Habitat-pattern and landscape ecological evaluation of the microregions of Csongrád county

Abstract of PhD thesis

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1. Introduction

The aim of my dissertation is to reveal the *habitat-pattern* of Csongrád county's microregions and the interactions between *abiotic and biotic factors* – with special care to the connections between surface deposits, hydrogeographical, geomorphological, soil and vegetation conditions – forming it, and to *specify the borders and name of microregions*. I tried to reveal the soil-vegetation connections at the habitats of the Dorozsma-Majsaian Sandlands (Őszeszék, Pántlika) and the secondary alkali vegetation of Nagysziget (Hódmezővásárhely) with the examination of near-to surface soil-samples. I created a reconstructed habitatmap-series for 3 sample areas using historical maps and my own field-knowledge and evaluated the changes of the percentage of habitats. I examined the vegetation-pattern on local and microregional level. I determined the *local habitat-patterns* with the help of polygonal maps for smaller sample areas. I determined the percentage of the area and patch-number of main habitats, their size – patch-number distribution and their typical patch-size intervals at the sample-areas of the floodplains and loesslands of Csongrádian Plain. I used the MÉTA-database for evaluating the *landscape-level habitat-patterns and gradients*, which is based on own data of field-work in 68% for this county. On the base of MÉTA I calculated the *spatial ratio of natural habitats* comparing to each other. I ordered the habitats *habitat-complexes* according to their patterns, roles in zonation and connection with other biogeoecological factors, which are base of the *vegetational landscape-types and vegetational landscape main-types*. The differences between the habitat-composition were used to *specify the border of the flora districts of Crisicum and Praematricum* (Újszász-Szeged-line).

2. Methods

The landscape pattern of *surface deposits*, *climate features*, *groups of geomorphological formations* and *soil-types* were evaluated on the base of existing maps. The vegetation-types were identified as the result of 400 days of field-work (2002-2007) extended to the 2/3 of the natural areas of the county. At the actual habitat maps I used *ÁNÉR*, whereas at the historical maps the *CORINE-based habitat category-systems*. I deliniated the *local habitat patterns* and the *historical map-series* with *polygonal* (vectoric) *maps*. I made more detailed maps for the Kiskunságian Loesslands (Baksi-puszta), the Dorozsma-Majsaian Sandlands (Kisiván-szék, Kerekes-rét, Jancsár-szék, Madaras-rét, Kancsal-tó), the Csongrádian Plain and the floodplains (active floodplain (river Körös between its estuary and the county-border, river Maros between Újszeged and Ferencszállás; Makó and Apátfalva); saved-side non-saline landscape (Kis-rét at Szegvár); secondary saline landscape (Darvas, Mártélyi-lapos, Nagysziget); lag-surface (Tőkei-gyep)). In the sample areas of Crisicum I determined *the proportion of the area and the patch-number of the habitats* and their *patch-number - patch-size distribution*. At *landscape-level evaluations* the *rasteric MÉTA database* was used, which were base to *compare the proportion of the natural and near-to natural habitats of the county* (Horváth F. et al. 2008). In order to research *soil-vegetation connections* soil-samples were collected in Balástya (Dorozsma-Majsaian Sandlands) at 20, whereas in Nagysziget, Hódmezővásárhely at 16 places from the upper 20 cm layers. The classification of soil-types happened after Stefanovits (1999). I determined the *pH*(H_20) with *Radelkis electrometric method*, the humus-content with *spectrofotometric method*, the *soda-content* with *titration*, the *water-soluble salt-content* with measuring conductivity with *electrometric method*, the *percentage distribution of grain-fractions* with *settling method*.

3. Results

- Those habitats which are in closer dynamical and successional connection can be sorted into **habitat-complexes** which can be ordered into **vegetational landscape-types** and **vegetational landscape main-types** – *sand-, loess- and floodplain-landscapes* - according to their typical habitat-composition.
- ***In Csongrád county 10 microregions can be identified on the base of the landscape-level researches of landscape ecological conditions***. The ***sand-landscapes*** are represented by the Dorozsma-Majsaian and the Pilis-Alpárian Sandlands, the ***loess-landscapes*** by the Kiskunságian Loesslands, the Szegedian and the Csongrádian Plain, the ***floodplain-landscapes*** by the South-Tisza-valley, the Lower Maros Floodplain, the Hármas-Körös Floodplain, the Körösszög (Körös-angle) and the Bánságsarok (Arankaköz).

3.1. Sand-landscapes
3.1.1. Statements refering to the Dorozsma-Majsaian Sandlands

- The matrix of the landscape is formed by the ***yardangs*** and ***sand-sheets*** built-up of *wind-blown sand* which are covered by *humous sandy soils*, where mainly *sand steppe-grassland*s exist nowadays.
- The near-to-surface meadow dolomite and meadow limestone layers improving the water balance of sandy soils could contribute to the formation of the sand steppe-grasslands. The yardangs and sand-sheets

because of their less intensive relief and near-to surface ground-water table are affected less by wind erosion, so the vegetation closes faster on them.

