

STATUS ASSESSMENT OF BALATONKERESZTÚRI-RÉTEK (SOMOGY, HUNGARY): A LANDSCAPE HISTORY AND LAND USE BASED APPROACH

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Summary: The multifaceted study of land-use changes and landscape history helps to understand the actual state of landscapes and habitats. The shore areas of Lake Balaton including the connected marshlands were significantly modified in the last 150 years. The traditional land use has almost completely disappeared from the southern shore areas; however the remnants of valuable wetlands are still represented. Our study area, the Balatonkeresztúri-rétek, is a highlighted nature conservation area and Natura 2000 site. Its land-use changes can represent the shifts of the whole marshland area of the southern shore. In our study the landscape history and the changes in land cover as an indicator of land use were followed up. The changes in land use were analyzed based on the surface covering data of historical maps and recent orthophotos using ArcGIS (ESRI) software. Each habitat of the study area was classified to the appropriate category of ÁNÉR (Hungarian General National Habitat Classification System). The changes in surface cover was compared and rated based on their naturalness status. Our results revealed, that the former, deep situated marshes, which were spotted with open water surfaces were replaced by reed stands characterized with different, mostly degraded status. The remnants of the original marsh vegetation and species have found refuge the pits of canals and peat or clay mines. The terms of existence of the natural vegetation mostly disappeared until nowadays, however some valuable habitats survived in the study area, thanks to the human activities.

Introduction

The land-use changes of the area have not been studied before. The changes of landscape history can be deduced from studies about the local history of the settlements (TENGERDI 2008, ZÁKONYI et al. 1985, BUZA 1993), ethnographic researches (TAKÁTS 1934), essays (MARTON 1982), and scientific publications about the changes of Lake Balaton (BENDEFI – V. NAGY 1969, LIGETI 1974). According to these literatures the Balatonkeresztúri-rétek (“meadows at Balatonkeresztúr”) remained natural until the 20th century. Then the mosaic-like, economically worthless, sparsely populated surroundings of the study area have become an anthropogenic, built-up resort area in less than a century.

The extent of natural habitats has increasingly decreased in the last 150 years as a consequence of the development of the shore areas. Natural and semi-natural areas became smaller and fragmented because of human interventions (drainage, reclamation, management and replenishment of shoreline). As a result the number of species is decreasing, valuable species are becoming rare and invasive species are spreading. Tourism fundamentally changed the livelihood of inhabitants. The traditional, sustainable land use, which helped to maintain the valuable habitats, has almost disappeared.

The inhabitants of Balatonkeresztúr and the neighbouring villages dealt with agriculture, livestock farming and fishing. Large continuous stands of reed beds and untraversable marshes have been found between the villages.

First the landscape was changed by the spread of agriculture and the control of the water level of Lake Balaton, then by the development of road network and the increased tourism. Marshes disappeared in parallel with these significant landscape changes. These days only small remnants of the former marshes can be found in the area as a consequence of drainage, the building of M7 motorway and the disappearance of agriculture. However these small, fragmented wetlands have high natural value.

The Balatonkersztúri-rétek is a part of the Natura 2000 Network, which was established by the EU to preserve and maintain natural habitats. The land-use changes and the landscape history of the Balatonkersztúri-rétek represent adequately the changes of marshy areas along the southern coast of Balaton. The rules and regulations of Natura 2000 areas provide opportunities for the proper management and protection of the habitats.

Material and methods

The Balatonkersztúri-rétek is located in SW Hungary, at the western end of the southern coast of Lake Balaton (Figure 1.) (DÖVÉNYI 2010). It is part of the Nagyberek, which was a large marshland before drainage. The area is bordered by the main road No. 7 on the north and arable lands and abandoned fields on the south. The topography is characterized by the mosaic of flat areas and micro-relief features. Typical features are sand banks, longitudinal and oval swales. Characteristic soil types (according to IUSS Working Group WRB) of the area are Calcic Histosols and Calcic Gleysols, which formed under permanent water cover, and Arenosols (MAROSI and SOMOGYI 1990).



