Szent István University

HABITAT MAP BASED HABITAT STUDIES IN SOUTH TISZÁNTÚL

Ph.D. thesis

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INTRODUCTION AND GOALS

Biodiversity is decreasing worldwide at an alarming rate because of rapid industrial development and landscape transformation (Chapin et al. 2000, Kerényi 2003, MEA 2005). Biodiversity decline can indicate some irreversible and consequential environmental effects which endanger the future of biosphere and ultimately the survival of humanity (Hooper et al. 2005, MEA 2005). The drastic decrease of natural and semi-natural areas is a key component of these negative processes (Pimm and Raven 2000, Woodruff 2001, MEA 2005). Species, biological communities can disappear as a consequence of habitat conversion, destruction or habitat loss (Rakonczay 1989, Ehrlich and Ehrlich 1995, Borhidi and Sánta 1999), which can disturb the balance and stability of ecosystems in the long run (Diamond 1989, Juhász-Nagy 1993, Vida 1996, 2000, Novacek-Cleland 2001, Pimm et al. 1995, Standovár and Primack 2001, Woodruff 2001).

The Convention on Biological Diversity (CBD) was established to conserve biodiversity; disrupt, reverse and prevent negative processes. The assessment and detailed mapping of habitats is an important tool for the conservation and development of natural and semi-natural areas, which is one of the main aims of the CBD. Habitat changes can be detected and followed with the registration and detailed, precise description of habitats (Fekete et al. 1997). Habitat maps represent the actual condition of habitats/vegetation, so they serve as an important basis for conservation management, environmental impact studies, landscape ecological studies, etc. Furthermore these maps provide basic data about the ecosystems (Báldi 2006, 2008, Takács and Molnár 2009).

According to the Habitat Directive the area of Hungary represents a biogeographical region of Europe (Pannonian biogeographical region) thanks to its special physiographic features. The characteristic Pannonian habitats are on the list of habitats of community interest. It is internationally accepted that the habitats of Hungary preserve high biodiversity. Therefore the multifaceted and extensive study of these habitats is of great importance (Varga 2006).

My thesis represents the habitat studies and habitat maps of four sample areas of international importance located in South-Eastern Hungary (Hortobágy-Berettyó region, Dévaványa region, Vésztő-Mágorpuszta, Kis-Sárrét).

The multifaceted study of areas with high nature conservation value can be considered as the key to conserve these areas. The detection of habitat changes can be more precise when we study the habitats from more aspects. As a consequence the reaction to the changes can be faster and more effective.

The aims of the thesis were the following ones:

- Draw the habitat maps of sample areas according to the General National Habitat Classification System of Hungary (GNHCSH) and the General Habitat Categories (GHC, has been rarely used in Hungary). Descriptive analysis of habitat maps.
- Build up a detailed, habitat patch based database to help the comprehensive description of sample areas.
- The mosaic-like structure of the landscape and the high number of habitat complexes and GNHCSH category combinations make habitat mapping and analysis more difficult. Therefore it was important to reduce the number of habitat types and complexes. The new habitat classification represents the speciality of the landscape and reflect the water level and salinity characteristic of habitats. This classification can facilitate habitat mapping and can serve a base for habitat studies.
- Descriptive study of the sample areas according to 1. landscape specific habitat groups and 2. water level and salinity based categories. Precise study of sample areas with landscape metrics. Draw landscape specific and water level and salinity based thematic habitat maps.
- Study the naturalness/degradation, the condition and the stability/vulnerability of habitats. Draw the maps of sample areas using these parameters (naturalness, habitat condition, stability).

- Create new, complex, multifaceted methods to study habitat condition, naturalness and stability.
- Connect the General National Habitat Classification System of Hungary (GNHCSH) with the system of General Habitat Categories (GHC).

MATERIAL AND METHODS

The selection and location of sample areas

Four sample areas were selected in the Berettyó-Körös Region in South-Eastern Hungary (South Tiszántúl). The sample areas had to meet some conditions: be representative and landscape specific; contain some characteristic habitat types.

The following areas were selected according to the above mentioned criteria:

1. Hortobágy-Berettyó: unregulated section of river Hortobágy-Berettyó and its surroundings (~2721 ha);
2. Dévaványa: mosaic-like area near Devaványa with saline soil (~2532 ha);
3. Vésztő-Mágorpuszta: riverside of Holt-Sebes-Körös and the surroundings of Mágorpuszta (~982 ha);
4. Kis-Sárrét: marshy area between Biharugra and Mezőgyán and its surroundings (~8047 ha).