- The ***fields of blow-out dunes*** with more intensive relief affected by higher wind-erosion consist of *wind-blown sand* too. They are covered by *humous sandy* with less *humus-content* compared with the soils of yardangs and sand-sheets, as the layers slowing the infiltration are situated deeper, so their vegetation consists of *open sand grasslands (Festucetum vaginatae „danubiale")*, *sandy poplar and open sandy oak forests*, but they are *rare* in this microregion, their *sandy poplar forests are the hawthorn-poplar forest*.
- The ***deflation hollows*** are filled with calcareous silt, calcareous silty sand, meadow limestone or meadow dolomite. The northwest *parts of them is dominated by moor-type of vegetation*, whereas at their southeast parts *saline habitats* can be found. I call the moor-like parts as ***fen-heads***, whereas the saline parts as ***saline feet***. This local habitat-pattern typical for the Dorozsma-Majsaian Sandlands is named as ***fen-head – saline foot pattern*** which was described me first in Kisiván- and Sáros-szék, but found in more than 200 deflation hollows during my researches later.
- At the ***fen-heads*** the *meadow soils* are the most frequent covered by *Molinia fens (Succiso-Molinietum hungaricae)*, *wet fens, sedgefields, Deschampsia meadows, fen tall-stalk vegetation, Salix cinerea wet shrubs* and *closed lowland pedunculate oak forests* can appear. The *tussock meadows, peat-producing reeds, willow-, alder-, ash-fen-woodlands* are the habitats of the *peaty meadow soils* which have higher ground-water surface and dry out just by the end of summer.
- These habitats are followed southeastwards by the *salt meadows* of the saline feet which have mainly *solonetzic meadow soils* rarely *solonchak-solonetzes*, so to these grasslands the ***sandland-type salt meadows*** expression is suggested instead of „solonchak" salt meadows.
- Among the sandland-type salt meadows the ***Festuca arundinacea dominated salt meadows*** - *Achilleo asplenifolii-Festucetum arundinacea* – can be separated as a new plant-associations, which appear between the zone of sand steppe-grasslands and *Agrostio-Caricetum distantis* on the edge of saline feet covered by 10-20 cm sand sheet. The *pH* and *total salt-content* of the uppermost layers of soils *is somewhat higher*, whereas *the humus-content is lower* compared with *Agrostio-Caricetum*s.
- In the southeast parts of saline feet the salt meadows are changed by the Danube-Tisza Interfluve type of *Puccinellia swards* (*Lepidio crassifolii-Puccinellietum limosae*) and *annual salt pioneer vegetation* (*Lepidio crassifolii-Camphorosmaetum annuae*) indicating higher pH and surface salt-accumulation as they have *solonchak* and *solonchak-solonetz* soils. *Salt swamps* are typical at dm surface water coverage lasting until mid-summer.

- Alongside this soil and habitat gradient the ***cross-section zonation of saline feet*** also changes. The *parts of the saline feet situated closer to the fen-heads are dominated by salt meadows in the deeper parts*, *which are bordered by Puccinellia swards*, while *the southeast parts are filled by Puccinellia swards*, *which are bordered* by rarely *annual salt pioneer swards,* more often *salt meadows* which can be wider if the edge of the saline depressions are covered by thin sand sheet.
- ***The development of habitat and soil-pattern*** of ***fen-head-saline foot*** gradient can be explained with the *flow of subsurface water (groundwater)* and their *appearance on the surface* and with the *evapotranspiration*, but the near-to-surface aquicludes or semi-permeable layers (e.g. clay, meadow dolomite, meadow limestone, calcareous silt) have also an important role. The precipitation fallen down in the Dorozsma-Majsaian Sandlands and in the central part of the sandlands of the Danube-Tisza Interfuve feeds a *regional (landscape-level) groundwater-flow system* keeping from northwest to southeast according to the general sloping of the surface and sub-surface layers of the microregion. However the *local groundwater-flow system* comes into the deflation hollows from the fields of blow-out dunes and sand sheets surrounding them. The first system can be made parallel with the intermedier gravity driven flow regime, whereas the second one corresponds to the local gravity driven flow regime. The regional subsurface water flows reach the surface at the fen-heads at the northwest parts of deflation hollows and as they run southwards on the surface or near to the surface their salt-concentration and pH increases because of the evaporation, which favours the appearance of saline habitats.
- The extensive *fields of blow-out dunes, sand sheets* as *„extra" local infiltration zones* can increase *the proportion of the fen-heads*.
- There are differences in the features of soils of the microregion's habitats according to the **researches of soil samples** taken from the uppermost 20 cm layers in Balástya:

- There is a ***pH- and salt-gradient*** between the saline feet of ***deflation hollows*** and the neighbouring ***yardangs***.
- There is a ***pH-gradient*** between the ***fen-heads and saline feet of deflation hollows***. In both searched transects *the pH of the Puccinellia swards of the southeast ends of the deflation hollows is almost higher with 2 values than the pH of the Molinia fens of the northwest part of these depressions. Alongside the gradient the Molinia fens with slightly alkaline pH is followed by the slightly alkaline salt meadows, and the strongly alkaline Puccinellia swards.*
- There is a ***salt-gradient between the fen-heads and saline feet*** which distribution is similar to the pH-gradient.

- The ***humus-content of the habitats of deflation hollows*** also changes alongside the gradient. *The highest humus-content is at the Molinia fens, which decreases towards the Puccinellia swards, but there is a local minimum in the transitional zone between the fen-heads and saline feet.*
- The soil-types and habitats of the land-forms can be also separated on the ***mechanical composition*** of the uppermost 20 cm layer of soils too:

- The most frequent grain-fraction of the ***humous sandy soils*** of the ***yardangs and sand sheets*** is the *small-grain sand*.
- At the *meadow soils* of the ***Molinia fens*** the *medium-* and the *small-grain sand* is co-dominant, but the amount of *rock-flour* is significant too.
- *Approaching the saline feet the ratio of the coarse-, medium- and small-grain sand decreases also in the surface layers of the soils, whereas the proportion of silt (rock-flour and silt) and clay increases.* However the distributions of the grain-fractions of the associations of *salt meadows* are different, they are influenced by former sand-movements. At the *Puccinellia swards, annual salt pioneer vegetation* and *Bolboschoenus maritimus* dominated salt swamps the fractions of *small-grain sand, rock-flour and clay* are the highest.