Figure 1. Geographical location of the Balatonkersztúri-rétek
1. ábra A Balatonkersztúri-rétek földrajzi elhelyezkedése

The Balatonkeresztúri-rétek (HUDD20059) is a Natura 2000 Site of Community Interest, part of the Hungarian National Ecological Network and the network of High Natural Value Areas as well. The area of Balatonkeresztúri-rétek is 557 ha, which is located between Balatonkeresztúr, Balatonfenyves and Kéthely. Some protected and valuable species can be found in the area. For instance such important species like *Cirsium brachycephalum* which is a species of community interest (ROZNER et al. 2011). One of the largest populations of *Juncus maritimus* in Hungary can be found here as well (FARKAS 1999). More floristical data are published in other literatures as well, e.g. a thesis about the area (MIÓKOVICS 2011), an expert report (VIDÉKI 2010), the environmental impact assessment of the building of M7 motorway (BÓDIS és SZALÓKY 2004).

Literatures from the early 20th century, local history studies, archives and digitized historical maps were used for the investigation of land-use changes and landscape history.

Land-use changes were studied with the separation of the listed land cover categories (Table 1). The areal changes of land cover categories were measured with ArcGIS 8.0.

One advantage of the method is that the areal changes of the land cover categories can be quantified and represented easily. As a result the maps from different ages become comparable. On the other hand the method has limits as well: inaccuracy of maps, different keys, different level of elaboration (see in BIRÓ 2006, 2010, MOLNÁR and BIRÓ 2010).

Table 1. Land cover categories used in landscape historical reconstruction
1. táblázat A táj történeti rekonstrukció során használt felszínborítási kategóriák

Land cover category	Description
Marsh	Lower parts of the area covered with water permanently or temporary, dominated by reed beds and non-tussock tall sedge communities.
Open water surface	Small lakes.
Grassland	Wet, semi-dry and dry grasslands on the higher parts of the area.
Woody area	Natural or planted shelter-belts, clump of trees, forests.
Arable land	Cultivated arable land.
Canal	Artificial network of canals, which drains the water from marshes in Lake Balaton.
Structure	Every structure in the area (e.g. building, well, lock).
Road	M7 motorway and other roads

The following georeferenced maps were used:

- Sheets of The First Military Survey (M: 1:28800) from the area, which was made by the cartographers of the Habsburg Monarchy between 1782 and 1785
- Sheets of the Second Military Survey from the area, which was made in 1856.
- Sheets of the Third Military Survey (M: 1:25000), which took place between 1879 and 1890. The reambuluted sheets of this survey, which was made from 1944 to 1945 (World War II), were used as well.

The analyzed orthophotos were made in the summer of 2005 within the framework of the Hungarian National Digital Orthophoto Database (MADOP). 1:10 000 scale digital orthophotos were made from the 1:30 000 scale photos.

The habitats and their spatial patterns were surveyed according to the manual of the National Biodiversity Monitoring System (TAKÁCS-MOLNÁR et al. 2009) to evaluate the naturalness of habitats. Data were recorded with Trimble Juno ST, Garmin Geko and Garmin 60 GPS receivers. Data were processed using GPS Pathfinder and ArcGIS 8.0. (ESRI) Habitat patches were classified according to the naturalness-based habitat quality categories of the Hungarian General National Habitat Classification System (BÖLÖNI et al. 2011) (Table 2).

Table 2. Naturalness-based habitat quality categories
2. táblázat Az élőhelyek természetességi kategóriái

Habitat quality category	Classification criteria
5	Species rich, natural habitat with extremely valuable communities. The abundance of invasive and weed species is negligible.
4	Habitat in good condition, rich in protected and character species. The abundance of invasive and weed species is low.
3	Weedy habitats with low number of character and/or protected species. Presence of adventives species is typical.
2	The abundance of invasive and weed species is high, however the species of the natural habitat are still present.
1	Degraded habitats, stands of adventive/invasive species, areas without vegetation (arable land, roads).

Results and discussion

Landscape history of the area and the changes of land use

The shore areas near Balatonkeresztúr were impracticable marshes until the 19th century. Some lakes and islands could be found in the marshes. The cart road ran on the narrow sand bank, where the 50–100 m wide pasture was located as well. The herder took cattle out to pasture on this road every day (TAKÁTS 1986).

