Additional information

Ecological character:

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.*

Physical features of the site:

Geology, hydrogeology,
Following the withdrawal and the sedimentation of the last lake, the so-called Late Miocene Lake Pannon in this region on the Great Plain, approximately 4.5 million years ago, the ancestor structures of the Danube, the ancient Tisza and the tributaries of the latter appeared. From this point on the previous lake sediment supply was replaced by river sedimentation (primarily by the Danube). Until the Günz-Minden Interglacial Episode in the Pleistocene Ice Age following Pliocene Epoch the Danube run southeast-bound towards Szeged, cutting the region in half, and supplied river sedimentation in a width of some 1000 metres. In the Günz-Minden Interglacial Episode of the Ice Age a major change occurred: with the development of the region's southwestern depression (Kalocsa depression) the Danube gradually started to drift westward by leaving its previous diagonal flow direction and took over its present north-south position. The Danube had already filled up the previous areas. River sedimentation ceased on the alluvial fan replacing these, situated east of the region, which remained higher than the Transtisza region, and a thick eolic sedimentary layer were deposited on it (in the areas undisturbed by water).
This sedimentary layer consists of sand blown out of the Danube valley in the ice-free periods of the Ice Age, which was structured as a series of sand piles in the north-south direction according the dominant wind direction, as well as loess developed during the ice formation periods, their transformed (e.g. soil) varieties and sediments washed out by local precipitation.
The sediment pattern delivered by the Danube-Tisza interfluvial winds protrudes slightly east of the current Tisza route, between the river layers of the Tisza. Therefore a geological situation developed in the smaller eastern section of the region where the Tisza, through its westbound movement, entered the alluvial fan of Danubian origin and in certain locations cut up and destroyed the surface of Danubian origin from the late Pleistocene period and enriched it with its own sediments (occasionally in an astonishing width of several hundred metres).
Based on geological evolution, the geological structures covering the surface and the morphological conditions the region can be divided into three major geological units:
- Danube Valley (a tectonic and erosional depression along the Danube river in a width of some 20-30 km) with an average height of 90-100 m above sea level.

Pedology
Prior to the river control of the Danube the Danube Valley used to be the river's normal floodplain, then it was an area covered with inland waters on a regular basis subsequently, as well. Also, as a result of its pedological (mainly calcareous-sodic plains developed on a fine granule rock bed) and geological structure (the significant presence of a fine waterproof clay layer) precipitation filter downwards with difficulty and may remain permanently in the depressions. It is generally true that due to the winter precipitation and the high ground water level in the spring significant water volumes appear in the depressed areas (in the isolated depressions of lake beds and old water flows).

The total solute content of the region's ground water is relatively high. Even the smallest values are around 1000 mg/l. The highest values vary between 2000-10.000 mg/l. In the event of high ground water levels the ground water also brings solutes to the surface via its capillary ascent.
The most important cations and anions in the ground water are Na^+, Ca^{2+}, Mg^{2+} and HCO_3^-, according to predominance Na^+, HCO_3^- couple with high pH values (sodic water).

The soil types developed here are:
- Chernozem meadow soil types, which are surfaces developed on a sandy loess base situated in the highest level layers in the region, with a high humus content. Their layer thickness varies between 20-40 cm. Generally the salty ground water already does not impregnate these layers. In cases where these highest locations are relatively expansive, tillage activities are carried out on them, and if they are smaller in size (a few 100 m^2), they form islands on the saline steppe, partly conserving the old sand and loess steppe flora of these areas.
- Solonetz meadow or carbonated solonetz soils, which appear in non-classical forms, in patches, and are more of a transition between the meadow and sodic soils in various combinations,
- Solonchak-solonetz soils, sodic solonchak soils, solonchak soils of eroded salt berms. Among these calcareous-sodic solonchak-solonetz soils are the most common, giving the character of the sodic plains found here. Due to their isolation and weak runoff conditions such depressions and low areas promoted the accumulation of periodic waters, which, as a result of the known salt composition of ground water, led to the formation of sodic wetlands and higher level sodic areas.
The cause of salination in all cases is the salty ground water with a high $Na(Mg,Ca)HCO_3$ content. The Pannonic salt (sodic) steppes, wetlands and marshes have developed by characteristic salt composition and continental climate.

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°C. The mean temperature of the coldest month (January) is between minus 1.5 and minus 2°C, while that of the warmest month (July) is 21-22°C. Characteristically of areas with a continental climate, the annual average temperature variance is quite significant (23-24°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°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°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 450-550 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).

The region so characteristic of the plain territories of the Carpathian Basin in terms of geology and climate offered settling opportunities for the natural continental fauna, including elements of both steppe and mediterranean nature. In addition, due to its geographical location (e.g. as a basin centre surrounded by mountains) and its other features it became a place for the development of numerous endemic plant and animal species.
Under the given geological situation and under homogenous climate conditions the varied fauna is primarily the result of the abundance of pedological, hydrological and micro-relief conditions.

Hydrology
The sodic-alkaline alkaline wetlands are 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 regurlary varies between hypo- (0,8-20 $g.l^{-1}$), sometimes in 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. Some shallow opened water tables have very high turbidity attributed to countinuos 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 depends 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 dull brown colour.

Physical features of the catchment area:

The sodic plain belongs to River Danube catchment area. The general physical features of the site is characteristic for almost whole catchment area of the pans, but have to put emphasis on sodic wetlands have more extensive groundwater catchment area than on the surface. The local wetland catchment area has two main parts, on the major part is the lowland River Danube basin, and on the eastern part is the plain sandy ridge plateau.

Prior to the river control of the Danube the Danube Valley used to be the river's normal floodplain, then it was an area covered with inland waters on a regular basis subsequently, as well. Also, as a result of its pedological (mainly calcareous-sodic plains developed on granulated gravel rocky bed) and geological structure (the significant presence of a fine waterproof clay layer) precipitation filter downwards with difficulty and may remain permanently in the depressions. It is generally true that due to the winter precipitation and the high ground water level in the spring significant water volumes appear in the depressed areas (in the isolated depressions of lake beds and old water flows).

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