- ***From the local fen-head –saline foot patterns a*** **microregional-level pattern** a ***landscape-level habitat-gradient has also been outlined.*** *Towards the eastern edge of the microregion the proportion of saline habitats* increases, the *Puccinellia swards* are more common. Whereas *the proportion of fen-heads increases, the saline habitat's decreses towards the western part of the microregion.*

- According to these gradients the *Dorozsma-Majsaian Sandlands have three parts*. In the *western third* the deflation hollows are filled with thick wind-blown sand, so they are filled by *sand steppe-grasslands or steppic type of dried-out (former saline or moor-like) meadows*. In the *mid-third typical fen-head – saline foot patterns* can be found, the proportion of fen-heads here is the biggest. In the *eastern third* the deflation hollows dominated by *salt meadows* is typical, the proportion of fen-heads is small. The border of the western and mid-third is at the Ásotthalom-Öttömös-Ruzsa-line, whereas the border of the mid- and eastern third is at the Madarász-tó – Domaszék – Kőhalmi-dűlő – Pántlika– Kömpöc-puszta – Perczel-Feketehalmi-tanyák) - line. These landscape-level *habitat-gradients* are the result of the near-to-surface *local* and *regional groundwater-flows*.

- The *role of regional* and the *local groundwater-flows is especially important in the formation of the wetter communities* of fen-heads *like wet fens, tussock meadows, peat-producing reeds, willow-* and *ash-fen-woodlands*, as they appear mainly at the western part of the mid-third of the Dorozsma-Majsaian Sandlands.

- *In the western third and in the western part of the mid-third* almost just the *saline meadows fill the saline feet.* The *Puccinellia swards* appear in the *eastern part of the mid-third and in the eastern third* of the microregion: east from the line of Királyhalom-Mórahalom-Zákányszék-Bordány-Forráskút-Alsópálos.
- Two natural **vegetational landscape-types** can be found in the Dorozsma-Majsaian Sandlands. Among them the proportion of ***sand-landscape with mosaics of deflation hollows with fen-head – saline foot pattern, steppe grasslands and forests*** exceeds the percentage of the ***sand-landscape of fields of blow-out dunes covered with open sand grasslands and forests***, which is more common in the Kiskunságian- and Bugacian Sandlands. On the place of these vegetational landscape-types as a result of more intensive landscape-use ***sand-landsape dominated by hamlets, small-field arable lands, orchards, vineyards*** were formed, but as a result of the give-up of this type of landscape-use ***sand-landscape with mosaics of fallows and planted forests*** appear.

3.1.2. Statements refering to the Pilis-Alpárian Sandlands

- The *sand steppe grasslands* of the *humous sandy soil covered sand sheets and yardangs consist of wind-blown sand* and the *open sand grasslands, sand poplar and oak forests of blow-out dunes* have mainly extincted because of the grape cultivation and arable lands established since the 19th century. In the *solonchak-solonetz* or *solonetzic meadow soils* filled *deflation hollows sandland-type salt meadows* occur.
- *The infiltrating water in the Pilis-Alpárian Sandlands feed groundwater-flows eastwards and westwards reaching the surface at the edge of the microregion, which is indicated by fen-zones.* The Bartók-rét is part of the fen-zone situated at the meeting point of the Pilis-Alparian Sandlands and the Kiskunságian Loesslands, where *in the northwest part moor-type of habitats – tussock-meadows, wet fens, sedgefields, Deschampsia caespitosa dominated meadows -,* whereas *in the southeast parts salt meadows occur*, which corresponds to the fen-head – saline foot pattern. The eastern up-welling (fen)-zone of the microregion is in the floodplain of the river Tisza.

3.2. Loess-landscapes of the Crisicum

- The *pusztas of the loess-landscapes of* the *Crisicum* can be classed among the ***ancient salt-berm steppe with mosaics of loess steppe-grasslands and oak loess steppe-forests*** **vegetational landscape-type**, which includes *3 habitat-complexes*: the *mosaics of loess steppe grasslands and oak loess-*

steppe forests of loess-ridges (dominated by loess-steppe grasslands and oak-forests formed on chernozems)*, wet saline habitats of ancient river-beds* (salt swamps, meadows, Puccinellia and annual salt pioneer swards on solonchak, solonchak-solonetz, solonetzic or solonchak meadow soils) and the *salt-berm steppe* (*Artemisia alkali steppes formed on meadow solonetz dominated complex)* situated between them. On the place of mosaics of loess steppe grasslands and oak loess-steppe-forests *the* ***arable land dominated loess-landscape with boundaries and channels*** evolved.

- *The loess-landscapes of Crisicum have large-size patches on landscape level* (e.g. large-field arable lands, pusztas), but the *local habitat pattern of the more natural habitat-complexes is small patchy, their β-diversity is high* (see salt-berm steppe, channels, boundaries).

The features of Crisiscum is the presence of salt-berm steppes, loess steppe-grasslands, Artemisia alkali steppes and the Alopecurus-dominant salt meadows.

3.2.1. Statements refering to the salt-berm steppes of Crisicum

- The ***habitat zonation, composition, vegetation dynamical processes, soil-vegetation connections of alkali vegetation of the Kiskunságian Loesslands, the Szegedian- and the Csongrádian-plain and the lag-surfaces are similar****, as* **their alkali vegetation is the salt-berm steppe**.
- *In natural circumstances the salt-berm steppes are formed at the meeting of the ancient river-beds and the loess-ridges*, but *their formation and development is influenced by human landscape-use* (e.g. treading of vehicles and farm animals, building of channels).
- The ***habitat pattern,*** the ***processes of vegetation dynamics, succession*** and ***soil-development of salt-berm steppes*** are mainly determined by the ***erosion of salt-berms***, but the role of ***water-supply, water dynamics*** and ***landscape-use*** is also important.
- Because of the linear and areal **erosion of salt-berms** ***the loess-ridges are cut into pieces and declined, the salty subsurface comes near to the surface, so the proportion of saline habitats grows at the expense of loess steppe-grasslands.*** The *chernozems solonetzic in the deeper layers of the edges of the actually with* **areal erosion** *denudating salt-berms are altered into meadow solonetzes,* which is indicated by the *fragmentation,* the *decrease of species* and *extension of steppe-grasslands,* the *appearance of Achillea dominated patches* and the *ground-gain of Artemisia alkali steppes.* Because of the ***linear erosion*** *of the retreating alkali brooks the zone of Artemisia alkali steppes is broken up too. In the alkali brooks* as the surfaces equals *Puccinellia, annual salt pioneer swards*, *salt meadows* can