There is evidence that the marshes on the southern coast of Lake Balaton started to become drier before the construction of the Sió lock, as a consequence of increasing drainage (ZLINSZKY 2011). The first phase of drainage in the area started in 1785 at the instance of Festetics family. Two fathom wide and one fathom deep ditches were dug. As a result the water level decreased by one meter (TAKÁTS 1934). The area of Festetics Estate increased by 250 ha through this intervention (TENGERDI 2008). Keresztúr had operated two wooden water mills and the area was navigable from the Lake Balaton to the village of Boronka before the drainage.

The sheets of the First Military Survey show that the Balatonkeresztúri-rétek was dominated by marshes and grasslands (Figure 2.). Little clumps of trees are represented on the map in the eastern part of the area. According to the sources the intensity of land use was very low in the marshy area.

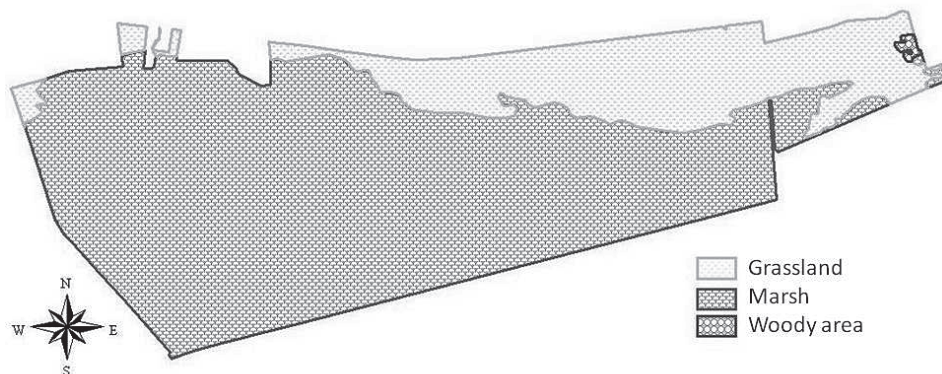


Figure 2. Land cover categories according to the First Military Survey
2. ábra A felszínborítás megoszlása az I. Katonai Felmérés alapján

The Second Military Survey (middle of the 19th century) represents the marshland with open water surfaces (Figure 3). The railway line, which was built in 1861 on the southern coast of Lake Balaton, separated the marshy area from the lake. The water level of Lake Balaton decreased by one meter with the construction of the Sió lock in 1863. As a result the water disappeared from the flooded shore areas. The process was accelerated in 1867 when an association (“Nyugati Bozóttelecsapoló Társaság”) was founded with the aim of helping the drainage of the area (TAKÁTS 1934). The goal was to ensure the stability of the railway embankment and increase the extent of agricultural areas.

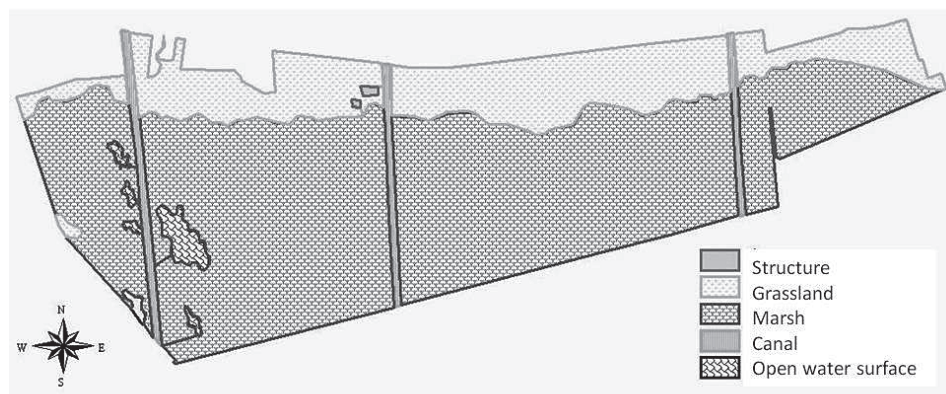


Figure 3. Land cover categories according to the Second Military Survey
3. ábra A felszínborítás megoszlása a II. Katonai Felmérés alapján

The Third Military Survey shows the decrease of marshy areas and their fragmentation by canals (Figure 4). The sign of other water management interventions can be seen on the map as well. Until the 19th century the small ploughed parcels could be found on the hill sides between the villages. The demand for arable lands increased until the early 20th century, therefore the former uncultivated areas were ploughed up as well. The construction of the Western Belt Canal (“Nyugati Övcsatorna”), which tails in Balaton in

Balatonkeresztúr, was finished in 1908. The canal was built to drain the area thoroughly (ZÁKONYI et al. 1985). At the same time the network of canals was expanding as well.