The Hortobágy-Berettyó sample area and the area near Dévaványa are sample areas (O5x5_014 and O5x5_051) of the National Biodiversity Monitoring System, while Vésztő-Mágorpuszta and the Kis-Sárrét are parts of the Körös-Maros National Park.

Habitat mapping

The field work was carried out between 2003 and 2010. We applied two, fundamentally different systems for habitat mapping: the General National Habitat Classification System of Hungary (Fekete et al. 1997) and the General Habitat Categories (Bunce et al. 2005, 2008). During the digitization of habitat maps - with ESRI ArcView GIS Version 3.1, ESRI ArcGIS Version 9.3, Microsoft Office Excel 2007- a habitat patch based database was built up. The database contains the data registered in the field [GNHCS code, GHC category, short habitat description, naturalness (Németh-Seregélyes scale, complex habitat condition evaluation system), characteristic, protected and invasive species], and the results from habitat studies of the patches (stability, habitat groups, water level and salinity based categories, landscape metrics data). This database was completed with a table which contains the nature conservation value category (Simon 2000), the social behaviour type (Borhidi 1993) and the relative ecological indicator values (Borhidi 1993) of the species. As a result studies can be carried out on the level of species.

Habitat studies

1. Studies according to habitat types

Data preparation of GNHCS habitat maps

Before the habitat type based studies it was necessary to re-arrange the habitat maps and the patch based database because of the high complexity of patches.

Habitat patches of sample areas generally include more than one habitat type (habitat complex). In the case of our four sample areas it means that the 1179 habitat patches include 392 habitat types. The results of habitat studies can not be analyzed when the number of habitat complexes are too high. Therefore we simplified the categories and reduced the number of habitat types.

The number of habitat species was reduced according to two different habitat classification. On one hand I created *landscape specific habitat groups*, on the other hand I formed *water level (wetness) and salinity based habitat groups*.

The methods of habitat type based studies

These studies were perfomed according to landscape specific habitat groups and according to water level and salinity based categories. Descriptive methods and more complex landscape metrics were used to analysis.

The descriptive provide general information about the main characteristics of sample areas (e.g. distribution of habitat types, number of habitat types, ratio of habitat types, frequent habitat types and their coplexes), and about habitat patterns. Thematic habitat maps of the sample areas were drawn according to landscape specific habitat groups and water level-salinity based categories.

Landscape metrics were applied on patch, class and landscape level. The studies on the level of classes was based on landscape specific habitat groups and on water level-salinity based categories. ESRI ArcGIS Version 9.3. V-LATE 1.1.was used for landscape metric studies (Lang and Tiede 2003). The indexes (e.g. number of patches, patch area, median of patch size, edge density, fractal dimension) were selected according to relevant publications (Szabó 2009, Mezősi and Fejes 2004, Mezősi et al. 2008, Csorba et al. 2006, Kollányi 2006).

2. Studies on naturalness and habitat condition

The studies on naturalness and habitat condition were based on the *Németh-Seregélyes scale*, and on *own developed new systems* (1. Habitat condition evaluation system for habitat mapping 2. System of stability-vulnerability of habitats).

A *Németh-Seregélyes scale* define the categories of naturalness according to degree of degradation, human disturbance, species richness, vegetation structure, species composition (ratio of colouring species, dominant species, weeds, uncharacteristic species) (Seregélyes and Németh 1989).

The *complex habitat condition evaluation system* emphasizes the naturalness of habitats. This classification combines the generally used Németh-Seregélyes scale with the naturalness of main groups of the GNHCS and social behaviour type values of abundant species. It is importance to notice that the system categorize agricultural and silvicultural habitats, and underlines tha transitional habitats.

The habitat stability-vulnerability classification system was based on landscape metrics, but was completed with other features as well, such as habitat type, habitat condition, effect of adjacent patches.

Connection of landscape mapping systems (GNHCS and GHC)

The two classification system was connected with the help of Raunkiaer life forms. The characteristic life forms of GNHCS habitats was defined according to their definition, characteristic and abundant species, biotic features and subcategories. (Fekete et al. 1997). The flora database (Horváth et al. 1995)was used for life form based classification; then the GHC categories were connected to the proper defined life forms.