expand. ***Because of the change of surface-morphology and the near-to-surface come of salt-accumulation layer the habitat zonation of salt-berm steppes are shifted towards the centre part of the eroding loess-ridges.***
- At the *salt-berm steppes* the *organic material accumulation based* **succession** *schemes are overwritten by the salt- and water dynamics, the landscape-use and the erosion of salt-berms which determine the extension, shape, fragmentation*, *spatial position, formation of transitional types and the intensive dynamical processes*.
- *The habitat diversity of the Crisicum loess-landscape is the highest at salt-berm steppes,* as the *total number of patches* here is the highest*,* the number of *small-size and transitional patches* indicating the dynamical and successional changes here *are here the most common*, as the changes in water and salt regime and the salt-berm erosion here is the most intensive.

3.2.2. Statements refering to the Kiskunságian Loesslands

- The ***Kiskunságian Loesslands belongs to the Crisicum flora district*** on the base of *surfaces deposits, soils, habitat-composition, processes of vegetation dynamics*, but ***alongside*** a ***gradient*** *westwards* the *Praematricum's*, while *eastwards* the *Crisicum characteristics* increase.
- The *Újszász-Szeged-line is situated at the southern, western and northern border of this microregion.*
- The **less saline habitats of *Kiskunsági-löszöshát* – salt meadows, Artemisia alkali steppes and loess steppe-grasslands – are Crisicum-type.**
- The **most saline habitats of the Kiskunságian Loesslands – Puccinellia swards and annual salt pioneer swards – are Praematricum-type** (*Lepidio crassifolii-Puccinellietum limosae, Lepidio crassifolii-Camphorosmaetum annuae*).

3.2.3. Statements refering to the Szegedian Plain

- The loess-landscape of the **Szegedian Plain** situated between Sándorfalva and Röszke differs in its *landscape evolution, surface deposits, morphology, soil-types, natural vegetation, landscape-use, present and former hydrogeographical characteristics* from the floodplain of the river Tisza and the Danube-Tisza Interfluve Sandlands.
- The ***landscape ecological conditions*** *of the Szegedian Plain show relationship with the Kiskunságian Loesslands. The most saline habitats of Szegedian Plain* - the Puccinellia and the annual salt pioneer swards – *are*

Praematricum-type too, whereas the less saline ones – salt meadows, Artemisia alkali steppes and loess steppe-grasslands – *are Crisicum-type.*
- A moderate *habitat-gradient* in the Crisicum and Praematricum character of the associations can be pointed out in this microregion too.
- The *western border of the Szegedian Plain coincides with the Újszász-Szeged-line*, so ***the Szegedian Plain is part of the Crisicum flora district***.

3.2.4. Statements refering to the Csongrádian Plain

- The ***surface deposit-morphology-soil-vegetation connections*** of the Csongrádian Plains are almost the same with the two above mentioned microregions. The most extended habitats of the pusztas of Csongrádian Plain are the *salt meadows* and the *Artemisia alkali steppes,* but the proportion of *loess steppe-grasslands* can be significant too. The most kurgans of the county can be found in this microregion, so the extension of the *loess-abyss vegetation* here is the highest.
- On the base of the researches in ***Gulya-kút of Nagyér*** the *salt meadows* and *loess steppe-grasslands* can be either *small-, medium-* or *large-sized*, the *Artemisia alkali steppes* (largest patch-number)*, salt swamps, Achillea alkali grasslands* are rather *small or medium-size habitats,* whereas the *Puccinellia swards* and *annual salt pioneer swards* are *small patch*y.

3.3. Floodplain landscapes

- Because of the *diverse geographical conditions, differences in landscape use and history not just the β-diversity* (diversity of habitats), *but the γ-diversity* (diversity of vegetational landscape-types) *of floodplain landscapes is also higher compared with the neighbouring microregions*. I separated ***5 vegetational landscape-types*** in the floodplain landscape of Csongrád county (*active floodplain (wave-area)*, *saved-side non-saline low floodplain; floodplain moor-landscape; saved-side (low floodplain) secondary saline landscape; saved-side lag-surfaces of high floodplains*).
- The ***type*** (15 habitats)**,** the ***spatial distribution*** and ***pattern*** of ***the habitats are determined by the hydroecological parameters and the landscape-use more than the spatial pattern of the genetic soil types and soil textur****e of the* ***active floodplains*** and the ***saved-side non-saline low floodplains***.
- The ***willow-poplar alluvial forests*** in these microregions can be classified into *Salicetum albae-fragilis* or into the coenologically non-described *Tisza-valley type of willow-poplar alluvial forests* which have several ecotypes (*riparial; mid-active floodplain; active floodplain's oxbow lake-side* forests*; willow swamp-forests; rodding willow forests planted into active*

floodplain's oxbow lakes, navvy-forests; rodding willow forests planted into saved-side cut-off meanders; saved-side oxbow lakes's littoral forests).

- The yearly and several yearly changes of the duration and height of inundation cause the shift of the habitats of the littoral zonation, the development of transitional stocks and small size patches in the shallower floodplain wetlands (active floodplain's oxbow lakes, navvy-holes, saved-side paleopotamals, crescentic flats).