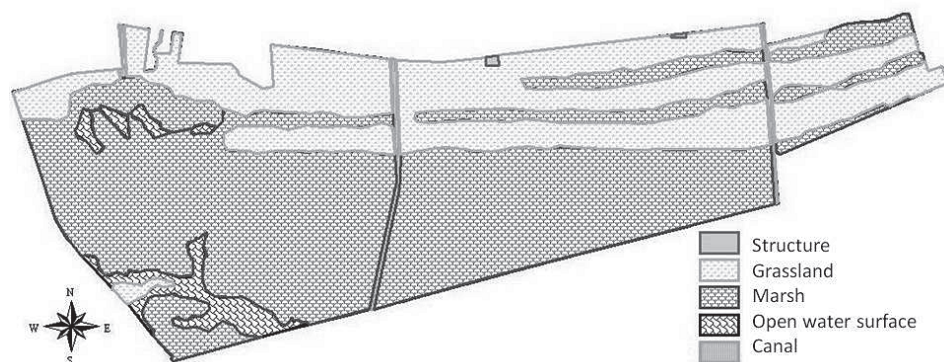


Figure 4. Land cover categories according to the Third Military Survey
4. ábra A felszínborítás megoszlása a III. Katonai Felmérés alapján

The Balatonkeresztúri-rétek was last flooded in 1944–45, at the end of World War II, when the retreating German soldiers exploded the pumping plant near Balatonfenyves (KOLTAY 1971). At that time the extent of arable land was large (Figure 5).

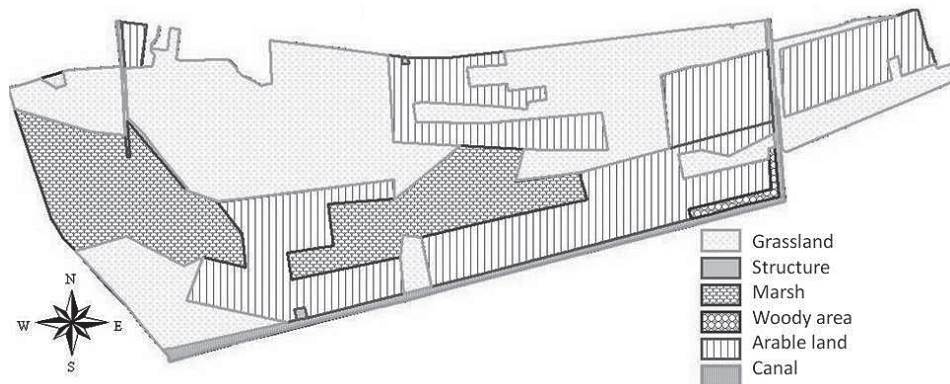


Figure 5. Land cover categories at the end of World War II
5. ábra A felszínborítás megoszlása a II. világháború végén

The open water surfaces disappeared from the area in the second half of the 20th century, in parallel with the appearance of large-scale arable fields, on the eastern parts of the area beef cattle were bred. The area was managed by the Balatonnagyberek State Farm (“Balatonnagyberek Állami Gazdaság”).

From the 1970s, beside the intensification of agriculture, areas farther from the coast were parcelled out for holiday houses and built up as well.

In the early 1990s, after the collapse of socialism, the area of arable land, meadows and pastures started to decrease partly as a consequence of the privatization of Balatonnagyberek State Farm. In 2004 the area of Balatonkeresztúri-rétek was divided into two parts with the building of M7 motorway. The building of the motorway affected 5% of the area (Figure 6).

The following structures and types of wasteland are present in the area (2012): grass runway and its surroundings with wood houses and sheds, mineral well, small fenced gardens with mobil houses and tool storage buildings, former livestock farms, former watering places, a sand-pit which was opened when the motorway was built.