RESULTS

Methodological results

1. Results of GNHCS habitat maps preparation

Elaboration of landscape specific habitat groups

The habitat types were merged at the level of GNHCS groups. As a result of simplification the 392 habitat types were merged in 50 habitat groups. The sample areas differ from another, therefore the sample areas do not contain every habitat groups. Only the marshes (B), halophytic habitats (F), marsh-halophytic habitat complexes (FB), secondary, uncharacteristic habitats (O), halophytic-secondary, uncharacteristic complexes (FO) and agricultural habitats occur together in the sample areas. As the habitat groups represent properly the characteristics of the area, they can be considered as a landscape specific „habitat set".

Elaboration of water level and salinity based habitat categories

The 392 habitat types were rearranged according to their water level (wetness) and salinity to facilitate multi-faceted studies of the sampel areas and to emphasize the characteristics of the landscape. This classification was elaborated on the level of main groups and on a more detailed level as well. The detailed classification contains the halophytic habitats(F), the euhydrophyte (A) habitats and the marshes (B) with their subcategories (e.g. . F2, F4, A1, B1, B2) and the remaining habitats as „other habitats". As a result the number of habitat types reduced to 161.This number was still to high for proper habitat studies, so I classified the water level and salinity categories on the level of main groups as well. This classification contains the halophytic (F), euhydrophyte (A) habitats and marshes (B) as main groups, but the „other habitats" were distinguished according to their wetness. The main groups of water level and salinity categories represent the ratio of habitat types as well (e.g. O5R1F1 → Mainly other dry habitats-halophytic habitats). As a result of this classification the number of habitat types reduced to 58, which proved proper for habitat studies.

2. Methodological results of habitat studies

Methods for study naturalness and habitat condition

I compiled two systems for complex and multi-faceted evaluation of habitats (Complex habitat condition evaluation system for habitat mapping, Habitat stability-vulnerability classification system).

The *complex habitat condition evaluation system for habitat mapping* is based on the Németh-Seregélyes scale, the main groups of the GNHCS (natural, semi natural, forested, agricultural and other habitats) and the short description of habitat patches. Furthermore it takes the species which indicate naturalness or disturbances (social behaviour types) into consideration. The system consists of 3 main categories (A: semi-natural and disturbed semi-natural habitats; B: Habitats influenced by silviculture or agriculture; C: Other habitats) and 12 subcategories. This evaluation system uses the following characteristics: naturalness, human disturbances, ratio of weed species and the ratio of species which indicate degradation. Moreover it is completed with habitat-structure features (e.g. co-occurrence of habitats in good condition and weedy habitats; co-occurrence of natural habitats and agricultural habitats; co-occurrence of natural and semi-natural habitats; etc.).With the help of this system we can get information about the transition and complexity of habitats (e.g. EMGTKJO, TKMOZ), because it underlines the complex and changing habitats. It is a novelty that the system evaluates the habitats influenced by agriculture as well. A uniform key (consist of colours and letters) belongs to the categories.

The *habitat stability-vulnerability classification system* uses the landscape metrics data of patches, the condition of habitats, the habitat types and characteristics of adjacent patches to define stability. The system groups the habitats in low, medium, high stability (KIS, KOZ, JO) categories.

Results of habitat mapping

1. Results of GNHCS habitat maps

The results of GNHCS habitat maps show that all of the sample areas are complex, the number of habitat types and habitat complexes were high in every sample areas. The complexity and area of habitats was the greatest in the case of Vésztő-Mágorpuszta. The considerable habitat complexity reflects the landscape characteristics. The euhydrophyte-marshy habitats, the complex habitats of different halophytic habitat types and the halophytic habitats with euhydrophyte-marshy mosaics were frequent.

2. Results of GHC habitat maps

The results of GHC mapping show that the caespitose hemicryptophytes, the complexes of caespitose hemicryptophytes and helophytes, the complexes of caespitose hemicryptophytes and leafy hemicryptophytes are abundant in the sample areas among natural/semi-natural types. The highest number of GHC habitat categories – as in the case of GNHCS results- was registered in the Kis-Sárrét, because of its large area. If we measure the number of GHC habitat types related to the size of sample areas Vésztő-Mágorpuszta shows the highest diversity. The complexes of caespitose hemicryptophytes and leafy hemicryptophytes had the highest area ratio in every sample areas. This is the consequence of the considerable area of halophytic habitats and represents the characteristics of the dominant vegetation. The ratio of hydrophyte-marshy habitats was the highest in the Hortobágy-Berettyó sample area, while the dry habitats had the highest area ratio in Dévaványa. The Kis-Sárrét and the sample area of Vésztő-Mágorpuszta are similar according to hydrophytes. In the case of sample areas with higher water level the complexes of caespitose hemicryptophytes and hidrophytes are more frequent. These are equivalent to euhydrophyte-halophytic habitats, which are typical in the landscape. The are ratio of trees and shrubs dominated GHC types was the highest in the Kis-Sárrét as a result of the extensive forestation in the 19-20th century. The habitat types dominated by therophytes and leafy hemicryptophytes were remarkable in the drier Dévaványa sample area. Their presence in the other sample areas was negligible.