3.3.1. Active floodplain (wave-area) landscape

- This landscape type can be divided into ***5 habitat-complexes*** (active floodplain's oxbow-lakes; navvy-holes; grassland and forest mosaics with arable lands and orchards in the middle of the active floodplain; vegetation of river-beds and river-banks; dyke-vegetation).
- The *vegetation,* the *zonation,* the *vegetation dynamical* and *successional processes* of the ***active floodplain's oxbow lakes*** and the ***navvy-holes are very similar,*** but there are ***differences*** too.
- The *water capacity of the* ***navvy-holes*** *is lower, so they dry out faster* resulting more intensive *water and vegetation dynamics*, whereas their *bank is steeper.* So the habitats of navvy-holes *are more fragmented*, *has more small-sized patches, their extension and habitat-pattern changes more intensively,* the *vegetation remains pioneer-type*, *the transitions* and the *ruderal inundation vegetation* is more *common.*
- Alongside the river Hármas-Körös 5 *types of navvy-holes* were separated (1. *Eutrophic reed-grasses with micromosaics of Butomus, Eleocharis, Alisma, Oenanthe dominated swamps in the summer*, 2. *Eutrophic reed-grasses with micromosaics of sedgefields in the summer*, 3. *Eutrophic reed-grasses with micromosaics of sedgefields, ruderal inundation vegetation*, *Butomus, Eleocharis, Alisma, Oenanthe dominated swamps in the summer,* 4. *Eutrophic reed-grasses after dry-out with ruderal inundation vegetation*, 5. *Eutrophic reed-grasses after dry-out with ruderal inundation vegetation and invasive tree species*).
- The more extended water-surface and the continuous summer water-level decrease of the ***active floodplain's oxbow lakes*** ensures more equalized water regime, the *littoral zonation is more stable, wider, less fragmented*, but it can shift and transitions can develop dependent on water dynamics.
- The *willow-poplar alluvial forests* of the active floodplain's oxbow lakes have 3 *ecotypes* (*active floodplain's oxbow lake-side willow-poplar alluvial forests*, *willow swamp-forests, rodding willow forests planted into active floodplain's oxbow lakes*).

- The habitat-complex of ***grassland and forest mosaics with arable lands and orchards in the middle of the active floodplain*** has been consisted of the *floodplain meadows and sedgefields* with the mosaics of willow and poplar groups of the wooden hay-fields and pastures from the 19th century to the 1950-1960s, but nowadays the *mid-active floodplain willow-poplar alluvial forests* became more common. The *extensive floodplain orchards with ancient varieties* are the most common in this habitat-complex.
- The *annual wet pioneer vegetation* and the *willow-shrubs* are the most common in the ***vegetation of river-beds and river-banks***, their willow-poplar alluvial forests are the *river-side (riparial) ecotype*.
- The ***dyke-vegetation*** is dominated by *loess steppe-grasslands* and *floodplain meadows*, their ratio is influenced by the exposure of slopes and the microclimatic conditions.
- On the researched sample areas the *willow-poplar alluvial forests* and the *hard-wooden alluvial forests* are *large-sized*, rarely *medium-sized* habitats, the *loess steppe-grasslands, floodplain meadows, sedgefields* are *large-* and *medium-sized*, rarely *small-sized*, whereas the *reeds and bulrushes,* the *floodplain tall-stalk vegetation*, the *annual wet pioneer vegetation,* the *ruderal and semi-ruderal inundation vegetation*, the *willow-shrubs,* the *Glyceria, Typhoides, Bolboschoenus***,** *Butomus, Eleocharis, Alisma, Oenanthe dominated swamp* are *medium- and small-sized.*

3.3.2. Saved-side non-saline low floodplain

- This landscape-type can be broken down into three habitat-complexes (*saved-side oxbow lakes, abandoned channels; mosaics of non-saline grasslands, paleopotamals and forests of saved-side low floodplains; saved-side low floodplains with channels, boundaries and arable lands*).
- In the vegetation of ***saved-side oxbow lakes, abandoned channels*** the *eutrophic reed-grasses*, the *non-peat-producing reeds, bulrushes and clubrushes*, the *native tree dominated tree-groups, tree-rows* are typical.
- The matrix of the ***mosaics of non-saline grasslands, paleopotamals and forests of saved-side low floodplains*** is formed by *floodplain meadows*, in which *sedgefields, different swamps* of *crescentic* flats and paleopotamals rarely *rodding willow forests planted into saved-side cut-off meanders* are incorporated.
- The ***saved-side low floodplains with channels, boundaries and arable lands*** is the plough-up version of the above mentioned habitat-complex. *Because of the dominance of arable lands this habitat-complex can be separated from the neighbouring loess-landscapes's similar landscape type.*

- On the base of the sample are of Kis-rét in Szegvár the *floodplain meadows* are *large-sized*, partly *medium-sized habitats* in this landscape type, whereas the swamps can be *small-, medium- and large-sized*.

3.3.3. Floodplain moor-landscape

- The **floodplain moor-landscape** can be divided into the *mixed eutrophic and moor-lake wetlands at the loessland-border of floodplains* and the *mosaics of moor and floodplain habitats at the sandland-border of floodplains* (see Tiszaalpár). The previous one appears in the Kurca as a result of the mix of surface and sub-surface water-supply so the *eutrophic and the Nymphea dominated moor-lake reed-grasses* can appear together.

