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ORNITHOLOGICAL CHANGES FOLLOWING WETLAND RESTORATIONS

Szilvia Göri[1], Csaba Aradi[1] and Gyula Lakatos[2]

[1] Hortobágy National Park, Debrecen 4024, Sumen u. 2., Hungary
[2] Ecological Department, Kossuth Lajos University, P. O. Box 21, Debrecen 4024, Hungary

ABSTRACT

In the course of the habitat restorations it was shown, that the already existing mosaic structure of the vegetation had basic importance for the rapid stabilization of the avifauna. During the first period of the restorations, an over-population of the site was observed, which is characterised by the relatively low number of species and high number of individuals. During the stabilization of the birdlife, this process is replaced by the decline of individuals and the increase of species. The effectiveness of the restoration is influenced by existing mosaic structure of the vegetation, the connections of the restored sites with the habitats nearby and the migratioty corridors.

INTRODUCTION

Our study is based on the data of the changes following the flooding of two sites of the Egyek-Pusztakócs Marshes covering an area of 4070 hectares in the Hortobágy region (East Hungary). The restoration work began in 1982 on the Fekete-rét marsh and at the same time a long-lasting research process was initiated, focusing on the recolonization process of the area (Aradi 1984, 1990). Valuable new data were obtained for improving the methods of nature conservation management and the conservation - biological approach of this issue. Based on these experiences there has begun the reconstruction of the Kis-Jusztus marsh in 1992, as well as a plan with the scope to ensure an adequate water supply to the whole marsh system. The implementation of this plan will be the next step of the restoration process.

In the course of our investigations, the principles of the restoration were drawn up, which were to be followed during our further experiments. These are the following:

- Only the most necessary work should be implemented, leaving the largest part to nature.
- Only habitats proven to have existed before should be restored.
- Changes that have taken place in the meantime must be considered and the valuable habitats that developed secondarily should be preserved.
- Attention has to be paid to the connections (corridors) between both near and distant refuges, gene-centers, those places which assure the natural recolonization of the restored site.
- Part of the reconstruction work is to restore the natural migration corridors, the typical "ecological network" of the region.
- Prior to the beginning of the reconstruction, the basic causes for the transformation of the area have to be known. The work can only be started when the causes of the previous destruction are stopped.
- During the first two years of the reconstruction - in the so called stabilization period - the artificial reintroduction of species which have became extinct should be avoided. The development of the "ecological framework" of the habitat should be left to nature.
- It is very important to choose the adequate size for reconstruction (e.g. it is not worth it to try to restore small remains of marshes inserted in ploughfields).

STUDY AREA

Once the Egyek-Pusztakócs marsh system occupied an area of 10.000 ha on the western edge of the Hortobágy. Originally the area was dominated by a vegetation which combined the characteristics of the backwaters, oxbows along the Tisza river, and the typical astatic and semistatic waters of the Hortobágy (Bulla, 1962). The difference between the water depth was significant and could reach 2 metres. The remains of these marshes did not extend to more than 4000 ha due to the regulation of the riverways done in the last century which resulted in many separate water bodies. The degradation was accelerated by the drainage and the cultivation of the levees covered by rich soil. The adverse weather conditions (for 10 years, an extremely dry period is being recorded) together with the agricultural drainage

speeded up the drying of the area. To prevent the changes mentioned, reconstruction work has been started on the Fekete-rét. This site was in the best condition- with the capability to assure adequate water supply for the site. The favourable changes following this work have raised the possibility and necessity to continue the restoration.

The Fekete-rét is originated from an ancient permanent marsh and was transformed into a habitat which could hardly be called a temporary marsh. Mostly the spring rainfall and the snow melting supplied the site with water. The largest part of the site remained dry and the meadow zone developed (Aradi, 1988). Nowdays the habitat is an oligotrophic marsh with rich macrophyte vegetation.

The Kis-Jusztus marsh kept its alkaline marsh character only in patches of some m^2's. A relatively small area was covered by meadow vegetation and the different types of the alkaline grassland dominated to the greatest extent. In the restored status this habitat represents the alkaline temporary marsh type. The other wetland types we were working with are a typical astatic marsh (the Polturás marsh), a large fish pond system (Hortobágy Fish Pond, created after the WW I), and an example of the original semistatic marshes of the region (Kunkápolnás Marsh). The size of the sites is given in the **Table 1**.

Table 1. Comparative ornithological investigation of water bodies in the Hortobágy Study sites are listed at the end of the **Table 2**.

