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Vegetation of Külső-Somogy in Hungary III Regional diversity and pattern of abandoned fields and plant invasion

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Abstract: A systematic overview and landscape pattern of abandoned fields and plant invasion according to semi-natural habitats in Külső-Somogy are summarized based on MÉTA method. Areal distribution of abandoned fields and plant invasion was mostly overlapping, centres were revealed from the North-Western and South-Eastern parts. Dry and semi-dry grasslands (e.g. E habitats) were significant to abandoned fields and/or set of alien species, mesic deciduous woodlands (e.g. K2), dry and rocky woodlands (e.g. L2a) and bush vegetation (e.g. P2a and P2b) to the centres of plant invasion. Cover of threatened habitat types, number and ratio of invasive species were analysed and compared to national results. Average threatening of real semi-natural habitats were greater in Külső-Somogy than similar ones at national scale. Hardly threatened habitat types were among woodlands in great proportion. Most invaded semi-natural habitats are riverine shrublands and woodlands, marshes, mesic deciduous woodlands in lowlands, dry open *Quercus* woodlands and rocky woodlands. Dry closed *Quercus* woodlands, colline and montane hay meadows and euhydrophyte habitats were the least invaded groups. Among alien species *Robinia pseudo-acacia, Solidago* spp., *Ailanthus altissima* and some other species were the most significant. *Prunus serotina* is sporadic, *Reynoutria* spp. is absent in the region. By the analyses a regional order of invasive species importance was created. It is clearly verifiable that plant invasion is a more serious problem than spreading of abandoned fields in Külső-Somogy region.

Keywords: abandoned field, alien species, GIS database, MÉTA method, habitat patches, landscape ecology

Introduction

Külső-Somogy is a characteristic hilly landscape with several types of semi-natural woodlands and grasses in the middle of Transdanubia belonging to Kaposense and Somogyicum phytogeographical regions. This landscape is a poorly documented area in Transdanubia and in Hungary as well according to its natural vegetation. Last years some systematic overview were published about semi-natural habitat diversity and pattern of this region (e.g. Salamon-Albert and Horváth 2008a, 2008b). They were presented as the reference verifying and finding new occurrences of vegetation types and corresponding analyses of existing semi-natural habitats.

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Vegetation pattern with different origin and former land use could be developed in abandoned fields. Abandoned fields can be established from unused vineyards, arable lands or orchards. Some annual species strongly affect the vegetation composition of 2-5 year-old abandoned field, but perennial species dominate on the 5-10 year ones. On the 10-50 year-old abandoned fields semi-natural grasses, on the oldest ones (50- years) woody vegetation could exist.

Biological invasion is one of the most important danger in habitat changes, connected to fragmentation of natural vegetation (CRONK and FULLER 2001). Status of biological invasions and actual knowledge about species concerned in Hungary was earlier summarized (TÖRÖK et al 2003, MIHÁLY and BOTTA-DUKÁT 2004, BOTTA-DUKÁT and MIHÁLY 2006). There are numerous papers as case studies from smaller areas of Hungary about alien species responsible for biological invasion (e.g. BALOGH 2001), but not in Külső-Somogy region. Data on species distribution and habitat preferences of them could be gained by combining with maps and any other databases, e.g. phytosociological ones (BOTTA-DUKÁT 2008).

In our work, as the third study of a landscape series, we present and evaluate basic statistics of abandoned fields and plant invasion connected to semi-natural woodlands and non-woody habitat types and groups in Külső-Somogy region. Analyses are executed for the cover of abandoned and invaded areas at landscape scale, and for 15 selected alien species in habitat types and groups with MÉTA method and mapping (GIS database for Hungarian Habitats, Magyarországi Élőhelyek Térképi Adatbázisa, HORVÁTH et al 2008) based on a landscape ecology oriented protocol fitted to the whole territory of Hungary (BÖLÖNI et al 2007, MOLNÁR et al 2007).