3.3.4. Saved-side secondary saline landscape

- *This landscape-type can be taken apart into two habitat-complexes*: *meadow-steppic* and *Achillea secondary saline sub-types*.
- The ***meadow-steppic secondary saline sub-types*** are wetter and they are situated closer to the active floodplains, their soils have salt accumulation in the deeper layers because of the boils, so they are dominated beside the *salt meadows* by *meadow-steppes*, which can be *small-, medium- and large-sized* too. The meadow-steppes has the largest patch-number in the sample areas.
- The ***Achillea secondary saline sub-types*** are drier, the influence of boils doesn't succeed. Beside *salt meadows* the *Achillea alkali steppes* are the most typical habitats here.
- The *saline meadows and Achillea saline grasslands* of this subtype can be *small-, medium- and large-sized*. The played role in landscape pattern, the significantly higher patch-number in every size-range (especially at the medium-sized patches), the presence of the large-sized patches and the higher territorial proportion make different these stocks from the ones in the loess-landscapes.
- 3 vegetational units of the Achillea secondary saline sub-types can be separated. The ***homogenous salt meadows*** appear in *crescentic flats, paleopotamals* at near-to-surface *0-0,5 m deep average yearly groundwater-level*, on *meadow solonetz, meadow, carbonated alluvial meadow* and *meadow alluvial soils.* The ***homogenous Achillea alkali steppes*** are formed on *levées*, at deeper - *1,3-2,0 m - average yearly groundwater-level* on *non-sodic – carbonated humous alluvial and carbonated humous alluvial meadow - soils*. The ***mosaics of salt meadows and Achillea alkali steppes***

occur on *point bars*, at *0,1-1,3 m deep average yearly groundwater-level*, on *meadow solonetz*.

- On the base of **soil measurements** taken from the upper 20 cm layers of Achillea secondary saline grasslands of Nagysziget the following statements can be done:
    - The ***pH*** of *homogenous salt meadows* and *mosaics of salt meadows and Achillea alkali steppes* can be *slightly acid* or *slightly alkaline*. The *Beckmannia dominated salt meadows are slightly alkaline*, whereas the *Alopecurus dominated salt meadows are slightly acid*.
    - *There is a pH-gradient between the salt meadows of the point bars and crescentic flats*.
    - The *homogenous Achillea alkali steppes of the levées have slightly acid pH*.
    - *The pH of this Crisicum type Pucinellia swards here is behind the Praematricum types with almost 2 values*.
    - The *Beckmannia dominated salt meadows* in *homogenous patches are very slightly humous*, whereas in the *mosaics of salt meadows and Achillea alkali steppes* are *slightly humous*. The humus-content of the *Alopecurus dominated salt meadows is higher:* the homogenous stocks are moderately, whereas the ones in the mosaics are slightly humous.
    - The *homogenous Achillea alkali steppes* are *moderately,* whereas the ones in the *mosaics with salt meadows* are *slightly humous*.
    - The organic material content of the Achillea alkali steppes of the mosaics of salt meadows and Achillea alkali steppes is with 1,1-1,5 % higher compared with the salt meadows of these mosaics.
    - At all the researched vegetation- and soil-types the *fine sand* is the dominant (30-50%) ***grain fraction.***

3.3.5. Saved-side lag-surfaces of high floodplains

- The habitat-complexes of ***sand and loess lag-surfaces*** can be separated inside this landscape-type. The extension of sand lag-surfaces is smaller, their vegetation has extincted in this county. The vegetation of the *loess lag-surfaces* is similar to the loess-landscapes, the landscape-type of *lag-surfaces with channels, boundaries and arable lands* have formed after the plough-up their loess-vegetation.
- The *loess steppe-grasslands, saline meadows, Artemisia alkali steppes, Achillea saline grasslands, reeds, bulrushes* can be *small-, medium- and large-sized* on the loess lag-surfaces. The *floodplain meadows* are rather *medium-* or *large-sized habitats,* whereas the *Puccinellia and annual salt pioneer swards,* the *Glyceria, Typhoides dominated swamps* and the *annual*

wet pioneer vegetation are rather *small-sized, in lower proportion medium-sized* habitats.

3.3.6. The floodplain microregions of Csongrád county

The following principles are emphasizable at the taxonomy of the floodplain landscapes:

- *It's essential to determine the ratio of the low floodplains flooded regularly before the regulation of the river-ways and high floodplain terrains* incorporated into them.
- The *matrix of the low floodplain terrains flooded by the rivers formerly assigns the border of the floodplain landscapes*.
- *Those pleistocene sediment covered terrains at the edge of the young alluvium which were just rarely flooded or were never embraced around with the floods of rivers before the regulation of the river-ways, can't be classed among the floodplain landscapes.*
- *The ancient river-beds of the loess-landscapes bordering the floodplains can't be considered to the part of floodplain landscapes or microregions.*
- *The spatial distribution of the secondary saline areas formed after the regulation of the river-ways must be taken into consideration at the bordering of floodplains.*
- *The rivers are individual physical geographical entities, so the determinant river's flood before the regulation of the river-ways should be taken into consideration.*
- The connection systems of the landscape ecological sub-systems show unified functional principles. However the *soil- and vegetation pattern*, *the presence and proportion of different habitats, habitat-complexes, landscape-types are microregion-specific.*
- ***On the base of the above mentioned principles 5 floodplain microregions can be separated in Csongrád county***:

3.3.6.1. South-Tisza-valley

- In the *active floodplain* the proportion of willow-poplar forests is high.
- *The floodplain tall-stalk vegetation, the floodplain meadows, the sedgefields and the hard-wooden alluvial forests of the grassland and forest mosaics in the middle of the active floodplain are rare.*
- At the active floodplain's oxbow lakes and navvy-holes the proportion of eutrophic reed-grasses, Butomus, Eleocharis, Alisma, Oenanthe dominated swamps is more significant.
- All habitat-complexes of *saved-side non-saline low floodplains* appear.