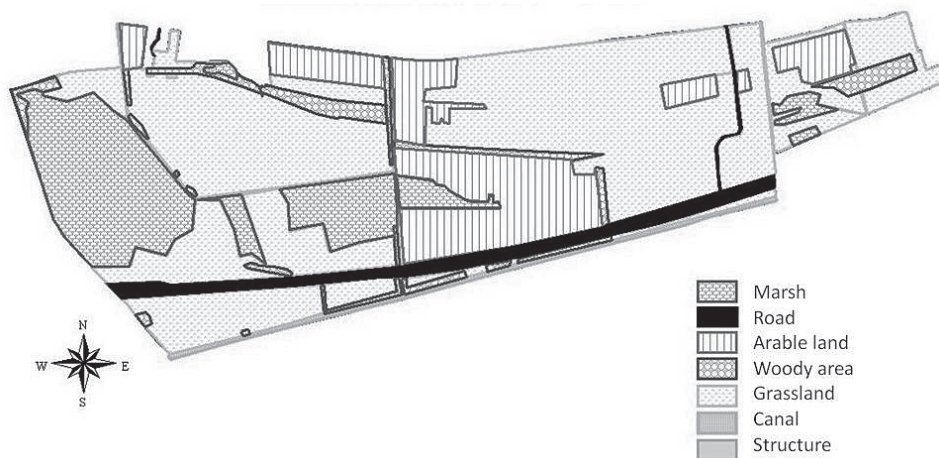


Figure 6. Land cover categories in 2005
6. ábra A felszínborítás megoszlása 2005-ben

Actually only 15% of the 557 ha is grazed or mowed by local farmers. The area is suitable for extensive agriculture, but the ratio of managed areas is much lower than the optimal (60%). Generally the meadows are mowed once a year to meet the requirement of agri-environmental schemes. The area of pastures can not be increased because the number of livestock is too low. Arable lands, abandoned fields and ploughed grasslands, which are mainly young abandoned fields, cover 20% of the total area. The maintenance of extensive grassland management is important for the survival of animal species of community interest (e.g. *Crex crex*, *Numenius arquata*) as well.

Actual state of the Balatonkeresztúri-rétek

Only one habitat patch belongs to the naturalness-based habitat quality category 5 from the 126 recorded patches (Figure 7). The extent of the patch is 5 ha (nearly 1% of the total area) and was formed in the pit of a former mine. This habitat patch is one of the richest in protected species. One of the largest populations of *Juncus maritimus* in Hungary can be found here as well.

The naturalness-based habitat quality category 4 constitutes 23% of the total area (Figure 7). These are oligotrophic reed beds, fen-sedge beds, fine scale mosaic of marsh communities, tussock sedge communities; mesotrophic wet meadows and semi-dry grasslands.

Areas belonging to the naturalness-based habitat quality category 3 are dominant, as this category covers 37% of the total area (Figure 8). These habitats are reed beds and non tussock tall-sedge beds, fine scale mosaic of marsh communities in canals, mesotrophic wet meadows, clumps and forest belts of native tree species.

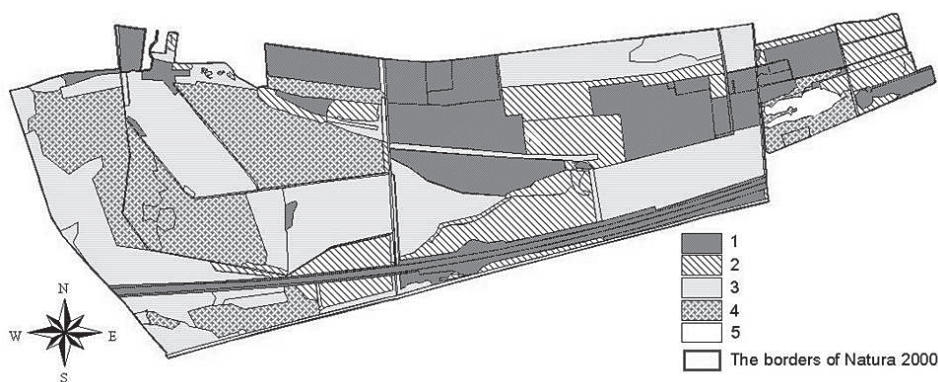


Figure 7. Naturalness of habitats patches
7. ábra Az élőhely foltok természetessége