Species	1	2	3	4	5	6	7	8
Podiceps ruficollis	0	1	1	1	1	1	1	1
Podiceps nigricollis	0	1	1	1	1	1	1	0
Podiceps cristatus	0	1	1	1	1	1	1	0
Podiceps griseigena	0	1	1	1	1	1	0	1
Ardea cinerea	0	0	0	0	1	0	0	0
Ardea purpurea	0	0	1	1	1	1	0	1
Egretta alba	0	0	1	1	1	1	0	1
Ixobrychus minutus	1	1	1	1	1	1	0	1
Botaurus stellaris	1	1	1	1	1	1	0	1
Platalea leucorodia	0	0	0	1	1	0	0	0
Plegadis falcinellus	0	0	0	0	1	0	0	0
Anser anser	1	1	1	1	1	1	1	1
Anas platyrhynchos	1	1	1	1	1	1	1	1
Anas querquedula	0	1	1	1	1	1	1	1

Table continues...

Species	1	2	3	4	5	6	7	8
Anas acuta	0	0	1	0	0	1	1	0
Anas clypeata	0	0	1	1	0	1	1	1
Anas crecca	0	0	0	0	0	1	0	0
Anas strepera	0	0	0	0	0	1	0	0
Aythya ferina	0	0	0	1	1	1	0	0
Aythya nyroca	0	0	1	1	1	1	1	1
Circus pygargus	0	0	1	0	0	0	0	0
Circus aeruginosus	1	1	1	1	1	1	1	1
Rallus aquaticus	0	1	1	1	1	1	1	1
Crex crex	0	0	1	0	0	0	1	0
Porzana parva	0	0	0	1	1	1	0	0
Porzana porzana	0	0	1	1	1	1	1	1
Porzana pusilla	0	0	0	0	0	1	0	0
Gallinula chloropus	0	1	1	1	1	1	0	1
Fulica atra	1	1	1	1	1	1	0	1
Vanellus vanellus	1	1	1	1	0	0	0	1
Charadrius dubius	0	1	1	0	0	0	0	0
Charadrius alexandrinus	0	0	1	0	0	0	0	0
Limosa limosa	1	1	1	1	0	0	1	1
Tringa totanus	1	1	1	1	0	0	1	1
Gallinago gallinago	0	1	1	1	0	0	1	1
Recurvirostra avocetta	0	1	1	1	1	0	0	0
Larus melanocephalus	0	1	1	1	0	0	0	0
Larus ridibundus	0	1	1	1	1	1	0	1
Chlidonias hybrida	0	1	1	1	1	1	0	1
Chlidonias leucopterus	0	1	0	0	0	1	1	0
Chlidonias niger	0	1	1	1	1	1	0	1
Sterna hyrundo	0	0	0	1	0	0	0	0
Cuculus canorus	1	1	1	1	1	1	0	1
Asio flammeus	0	0	0	0	0	1	0	0
Pica pica	0	0	0	0	1	0	0	1
Panurus biarmicus	0	1	1	1	1	1	0	0
Remiz pendulinus	0	0	0	0	1	0	0	0
Oenanthe oenanthe	0	1	1	1	0	0	0	0
Luscinia svecica	0	0	0	0	1	1	0	0
Locustella luscinioides	0	0	1	1	1	1	0	0
Lusciniola melanopogon	0	0	0	1	1	1	0	0
Acrocephalus arundinaceus	1	1	1	1	1	1	0	1
Acrocephalus scirpaceus	1	1	1	1	1	1	0	1
Acrocephalus schoebaenus	1	1	1	1	1	1	1	1

Table continues...

Species	1	2	3	4	5	6	7	8
Motacilla alba	0	0	1	1	1	1	0	1
Motacilla flava	0	1	1	1	1	1	1	1
Emberiza calandra	1	1	1	1	0	0	0	0
Emberiza schoeniclus	1	1	1	1	1	1	1	1
Number of species :	15	33	43	43	39	40	20	30
Number of species occuring exclusively in the given sample	0	0	2	1	3	2	0	0

METHODS

Sampling: during the nesting period (beginning of March - middle of July) without taking into account the quantitative data. On the Fekete-rét 5 sampling points were chosen (5-5 hectares) : homogenous reed stands, open water surface and hairweeds, meadow zone of the marsh, mosaic communities (open water, *Phragmites, Typha, Schoenoplectus), Bolboschoenus maritimus* stands.