- The *floodplain moor-landscape* appears just in this microregion.
- The *saved-side secondary saline landscape is* more common to the other microregions. The *meadow-steppic sub-type* is rarer than *Achillea sub*-type.
- The proportion of the *saved-side lag-surfaces of high floodplains* is low.

3.3.6.2. Lower Maros Floodplain

- It is the floodplain of the *river Maros,* which Hungarian reach contains *all the vegetational landscape-types except the floodplain moor-landscape*, but *the landscape type of the saved-side secondary saline landscapes, lag-surfaces of high floodplains* and the *habitat-complexes of the mosaics of non-saline grasslands, paleopotamals and forests of saved-side low floodplains,* the *saved-side* and *active floodplain's oxbow lakes and the navvy-holes are less common*.
- The *floodplain meadows,* the *oak-elm-ash alluvial forests,* the *annual wet pioneer vegetation*, the *willow-shrubs,* the *extensive floodplain orchards* and the *reeds* and the *floodplain Bolboschoenus dominated swamps* of navvy-holes and oxbow lakes are more common, but the proportion of the *sedgefields, Glyceria, Butomus, Eleocharis, Alisma, Oenanthe dominated swamps, eutrophic reed-grasses is lower.*
- The *active floodplain of the river Maros is separated into two parts with different landscape-use*: into a *small-plot dominated, more mosaic upper reach with more complex landscape-use* (mosaics of arable lands, orchards, grasslands, forests) preserving the *marks of the smallholder landscape-use* and into a planted *forest* and *large-plot dominated lower reach containing less habitat-patch and type*.

3.3.6.3. Bánságsarok (Arankaköz)

- The Bánságsarok (Arankaköz) is a loess-lag-surfaces dominated microregion divided with abandoned Aranka (Ancient-Maros) river-beds. The remains of the natural vegetation is represented by the *ancient salt-berm saline steppes*, the *wet saline habitats* the *closed lowland pedunculate oak forests,* the *oak loess steppe-forests*, the *saline oak forests*, the Achillea-subtype of *saved-side secondary saline landscape.*

3.3.6.4. Körösszög

- *The* Körösszög *is the complex of loess-lag-surfaces of high floodplains* formed from the alluvial cone of the *Ancient Tisza* containing its meanders *and the matrix of the near-to-estuary low floodplain of the Hármas-Körös*.

The *landscape-types, habitat-complexes and habitat-composition of Körösszög are similar to the South-Tisza-valley and Csongrádian Plain.*
- The natural vegetation of the *lag-surfaces* have preserved on greater area, but the proportion of saved-side non-saline low floodplains and secondary saline floodplains is lower.
- *All* the habitat-complexes of the *active floodplain landscape* occurs*, their habitat-composition is the same as the South-Tisza-valley's*. The *active floodplain's oxbow lakes* dry out more often and earlier so the ruderal inundation vegetation appears more often. The number of *navvy-holes* is high. The proportion of *floodplain grasslands is significant which are formed by rather sedgefields beside the floodplain meadows* because off the impounding effect of the river Tisza, but *„saline sedgefields"* also appear.

3.3.6.5. Hármas-Körös Floodplain

- The *Dögös-Kákafoki-bay* is the part of the microregion of **Hármas-Körös Floodplain** covered mainly by the *Achillea type of saved-side secondary saline grasslands*, the *loess lag-surfaces are rarer.*

4. The proportion of natural habitats in Csongrád county

- The *total estimated area of natural habitats* covers *10,8% of Csongrád county.*
- The *salt meadows* are the most extended natural habitats of the county amounting 1/3 of them and the 3% of the county. The second largest natural habitats are the sand steppe-grasslands and the willow-poplar alluvial forests (8,7%) which are followed by the reeds, bulrushes and clubrushes, meadows, Artemisia alkali steppes and loess steppe-grasslands.

5. Bordering of microregions

- The ***eastern border of the*** **Dorozsma-Majsaian Sandlands** can be drawn at the lone of Röszke – Subasa – Nagyszék - Hosszú-hát – Szatymaz-Neszürjhegy – Sándorfalva – Dóc – Ópusztaszer-Munkástelep-Tömörkényi-erdő-Pálmonostora-Kiskunfélegyháza-Városföld.
- The border between the **Pilis-Alpáran Sandlands** and the **Kiskunságian Loesslands** is at the line of Csongrád-Bartok-rét-Bokros.
- *The above mentioned two lines coincides with the* ***Újszász-Szeged-line*** *sharing the flora districts of Praematricum and Crisicum.*
- The border of the **Kiskunságian Loesslands** and the South-Tisza-valley runs more eastwards between Csanytelek and Csongrád.

- The **Szegedian Plain** is an individual microregion, which isn't part of South-Tisza-valley**.** The border of the two landscapes is at the line of Sándorfalva-Baktó-Tarján-Rókus-Alsóváros-Szentmihálytelek-Röszke.
- Inside the **Danube-Tisza Interfluve** the microregion-groups of ***Sand-ridge of Kiskunság*** (with the Dorozsma-Majsaian and Pilis-Alpárian Sandlands) and the ***Eastern Loess-ridges of the Danube-Tisza Interfluve*** (with the Kiskunságian Loesslands and Szegedian Plain) can be identified.
- The border of the **Csongrádian Plain** and the South-Tisza-valley was modified in the area Óföldeák-Földeák and Mindszent-Szegvár, which is part of the microregion-group of ***Békés-Csongrádian Plain*** and the mesoregion of ***Körös-Maros Interfluve***.
- Dögös-Kákafoki-bay was classed to the **Hármas-Körös Floodplain**.
- The border of **Körösszög** and Csongrádian Plain can be drawn at Veker-ér whereas the border of Körösszög and South-Tisza-valley at the line of Nagy-szék-hát - Tési-hát.
- I classed the northern part of the former Marosszög and the Vedresháza flood-bay to the **South-Tisza-valley**.
- I classed the low floodplain of river Maros into a distinct microregion the **Lower Maros Floodplain**. I drew its border with the South-Tisza-valley at the line of Szőreg-Újszeged-Maros-estury-Maroslele-Óföldeák-Makó.
- I classed the areas between Szőreg-Újszentiván-Térvár-Kübekháza and south from Kiszombor to the **Bánságsarok** (*Arankaköz*).
- Modifications were made in **mesoregional classification of floodplains of Csongrád county**:
- The *Körösszög* and the *Hármas-Körös Floodplain* are parts of **Berettyó-Körös Region**.
- The *Lower Maros Floodplain* and the *Bánságsarok* are parts of the new mesoregion of **Lower-Maros Region**.
- The *South-Tisza-valley* belongs to the **Lower-Tisza Region**.