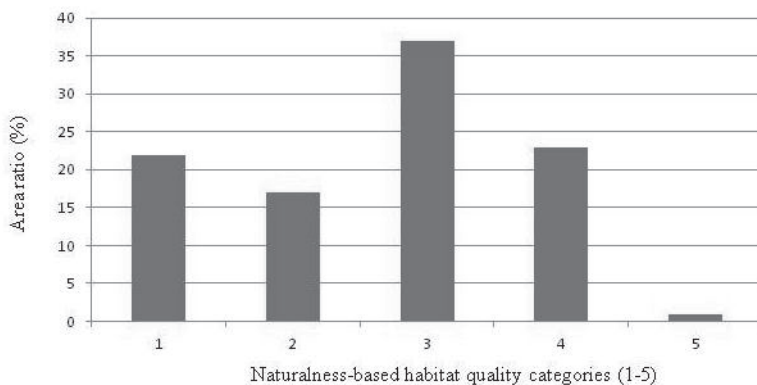


Figure 8. Naturelness status of habitats in the Balatonkeresztúri-rétek
8. ábra A Balatonkeresztúri-rétek élőhelyeinek természetessége

The naturalness-based habitat quality category 2 constitutes 17% of the total area (Figure 8). These are mainly planted or spontaneous forest patches, degraded mesotrophic wet meadows, weedy reed beds, uncharacteristic mesic or semi-dry grasslands and tall herb communities.

Habitats belonging to the naturalness-based habitat quality category 1 cover 22% of the total area (Figure 8). These patches are mainly roads (motorway, roads of former mines, frontage roads), wastelands (former livestock farms, mineral well and its surroundings, former watering places) and planted or spontaneous vegetation patches of non native species.

Connections between the landscape history and the actual state of the Balatonkeresztúri-rétek

The mosaic of marshes and open water surfaces disappeared and was replaced by (often weedy) reed beds of different naturalness. There is only one grazed grassland in the area (Felsőmelléki-legelő). As a result of grazing this area belongs to the naturalness-based

habitat quality category 4 with some protected species. A mosaic of different habitats can be found here: the strictly protected *Ophrys sphegodes* lives on a sand hill, while *Orchis elegans*, *Orchis militaris* and *Dactylorhiza incarnata* live on the lower parts of the pasture, which are covered with water in spring and dominated by mesotrophic wet meadows and tall herb communities. This habitat patch exemplifies that in many cases the naturalness of pastures is not the highest as a consequence of disturbances, but the survival of habitats and protected species is still assured.

In the other parts of the area the species and natural habitats survived in canals and pits of former mines after drainage and ploughing.

Figure 9 represent the changes of the landscape. It shows the area ratio of land cover categories in different years. The map from 1785 shows no open water surface. This can be explained with the inaccuracy of the cartographer as the open water surfaces have been already represented on the map from 1856. Names of folk ecotopes (e.g. retery) indicate the presence of open water surfaces as well (VÁRKONYI – KIRÁLY 1974). The largest change occurred in the case of marshes. This land cover category covered 77% of the area on the sheets of the First Military Survey, but its ratio has decreased to 16% based on the orthophoto from 2005. Between the quantitative decrease it means qualitative decrease as well. Presumably these oligotrophic reed beds and little fen-sedge patches, which are covered with water temporarily, were diverse fens with floating islands. As a consequence of drainage the area became drier, the extent of grasslands doubled, however this category contains large secondary grasslands formed after abandonment and stands of invasive species.