Results of habitat studies

1. Results of studies based on habitat types

Descriptive habitat studies

The results of habitat mapping based on landscape specific habitat groups show that the group of halophytic habitats had the highest area ratio in every sample areas. The following habitat types were frequent as well: complexes of halophytic habitats and secondary, uncharacteristic treeless habitats, marshes (Kis-Sárrét); halophytic habitats-wet meadows (Vésztő-Mágorpuszta), halophytic habitats-marshes (Hortobágy-Berettyó), secondary, uncharacteristic treeless habitats (Hortobágy-Berettyó, Dévaványa region). In the case of three sample areas the ratio of habitat groups was unbalanced. The area ratio of most groups was under 2-3%. The main part of areas was divided between 3-4 types. Vésztő-Mágorpuszta is the exception, where the ratio of habitat types was balanced. The halophytic habitats and their complexes were the most frequent in Vésztő-Mágorpuszta, while their area was the smallest in the Kis-Sárrét. The halophytic habitats are present in different complexes. The highest number of halophytic complexes was recorded in the Hortobágy-Berettyó region and in the Kis-Sárrét. On the other hand in the case of Dévaványa only two halophytic complexes were found. The halophytic complexes reflect properly the wetness of habitats. In the drier areas we found complexes of drier halophytic habitats, while in the wetter areas more fresh halophytic habitats were registered. The ratio and diversity of euhydrophyte habitats-marshes was the highest in the Hortobágy-Berettyó region. The area of riverine woodlands and their complexes was the largest in the Kis-Sárrét, however the planted forests were frequent as well. The combinations of wet meadows and marshes and the group of dry grasslands were typical only in the Kis-Sárrét, which shows the diversity of habitats in this area. Furthermore the agricultural habitats were present in every sample area. They ratio was the highest in Dévaványa.

The maps based on water level and salinity categories also emphasize the salinity of areas. The halophytic habitats and their complexes had the highest ratio among the habitat types in every sample areas. Artemisia salt steppes and salt meadows were typical from the group of halophytic habitats. They occurred mostly as complexes. The area ratio of Artemisia salt steppes and their complexes was the highest in Vésztő-Mágorpuszta, while the ratio of salt meadows and their complexes in Dévaványa. Generally Artemisia salt steppes formed habitat complexes with dry habitats, while salt meadows combine with fresher habitats. They occurred as independent habitats more rarely. It is important to notice that Artemisia salt steppes and salt meadows often occurred together and formed „double complexes”. The area of these habitats was the largest in the Hortobágy-Berettyó region. The ratio of euhydrophyte habitats and marshes was the lowest in the driest Dévaványa sample area. At the same time they had the largest area in Vésztő-Mágorpuszta, despite the fact that the Hortobágy-Berettyó region was the wettest sample area. This can be the consequence of the fact that these habitat groups occurred mainly in complexes with halophytic habitats in the Hortobágy-Berettyó region. The ratio of “Other habitats” was the highest ratio in Dévaványa and the lowest in Vésztő-Mágorpuszta.

Habitat maps and the connecting habitat studies reflect the main characteristics of the halophytic habitats dominated landscape of South-Eastern Hungary. The differences between the sample areas were the largest according to water level and salinity categories. The water level influences considerably the types, area and combination of halophytic areas and marshes. Wetter areas preserve more natural wetlands. In the Hortobágy-Berettyó region the river remained unregulated, so here was the area of wetlands the largest and the halophytic habitat complexes contained more wetter, fresh habitats. In Vésztő-Mágorpuszta the neighbourhood of Holt-Sebes-Körös helped the preservation of wetlands. Although the farther parts of the flood-plain dried out, the parts near the river preserve valuable wetlands. The ratio of halophytic habitats was the highest in this sample area, so we can say that here was the degree of salinization the highest. The effects of changing water level are considerable in the case of Kis-Sárrét as well, where drainage was made in the past. The area of wetlands was significant, at the same time despite of drainage the degree of salinization was not so high like in Vésztő-Mágor and Dévaványa. It can be a consequence of more precipitation and slack water. The are ratio of halophytic habitats was here the lowest, but their diversity and complexity was extraordinary. The Sample area near Dévaványa is far from rivers, so it was dominated by dry habitat types (dry halophytic habitat and other dry habitats), while the area of wetlands was small.