List of major publications

Deák J.Á 2002: A Csongrád környéki táj története a XVIII. század végétől napjainkig élőhelytérképek tükrében. Múzeumi Füzetek Csongrád 5., Juhász Nyomda Kft., Szeged. pp. 33-73.

Deák Á.J. 2003: Landscape changes of the Lódri-tó-Kisiván-szék-Subasa area in the Dorozsma-Majsaian Sandlands. Acta Climatologica et Chorologica Tomus XXXVI-XXXVII, Universitatis Szegidiensis, Szeged. pp. 27-36.

Deák J.Á. 2004: Aktuális és tájtörténeti élőhelytérképezés Csongrád környékén, Természetvédelmi közlemények 11, Budapest. pp. 93-105.

Deák J.Á. 2005: A természeti értékek, a táj és a hagyományos ártéri gazdálkodás Csongrád környékén a folyamszabályzások előtt. Múzeumi Füzetek Csongrád 7-8., Juhász Nyomda Kft., Szeged. pp. 34-61.

Deák Á.J. 2005: Landscape ecologiacal researches in the Szeged-Makó-Hódmezővásárhely triangle of the western Marosszög (Marosangle). Acta Climatologica et Chorologica Tomus XXXVIII-XXXIX, Universitatis Szegidiensis, Szeged. pp. 33-46.

Deák J. Á. 2006: Morfológia-talaj-növényzet kapcsolatának mintázat-vizsgálata a Dorozsma-Majsai-homokhátön. Táj, környezet és társadalom - Ünnepi tanulmányok Keveiné Bárány Ilona professzor asszony tiszteletére. SZTE Éghajlattani és Tájföldrajzi Tanszék - SZTE Természeti Földrajzi és Geoinformatikai Tanszék, Szeged. pp. 123-131.

Deák Á.J. - Bárány-Kevei I. 2006: Landscape-ecological mapping in the surroundings of Szeged. Ekológia vol. 25., Bratislava. pp. 26-37.

Deák J.Á. – Keveiné Bárány I. 2006: A talaj és a növényzet kapcsolata, tájváltozás, antropogén veszélyeztetettség a Dorozsma-Majsai homokhát keleti részén. Tájökológiai Lapok 4 (1), Gödöllő. pp. 195-209.

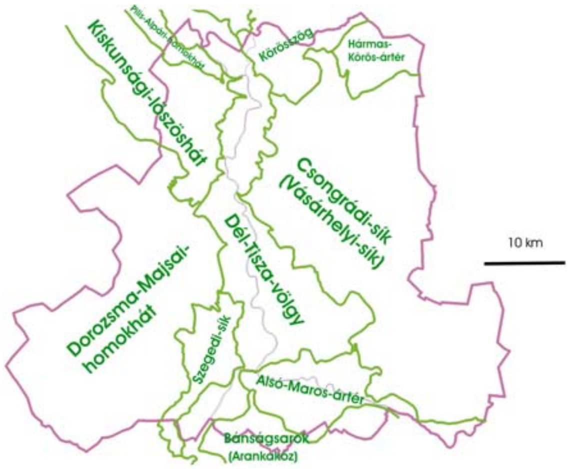
Deák J. Á. 2007: 200 years of habitat changes and landscape use in the South-Tisza-Valley, Hungary. In: Okruszko, T. – Maltby, E. - Szatyłowicz, J. – Świątek, D. – Kotowski, W. (eds.): Wetlands: monitoring, modelling, management. Taylor & Francis/Balkema, London, UK. pp. 45-54.

Deák J.Á. 2008: Az élőhelytérképezés felhasználása alföldi kistájak komplex szemléletű lehatárolásához Csongrád megyei példákon. In: Szabó V.-Orosz Z.-Nagy R.-Fazekas I. (szerk.): IV. Magyar Földrajzi Konferencia, Debrecen. pp. 239-245.

Deák J.Á. 2008: Csongrád megye kistájainak élőhelymintázata és lehatárolása. In: Csorba P.-Fazekas I. (szerk.) Tájkutatás-Tájökológia. Meridián Alapítvány, Debrecen. pp. 331-338.

Deák J.Á. 2008: Lokális és tájléptékű vegetációmintázatok alkalmazása Csongrád megye kistájainak lehatárolására. In: Csima P. – Dublinszki-Boda B. (szerk.): Tájökológiai kutatások: a III. Magyar Tájökológiai Konferencia kiadványa. Budapesti Corvinus Egyetem, Tájvédelmi és Tájrehabilitációs Tanszék, Budapest. pp. 237-244.

Deák J.Á. 2008: Dél-Tisza-völgy, Kiskunsági-löszöshát, Marosszög. In: Király G.-Molnár Zs.-Bölöni J.-Csiky J.-Vojtkó A. (szerk.): Magyarország földrajzi kistájainak növényzete. MTA-ÖBKI, Vácrátót. p. 22, 51, 52.



Map of the new borders of microregions in Csongrád county