Additional information

Criterion 5:

The sodic-alkaline wetlands are considered internationally important because they regularly support more than 20,000 waterbirds.

	Number of waterbirds in September	Number of waterbirds in October	Number of waterbirds in November
2010	13440	33100	24280
2011	16945	38222	78995
2012	13929	29290	62531

Source of the data: Online waterbird database of the Hungarian Ornithological and Nature Conservation Society http://vizimadaradatbazis.mme.hu/page/introduction

Ecological character:

One of the main natural ecological parts of the site is sodic-alkaline affected wetland around Pusztaszer region. The prevalence of different sodic alkaline wetland habitat structures depends on water levels and seasonal fluctuation, which may be very variable year to year.

Lepidio-Puccinellietum and *Astero-Agrostetum albae* sodic marshes: The feature of this habitat is that it has only temporary or ephemeral saline water-flooding zone (0-10 cm), usually from later autumn to later spring. After it has dried out saline crystals often occur in high density on the bare surface, that is why plant growth is strongly hampered here. The characteristic vegetation, which can thrive in these extreme conditions consists mainly of terrestrial halophyte and succulent plants such as: *Lepidio crassifolium, Puccinellia limosa, Camphorosma annua,* which occur sporadically on the surface. This habitat is one of the most important shorebird feeding zone because it has seasonal shallow (0-10 cm) water coverage and bare surface, often only the surface is wet and the muddy ground is soft. This feeding habitat exists mainly in spring and autumn for the waterbirds, when there is higher water level on the site.

Puccinellietum limosae sodic marshes: This habitat is similar to Lepidio marshes, but it has longer and a bit deeper saline water-flooding (0-20 cm), usually from early autumn to beginning of summer, due to more vegetation biomass that can be found here, with especially high dominance of halophyte *Puccinellia limosa*. The sodium crystal accumulation is not so expressed on the surface only in the deeper level of the soil. The vegetation coverage abundance may be very variable.

Bolboschoenus-Phragmitetum sodic marshes: This habitat is regularly covered with shallow water (0-30 cm) or is wet all over the year. Due to this it can overgrow with more abundant halophyte vegetation as in saline marshes. The characteristic dominant plants are *Bolboshoenus maritimus* and saline ecotype of *Phragmites communis*, these may occur in very different coverage proportion.

Open bed of pans: This habitat is regularly covered with deeper saline shallow water (10-50 cm) all over the year. There is no important emergent vegetation only few sporadic saline submerged water plants as *Potamogeton pectinatus*. This habitat has major importance for waterbirds. In hot summer, when the water level may drop seriously, so pool-bed surfaces can become only wet or dried out.

Other wetlands types can be also found such as *Alopecuretum pratensis* meadow.
Continental Pannonic sodic affected steppes are extensively scattered around the wetlands such as *Artemisio-Festucetum pseudovinae danubiale*, and *Achilleo-Festucetum pseudovinae*. Fragmented Pannonic loess steppic grasslands are also such as *Salvio-Festucetum rupicolae*.

The smaller part of this Ramsar-site is the living floodplain area of River-Tisza, which is divided into two separated parts, on North is Labodár, and on South is Sasér. The tree dominated floodplain parts are covered by *Saliceto-Populetum* wood with *Salix alba, Salix trianda, Salix fragilis, Populus niger, Populus albus* tree species. Some allochthonous and invasive plant species can take advantage of these unnatural conditions and invade the place of certain species in forest communities such as *Amorpha fruticosa, Echinocystis lobata, Acer negundo, Vitis riparia, Fraxinus pennsylvanica*. The most important spreading factor of the seed of the alien species is the floods. Usually general forestry management is also unfavourable in the floodplain region because of intensive planting of adventives Populus x euramericana and other artificial hybrid poplar and willow races, exploitation of natural forests in young age and executing large clear-cuttings so providing in this way good opportunity for adventive invasive plants to spread intensively.
Artificial hybrid poplar races made serious genetic pollution - by pollination - in the natural Populus nigra populations, so genetically unpolluted Populus nigra populations are close to extinction.

Some of the main human-made ecological parts of the site are extensive fishponds systems, such as Lake Fehér at Szeged, and Lake Csaj at Tömörkény. The artificial fishponds were created from original sodic-alkaline affected wetlands, and ponds are supplied by the water of River Tisza by now. The average water depth of ponds 0,6-1 meter, the submerged water vegetation is poor due to cutting, but the edge and the islets of the ponds are generally covered by reed and somewhere by trees such as Salix species.

Physical features of the site:

Three big rivers (Danube, Tisza, Maros) played a key role in the formation of the present landscape of this area. From the rivers silting up the one-time Pannon Lake, approximately 2.5-3 million years ago the ancient Danube appeared in the area, and running through the present Danube-Tisza Mid-Region, at first it flowed into the Tisza valley at Szolnok, later at Csongrád. The ancient Tisza and its tributaries arrived from the direction of the Körös basin at that time. The ancient Danube left the Danube-Tisza Mid-Region and took up its north to south direction of flow. The huge ridges of alluvial Danube sediments (which are of sandy origin in this reach) became free of the river and were gradually covered partly by wind-blown loessy sediments and partly by 'moving sand'. These wind-blown sediments (moving sand and loess) are characteristic near the surface up to the present day. About 18-20 thousand years ago the ancient Tisza took up its direction of flow as well. It was then that the bends of Tisza developed (which can still be traced on the surface) mainly as a result of 4-6 times bigger water output 12-16 thousand years ago. This surface continued to change due to the floods and unique lower and higher (free of flood) inundation area levels developed along the River Tisza.