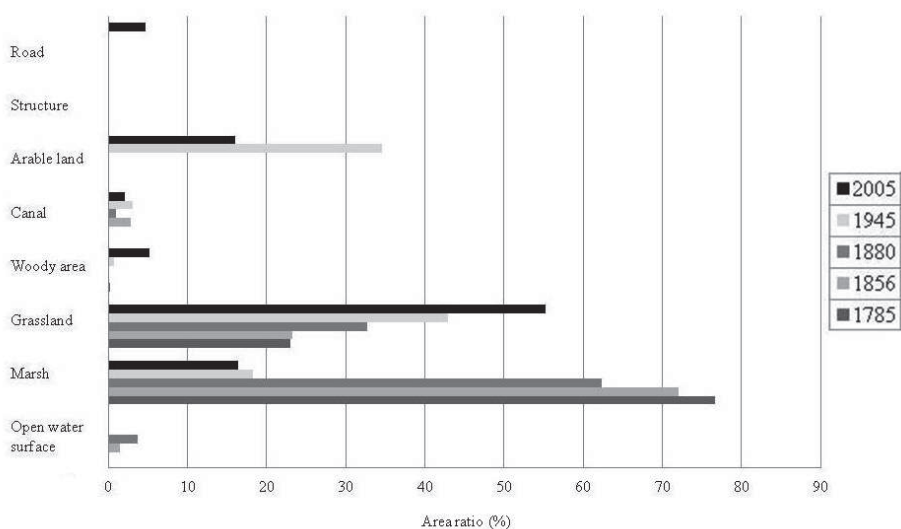


Figure 9. Area ratio of land cover categories in different years
9. ábra A felszínborítási kategóriák területi megoszlása különböző években

These days habitats of medium or high naturalness can be found in managed (grazed or mowed) areas with optimal water level (canals, ditches, lowest parts, pits of former mines) (Figure 7).

The state of the Balatonkeresztúri-rétek has been influenced mainly by the changes of land use. The water balance was changed fundamentally by drainage in the last century. The building of M7 motorway discouraged the management of grasslands as it divided the area into two parts. The grazing and mowing of meadows would be very important, whereas the main problem is the spread of invasive species (*Solidago gigantea*, *Elaeagnus angustifolia* and *Calamagrostis epigeios*).

Environmental conditions of natural habitats have changed fundamentally and the traditional land use has almost disappeared until these days, however some valuable habitats survived as a result of human activities (e.g. former mines, canals). The Natura 2000 Network can help to revive agriculture and the regulations of the Network can help to protect valuable habitats and protected species in the studied area.

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A BALATONKERESZTÚRI RÉTEK ÁLLAPOTÁNAK ÉRTÉKELÉSE A TÁJTÖRTÉNET ÉS TÁJHASZNÁLAT VÁLTOZÁS TÜKRÉBEN

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Kulcsszavak: vizes élőhelyek, természetesség, védett növényfajok, degradáció, Natura 2000

A tájhasználat, tájtörténet változásának minél szélesebb szempontok szerinti vizsgálata segít megérteni a ma meglévő tájegységek és élőhelyek állapotát. A Balaton partja, a hozzá kapcsolódó mocsarakkal jelentősen átalakult az elmúlt 150 évben. A hagyományos tájhasználat szinte teljesen eltűnt a déli part menti területekről, ennek ellenére a mai napig megtalálhatóak az értékes vizes élőhelyek maradványai. A vizsgált terület a Balatonkeresztúri-rétek Natura 2000 hálózat tag, kiemelt jelentőségű természetvédelmi terület, melynek tájhasználat változása jól mintázza a déli part egykori mocsárvilágának megváltozását. Kutatásunk során a terület tájtörténete mellett, a tájhasználat felszínborításban jelentkező változásait követtük nyomon. A tájhasználat változását történeti térképek és a jelen állapotokat mutató légi felvétel alapján ArcGIS program segítségével dolgoztuk fel a felszínborítási kategóriák lehatárolásával. Az Általános Nemzeti Élőhely-osztályozási Rendszer természetesség kategóriái alapján a rétek élőhelyeit besoroltuk a megfelelő osztályokba. A felszínborítás változásait összevetettük és értékeltük a rétek élőhelyeinek természetességi állapota alapján. Az egykori mélyebben fekvő nyílt vizes területekkel mozaikos mocsár helyén, jelenleg különböző állapotú (néhol erősen gyomos) nádasok találhatóak. A lecsapolások és szántóföldi művelés alá vonások után a természetes élőhelyek és fajok a csatornák árkaiba, tőzegnyerő- és agyaggödörök medencéibe szorultak vissza. Mára a hagyományos tájhasználat megváltozásával az eredeti természeti állapotok feltételei részben megszűntek, mégis éppen az emberi tevékenységnek köszönhetően (anyagnyerőhelyek) több értékes élőhely is fennmaradt a réteken.