Table 2: Sampling sites

1. Fekete-rét 1th year	460 ha
2. Fekete-rét 2nd year	
3. Fekete-rét 3rd year	
4. Fekete-rét 4th year	
5. Hortobágy Fish Pond	1350 ha
6. Kunkápolnás marsh	1500 ha
7. Polturás marsh	130 ha
8. Kis-Jusztus marsh	76 ha

During the period of the investigation on the Fekete-rét, we compared the trend of the changes in the number of the nesting species to the other characteristic wetland types of the region. Data were analysed using Jaccard Principal Coordinate Analysis and Rogers-Tanimoto Nonmetric Multidimensional Scaling (Legendre and Legendre 1983, Tóthmérész 1993).

Of course the question can be put if these habitats are comparable or does the comparison have any reason. Although we understand that it is difficult to compare a fish pond

with an astatic marsh, nevertheless this work can be considered necessary, as we are considering the most important waterbird habitats of the Hortobágy.

RESULTS

The species list of the investigated habitats is shown in **Table 1** (Aradi, 1990; Göri 1993). The evaluation of the first 4 years and a comparative study of some water bodies in the Hortobágy is shown on the figures based on the data of **Table 1**. Our research have been focused on the following of the recolonization process of the area:

1. In the first year of the restored status, the immediate reaction of the waterfowl was the most remarkable. The mass of birds present in the area was far beyond the amount, which had been registered before and was the multiple of the usual amount of birds present in the other habitats in the Hortobágy with similar ecological character (Aradi, 1990; Kovács, 1982 and 1984), although, to a lesser degree, this phenomenon was observed when the drained fish ponds were filled up (Kovács, 1984). Since the second year, this invasion began to decrease. This phenomenon can be similar to the "flocking to the place" reaction described by ethologists.
2. The first period was characterized by a low number of species and high number of individuals. The area supported large flocks of bird species nesting in the Hortobágy, but without any obvious reason, the breeding did not take place. This occurrence was observed in the case of all restoration work, usually for the species which have a very active exploration movement on large areas, such as the Black-headed Gull and Terns (Whiskered T., Black-winged Whiskered T.) (Aradi, 1990). That the breeding did not occur can be explained by the continuous and rapid transformation of the area, which is due to the man-made interventions.
3. Since the second period, the number of species began to slightly increase while that of individuals fell. Very soon, already by the fourth year, a peculiar species composition developed, remaining typical of the site after ten years as well. This immediate stabilization can be explained probably by the effect of the surrounding areas (marshes, fish ponds)

(Kovács, 1984). This does not mean that any structural or functional stabilization had happened (see point 6).

In a four year period following the reconstruction, the numbers of the nesting species were 16, 27, 37, 37. Behind the apparent similarity of the 3rd and 4th years, some smaller changes can be found: three atypical species disappeared (Pintail, Mediterranean Gull, Common Tern) and replaced by three typical marsh species (Pochard, Little Cracke, Moustached Warbler) (Aradi 1972). Another important change was that the huge Black-headed Gull colony (2500-3000 pairs) after the first year began to decline and in the 6th year completely disappeared.

4. The stabilization was accompanied by the appearance, brooding and disappearance of some atypical species of this type of marshes (Avocet, Little Ringed Plover, Kentish Plover), nesting on the bare sites created by the earthwork (Aradi 1990, Horváth and Szabó 1981).
5. Starting with a very rapid translocation, the botanical change of the habitat is still going on after thirteen years, although at a much slower rate. This slow change is not connected with the modification of the species composition or of the amount of waterbirds anymore, rather with a very fine restructuring of them.
6. The birdlife of the habitats dominated by mosaic-like vegetation structure already by the time of the reconstruction became stable, in a much shorter time inside the marsh, than in the homogenous stands. These patches played a significant role in the summarized data to suggest a stabilization already by the fourth year.

DISCUSSION

The territorial distribution of the waterbirds can be investigated in connection with the transformation of the mosaic structure of the vegetation and the characteristic points of the recolonization process (Aradi, 1990; Sasvári, 1986). Between the two phenomenon, the principles of the succesional processes can be compared. The research on the Fekete-rét showed, that, due to the rapid ecological change, special and stable bird communities don't belong to a certain part of the marsh. The changes in time in a fix direction is accompanied by

a continuos translocation in space. The direction of the changes can be evaluated by **Figures 1** and **2**.