Results of landscape metrics

The results of studies on the level of classes show that the number and ratio of halophytic patches was the highest in every sample area. The ratio of different habitat types was balanced in Vésztő-Mágorpuszta, while in the case of Dévaványa and the Hortobágy-Berettyó region the habitat patches can be divided between a few habitat types, most habitat types had low number of patches. At the same time in the Kis-Sárrét each habitat types had low number of patches. The average size of the patches was quite equable in Dévaványa, while the Hortobágy-Berettyó region had the most variable size of patches. The largest patches was found in the Kis-Sárrét, the smallest patches in Vésztő-Mágorpuszta. The degree of fragmentation of habitat groups was the highest in the case of Vésztő-Mágorpuszta, while it was the lowest in the Kis-Sárrét. As a consequence we can say that the degree of fragmentation is correlated with average patch size. The elements of habitat groups are more connected in Dévaványa, while in the other sample areas they are disperse. The habitats of Dévaványa and Kis-Sárrét showed less formal complexity, while the most complex forms was found in Vésztő-Mágorpuszta.

If we use landscape metrics on the level of sample areas (landscape level) the results of studies on the level of classes become confirmed.

<u>2. Results of studies on naturalness and habitat condition</u>

The studies on naturalness and habitat condition evaluate the habitats from different aspects.

According to the Németh-Seregélyes scale the results show that the degraded (1) and disturbed-semi-natural (3-4) habitats were the most common. The general naturalness of the studied areas was good, the degraded areas were agricultural habitats. The area ratio of habitats with medium or good naturalness value (3, 3-4, 4) was the highest in the (3, 3-4, 4) Kis-Sárrét. This represents the high nature conservation value of this protected area, which is part of the Körös-Maros National Park. The naturalness of habitats was the lowest in Dévaványa, however the ratio (45%) of habitats in good naturalness is quite high.

The elaborated complex habitat condition evaluation system gives more detailed information about the condition of habitats and emphasizes the evaluation of transitional and changing habitats and habitats with agricultural influence. The ratio of semi-natural habitats and transformed semi-natural was the highest in Vésztő-Mágorpuszta, while the area of agricultural habitats was the largest in Dévaványa. The semi-natural and agricultural habitats were in good condition in every sample area. The semi-natural habitats with good condition (TKJO) were the most frequent in the semi-natural category. The habitats of TKJO category were wetter habitats in the Hortobágy-Berettyó region, dry habitats in Dévaványa and Vésztő-Mágorpuszta, while variable habitats in the Kis-Sárrét. Habitats in good condition had the highest ratio on the Hortobágy-Berettyó region according to the TKJO category and other categories which indicate good, semi-natural conditions (TKMOZ, TKE). The area of semi-natural but transitional habitats (TKJOTKKOZ, TKMOZ) was the largest in the most fragmented Vésztő-Mágorpuszta. As a consequence of transitional habitat types fragmentation here are the habitat conditions the most changeable. The transitional-agricultural types (EMGTKJO, EMGTKGY) had the highest ratio in the Kis-Sárrét. The occurrence of semi-natural and agricultural habitats were different in the sample areas. In the Hortobágy-Berettyó region and in Vésztő-Mágorpuszta they were found in groups. In Dévaványa the semi-natural habitats were separated by agricultural habitats. In the Kis-Sárrét they are dispersed or located in groups.

The stability studies are more complex, because between habitat condition and habitat complexity it takes the effects of the environment (adjacent habitats), form and area of patches into consideration. According to this stability evaluation system the ratio of stable habitats was the highest in every sample area. The area of stable habitats was the largest in the Hortobágy-Berettyó region. The stable patches are mostly halophytic habitats, but the complexes of halophytic habitats and marshes (Hortobágy-Berettyó region), complexes of halophytic habitats and secondary treeless habitats (Dévaványa környéke, Kis-Sárrét, Vésztő-Mágorpuszta) were frequent as well. The stable patches can be characterized by semi-natural habitats in good condition.