Climate
The climate variations are limited in the region of the Carpathian Basin. The macroclimate can be considered a homogenous basic feature in terms of surface and fauna evolution, as well. The region has a temperate continental climate. Its unique features are limited cloudiness, a relatively high number of sunshine hours, high daily and annual temperature variation, relative dryness and very low humidity values.

This region is the area with the least cloudiness in Hungary. The annual average cloudiness is 52-57%. The annual average number of sunshine hours is approx. 2050. At the same time this is one of the warmest areas in the country. No significant variations exist in this region. The annual average temperature is between 10-11^{o}C. The mean temperature of the coldest month (January) is between minus 1.5 and minus 2^{o}C, while that of the warmest month (July) is 21-22^{o}C. Characteristically of areas with a continental climate, the annual average temperature variance is quite significant (23-24^{o}C). The region can be classified within Hungary as one with a short winter and a long summer. The number of winter days is only 26-31, however, major frosts are common. Spring comes early, and the average temperature rises above 10^{o}C in the whole region between 7-12 March. The number of summer days is 81-84. In the fall the daily average temperature falls below 10^{o}C again generally between 17-21 October.

The region is one of the parts of the country having the least precipitation. Under normal conditions the annual precipitation is between 500-600 mm in the region. The rainfall of the summer semester (April-September), the so-called breeding period, is around 300-350 mm. The winter precipitation occurs mainly in the form of snow. The number of snow-cover days is 30-40. The precipitation conditions therefore are relatively disadvantageous. This is further intensified by low humidity values, with an annual average of many years at 71-74%. Based on this data we may declare that the balance of precipitation and evaporation is negative in the region. The wetlands that have developed and exist can thank their subsistence to supplementary water influences (e.g. ground water).

Hydrology
River control and surface drainage from the middle of the nineteenth century radically changed the water conditions of the region. The comprehensive control of the River Tisza began in 1846 and started at the reach of Csongrád in 1856. The biggest bends were cut through and the river was forced between dykes. As a result, half of the county was freed from recurrent floods.

As a result of the embankments along the river and narrow floodplain the level of the floods are very high so the deep water (3-4 m) completely covers the total floodplain area. As a consequence of the inappropriate water management the water goes away very quickly from the entire floodplain, even from the wetland areas. Gallery forests are among the most endangered biotopes in Hungary. The forest biotope chains in the Tisza inundation area are at present considered indispensable natural treasures in the lowland environment. During the preparations for the work titled „Improving the Vásárhelyi Plan", which can be regarded as Hungary's new flood control strategy, it became evident how few and how vulnerable the valuable flood plain forests are, which provide a habitat for the remained assemblages of the one-time flood areas. Several factors endanger these forests. The biggest damage can be caused by intense sylviculture with treefelling and cutting purposes. Another problem that cannot be neglected is the extreme hydrological conditions of the flood plains, which can hardly be regarded as natural. High floods, water- and groundwater level changing with high amplitude, create competitive drawbacks for autochthonous tree and shrub species fit for the original habitat.

The sodic-alkaline pan is a special type of continental salt waters, which is a typical Pannonic wetland type in Hungary. These pans have primarily groundwater and rainfall supplied water bodies. These are seasonal intermittent shallow waters (max. depth = 0.4-0.5 m), because there is notable seasonal water level fluctuation and frequently dries out entirely to middle of summer or autumn. The salinity varies between hypo- (3-20 $g.l^{-1}$) mesosaline (20-50 $g.l^{-1}$) ranges corresponding with water level. The total dissolved solids is dominated in sodium (Na^{+}), calcium (Ca^{2+}), carbonate (CO_3^{2-}) ions, and high grey-brown coloured holomictic turbidity being permanently suspended by colloidal suspended ion complex. The very high turbidity is in opened pans attributed to the daily re-suspension of the sediments by the winds coupled with its shallowness.

The susceptibility to re-suspension of sediments is different for each lake as it depends on the sediment type and on the shape and depth profile of a lake. Hypothetically, wave re-suspension occurs depending on the critical fetch (F_{crit}) at which the wavelength exceeds twice the depth, relative to the total length of the lake measured in the direction of the wind. It causes that generally at lower find velocity there can be found a lower turbidity less re-suspended belt (F_{crit}) around the shoreline below a critical water depth. The lowest turbidity can be found every time among emergent marshland vegetation. The non-turbid transparent sodic-alkaline waters have brown colour.

The fishponds were created on the ancient floodplain of the River Tisza especially in former sodic-alkaline pans and marshes, and are supplied artificially by water from River Tisza.

Physical features of the catchment area:

The site belongs to River Tisza catchment area. The living Tisza-valley has a huge catchment area (157.000 km^2) which also comprises Carpathian mountain region and the major part of Great Hungarian Plain. The outside of embankment is the local catchment area of the site on the former ancient floodplain. The local wetland catchment area has two main parts, on the eastern part is the lowland River Tisza basin, and on the western part is the plain sandy ridge plateau.