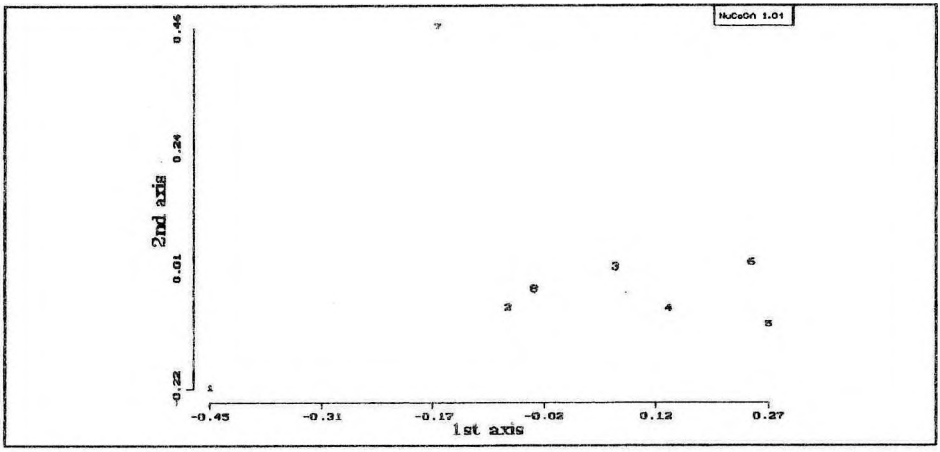

Figure 1: Jaccard Principal Coordinate Analyses

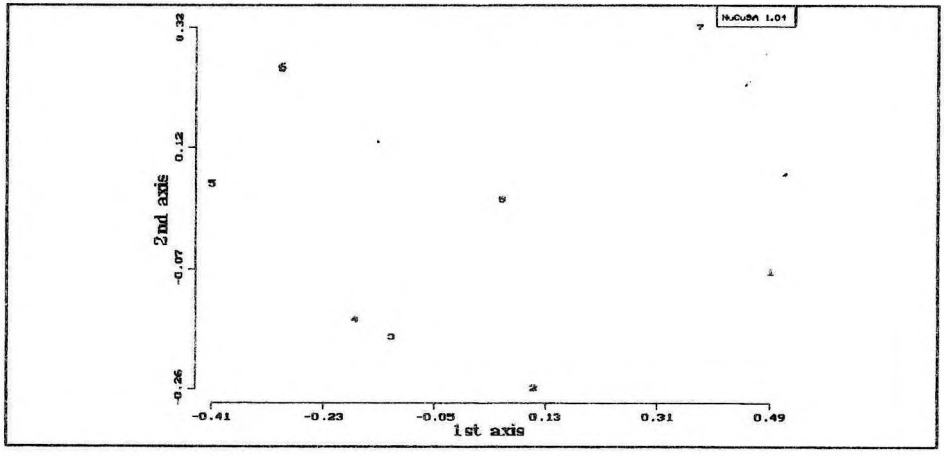

Figure 2: Rogers-Tanimoto Nonmetric Multidimensional Scaling

The Fekete-rét was functioning before the reconstruction as an astatic marsh, supplied with water only by the autumn - spring precipitation and by the confluence of the melt waters.

Therefore, the nature of the wildlife of the site has turned from the permanent marsh

type into the direction to become a temporary, astatic marsh type from the time of the regulation of the Tisza River until the restoration had been started. Before the reconstruction, it already showed the temporary type; after the first year of the restoration, the astatic character was still dominant. This can be the explanation for the closeness of points 1-7 on the figures.

The downward trend of the distance between the points of the series 1-2-3-4 indicates growing similarity and the slowing down of the change respectively. While the similarity between the points 1 and 2 is low, between 3 and 4 is rather high.

The transformation of the Fekete-rét has slowed down by the 4th year, pointing towards a development of an avifauna similar to the Kunkápolnás Marsh and the Fish Pond (points 5, 6) (Kovács, 1980).

Remarkable is the situation of the Kis-Jusztus marsh (8). This water body differs from almost all the other Hortobágy types in the same degree. It can be explained by its localization (closeness of the Fekete-rét) or the starting position of the stabilization process.

The high similarity of the Kunkápolnás Marsh (5) and the Fish Pond (6) can be explained by the large size of these sites or the permanent water coverage (Kovács, 1984). The disadvantage of the Fish Pond arising from its artificial being is balanced by its extra food resources.

CONCLUSIONS

The investigation of the birdlife and the recolonization process of these marshes leads to the conclusion that the communities with mosaic-like structure show prominent diversity due to a phenomenon called "internal edge effect" (Göri 1993). Investigated separately from the whole marsh, we find that their stabilization happens in a much shorter time compared to the homogenous communities. The mosaic communities responded the most favourably to the rapid changes following the reconstruction (Aradi, 1990; Dévai, 1991). Further studies need to be carried out in order to determine how to use the water level fluctuation as a major tool in the management to maintain the mosaic-like structure, since it would imitate the ancient water-movement of the region. It is very important from a conservation point of view to repress the environmental conditions which are causing homogenization of the habitat.

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