Results of the connection of habitat mapping systems (GNHCS and GHC)

The GNHCS based habitat maps can be analyzed and evaluated internationally with the connection of different mapping systems (GNHCS, GHC). With the help of GHC categories areas with different habitat types can be compared and analyzed from the same aspects. The GHC system can connect the habitat classification of different countries, which is a key element of long-term and effective biodiversity monitoring projects.

NEW SCIENTIFIC RESULTS

1. I carried out the habitat mapping of the four sample areas according to the General National Habitat Classification System of Hungary and the General Habitat Categories.

2. I drew the GNHCS based (Hortobágy-Berettyó region, Vésztő-Mágorpuszta, Kis-Sárrét) and GHC based (all sample areas) 1:15 000 scale digital habitat maps.

3. I evaluated the sample areas according to GNHCS and GHC maps.

4. I built up a detailed database connected to GNHCS and GHC habitat maps, the following data was registered to each patch:

- GNHCS code,
- GHC category,
- short habitat description,
- water-level and salinity based category,
- landscape specific habitat group,
- naturalness and habitat condition (according to Németh-Seregélyes-scale and complex habitat condition evaluation system),
- habitat stability-vulnerability,
- landscape metric data (e.g. area, perimeter, area/perimeter ratio, fractal dimension),
- characteristic, protected and invasive species,
- nature conservation value category, social behaviour type, and relative ecological indicator values of occurring species.

The database can serve as a base for further studies (e.g. extensive analysis of habitats, comparative studies).

5. The number of GNHCS types and complexes was reduced according to two different classification (1. landscape specific habitat groups, 2. water level and salinity based habitat groups). This reduction was necessary to precise habitat studies because of the high complexity of habitats.

6. I drew the habitat maps according to both classification (1. landscape specific habitat groups, 2. water level and salinity based habitat groups).

7. The descriptive habitat based studies and the studies with landscape metrics were carried out. The results from the sample areas were analyzed separately.

8. The habitats were evaluated according to their condition, naturalness and stability. The habitat maps were drown according to these parameters (condition, naturalness, stability) as well.

9. I elaborated a new complex method for the study of habitat condition. This method was used to evaluate habitat condition. This classification combines the generally used Németh-Seregélyes scale with the naturalness of main groups of the GNHCS (natural, semi-natural, forested, agricultural and other habitats) and the short description of habitat patches. Furthermore it takes the species which indicate naturalness or disturbances (social behaviour types) into consideration. It is a novelty that the system provide information about transitional areas and evaluates the habitats influenced by agriculture as well.

10. A new method was elaborated and used for stability studies as well. The habitat stability-vulnerability classification system is complex and multi-faceted, it uses the landscape metrics data of patches, the condition of habitats, the habitat types and characteristics of adjacent patches to define stability.

11. I connected the General National Habitat Classification System of Hungary (GNHCS) with the system of General Habitat Categories (GHC). The synchronization of the two habitat mapping system is of great importance, because it can serve as a base for international evaluation and comparison of GNHCS maps.

CONCLUSIONS

The results of habitat studies reflect the mosaic-like landscape of the South Tiszántúl, so we can say that the sample areas were selected properly. The four sample area was adequate to represent the main characteristics of the landscape.

The complexity and heterogeneity of habitats is an important characteristic of the Pannonian biogeographical region. Its conservation is important from the aspect of biodiversity maintenance and global climate change as well. The habitats of the Hungarian Great Plain with their mosaic-like structure are vulnerable. Their maintenance is of great importance, therefore our studies can serve as an important base for further studies in South-Eastern Hungary.

The elaborated landscape specific habitat groups and water level-salinity based categories reflect the characteristics of the landscape, they can be considered as a landscape specific „habitat set". These categories can be used in further habitat mappings.

The small habitat changes can be detected with the help of habitat evaluations. Their application can increase the effectiveness of monitoring. The detailed studies on naturalness and habitat condition can facilitate nature conservation management.

The introduced methods of habitat groupings and simplification can help in the evaluation of habitat maps from mosaic-like areas. The elaborated habitat condition evaluation system for habitat mapping and the habitat stability system can serve as a base for habitat condition analyses.

The evaluation and analysis of GNHCS habitat maps become possible in international level as a result of the connection of GNHCS and GHC systems. This result is of great importance in international biodiversity monitoring studies.

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