areas of it. Therefore, it is difficult to implement conservation measures. Although the Rába River is one of the country's most natural watercourses, it was ranked 16th in naturalness and 5th in its habitat group. This could be explained by the various uses and the high level of disturbance. Traditional, extensive land uses could be encouraged. Maintenance of water quality has become an international issue with Austria.

CONCLUSIONS AND RECOMMENDATIONS

In this paper the author evaluated the ecological changes of wetlands in Hungary.
The role of the Ramsar designations in the conservation of ecological character was analysed in wetlands of international importance. For this reason, changes in the ecology of sites was evaluated taking into account risk factors, ownership structure and land use.

All Ramsar sites were ranked along with four similar wetlands not on the List of Ramsar sites according to naturalness and their state of conversation.

Results are in line with other habitat studies, confirming that the naturalness of wetlands is still high among habitat types and that the majority of most natural areas are wetlands. Ecological factors include six related to the ecosystem (species and habitats of community importance of Natura 2000 sites) and two related to the degradation of habitats.

Floodplains, oxbows and alkaline ponds and grasslands were awarded high marks, while fishponds were ranked last. National characteristics involve three factors (e.g. size, isolation), and conservation factors include four related to conservation or reconstruction measures. According to the ranking system, the most natural wetlands in Hungary are those located in floodplains. This group includes wetlands which were unregulated and influenced the least by humans (Rába, Felső-Tisza), but also sites where human-induced degradation can already be detected (Gemenc). The Szigetköz wetland was given a high ranking, reflecting that the negative impact of the habitat's relatively recent degradation has not yet reached the species level. The second most natural habitat types are natural ponds and marshes, followed by alkaline pools and grasslands. The author has further evaluated the ecological state of wetlands with the results of the long term monitoring of waterbird populations.

Since the date of designation, the ecological state has improved at four alkaline pools and a grassland wetland (the Fertő, Kardoskúti Fehértó and Felső-Kiskunsági alkaline pools as well as Hortobágy), one wetland related to floodplains (the Béda-Karapancsa Ramsar site) and three man-made wetlands (lakes by Tata, fishponds at Rétszilasi and Biharugra).
A negative change of ecological state was observed at one wetland, the Pusztaszer Ramsar site.
Stagnant ecological states were detected at the Lake Balaton and Gemenc Ramsar sites. Changes of ecological state could not be interpreted at the following Ramsar sites: Kis-Balaton and Velence and Dinnyés Ramsar sites.

The complex evaluation of changes in ecological character is rather difficult. In this paper, migrating waterbird population changes were used to verify the changes of other factors. But other factors and changes (e.g. populations of breeding waterbirds, or other birds or indicator species) could refine the final conclusions. Wetlands of international importance in Hungary provide optimal feeding, resting and wintering sites for massive stocks of waterbirds. The total number and number of species clearly indicate the quality of a site and its naturalness and nature conservation value. Changes in wintering areas, or along migration routes, however, should also be taken into consideration when drawing conclusions for the Hungarian sites. Besides waterbirds, the long-term monitoring of other taxa could help in having a better judgment. Moreover, other external factors like climate change and industrial-infrastructural development should also be taken into account since these can have an overall influence on wetlands.
Results are in line with other international studies. In general, it can be said that the effectiveness of the Ramsar Convention in higher in countries in Africa or Asia, where no solid conservation legislation or systems/traditions exist. Nevertheless, the Ramsar designation can help in conserving the values of a site even in countries with more developed conservation systems.

Out of the 14 Hungarian Ramsar sites where the data of long-term waterbird populations was sufficient, the author observed eight positive changes in ecological character, one negative change in ecological character and there were five sites where neither positive nor negative changes could be detected.

NEW SCIENTIFIC FINDINGS

In his dissertation, the author summarizes the general state of Hungarian Ramsar sites, habitat types and natural values. Data on land tenure, land-use types and risk factors are analysed. A ranking system was developed and the 35 different regions of the 28 Hungarian Ramsar sites were ranked based on ecological state, national conservation state and exposure. Where data was available, long term waterbird populations were evaluated and analysed. Results were compared with other scientific studies.

1. In total, 59 significant changes in 24 waterbird species were found in Hungarian Ramsar sites during the study period.

2. The author found that obligations of the Ramsar convention undertaken by Hungary were fulfilled in the case of four alkaline pools and grassland wetlands (The Fertő, Kardoskúti Fehértó, Felső-Kiskunsági alkaline pools and Hortobágy), one wetland site related to floodplains (the Béda-Karapancsa Ramsar site) and three man-made wetlands (lakes by Tata, fishponds of Rétszilas and Biharugra).

3. The author found that obligations of the Ramsar convention undertaken by Hungary were only partly fulfilled in the case of the Balaton and Gemenc Ramsar sites.

4. The author found that obligations of the Ramsar convention undertaken by Hungary were not fulfilled in case of the Pusztaszer Ramsar site.

5. The author detected that changes in ecological character could not yet be verified at the Kis-Balaton and Velence-Dinnyés Ramsar sites, due to the impact of external factors.

6. The author ranked Hungarian wetlands of international importance based on their naturalness and conservation status. According to this, the most natural sites are Gemenc, the Kunkápolnási marsh and Kis-Balaton, while the least natural sites are the Csongrád-Bokrosi alkaline pool, the lakes by Tata and the Labodár, Sasér and Miklósfai Mórichelyi fishponds. As for habitat groups, wetlands related to floodplains are the most natural sites, followed by alkaline pools and grasslands, and the least natural ones are fishponds.

7. Based on the analysis, no relation was found between the size of Hungarian Ramsar sites and the species (number of waterbirds, number of waterbird species, endemic species, protected plant species) occurring there.

8. The expanding numbers of waterbird populations observed justify the conservation efforts in these wetland sites committed to by signing the Ramsar Convention.

9. While Kardoskút Fehértó was designated a Ramsar site, other alkaline pools in southern Hungary have not received such attention, so their ecological state has changed negatively due to the increasing risk factors. Wetlands which become protected attract more waterbirds than those left unprotected.

10. The most important risk factors at Ramsar sites were problems with water quality and quantity, fishing, and game populations (hunting). The least significant risk factors were reed harvesting and shoreline development. The most numerous risk factors were observed at alkaline pools and grasslands, and floodplains, while the least were found at natural lakes.

11. At present, the most important risk factors at Ramsar sites are problems with water supply, tourism, succession and the spread of invasive species. The magnitude of risk factors increased in floodplains, alkaline pools and grasslands, and natural lakes. Decreasing risk factors were observed only at fishponds.

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