Material and method

Region of Külső-Somogy (Fig. 1) is located south from Lake Balaton, bordered by Kapos River, Sió Channel and Pogány Valley in the territory of Somogy and Tolna counties. Its total extension is 3000 km^2, mean altitude is 186 m a.s.l., 200-300 m a.s.l. especially on the ridges of the hills. The bedrock is limestone covered by loess on the surfaces of the crests trended to north-south direction. In the western part of the area (West Külső-Somogy) the ridges of the hills are exposed to erosion and derasion. The eastern part of the region (East Külső-Somogy) is dissected with valleys parallel to Lake Balaton and the south part of it (South Külső-Somogy) is a horizontal loess plateau with moderate slope to Kapos River. Running through the main north-south valleys, Jaba Stream and Koppány Stream flow from west to east. According to the data of regional meteorological stations (Szabadhídvég, Kaposvár) the mean temperature is -2.5 C° in January, +20.5 C° in July, the sum of precipitation is 650 mm per year. There are some cities and many small villages, so Külső-Somogy is not a frequent region from an economical point of view (MAROSI and SOMOGYI 1990). On the basis of drought-sensitivity index several vegetation types existing in the south-eastern part of the region could be endangered in climatically dry periods (NÉMETH et al 2004).

Data collection and analyses

Field data collection was executed between 2003-2006 as a grid-based, satellite-image supported (SPOT4), multi-attributed, large-scale mapping method so called MÉTA (MOLNÁR et al 2007). It is based on Á-NÉR2003 mapping and habitat guide (BÖLÖNI et al 2007). The goals of the research were: 1) to collect data of all natural and semi-natural

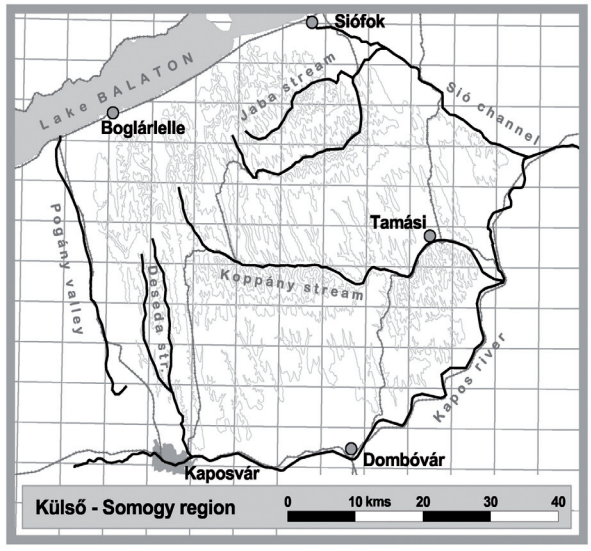

Fig. 1: Territory, settlements, geographical and hydrological elements of Külső-Somogy

habitat types in Hungary 2) to create maps of semi-natural vegetation patches and 3) to evaluate landscapes with vegetation types and their attributes as well, 4) to evaluate territorial extension and spatial distribution of the abandoned fields that could be the basis of grassland regeneration. The database is constructed on a hexagon grid system of 35 hectars covering the whole area of the country as the primary mapping units (HORVÁTH et al 2008). Approximately 100 hexagons are associated into a quadrat at landscape scale as a secondary mapping unit. In hexagons main existing habitat types, their roughly estimated areas and several vegetation attributes are listed (e.g. naturalness, neighbourhood, land use). This multi-attributed database is suitable to determine natural-based habitat quality, to estimate the relations of the wastelands in the Hungarian landscape and to compose the prognosis of future changes for vegetation and landscape. For more details see HORVÁTH and POLGÁR (2008).

On the basis of MÉTA method a basic statistical analysis and evaluation was carried out on one hand, spatial thematic map were constructed for displaying the territory and extension of abandoned and invaded fields. Relative areal proportion (ha) of abandoned fields and alien species were calculated for quadrats and compared with each other connected to semi-natural habitats. Data were displayed in tables and on GIS thematic maps with appropriate additional layers (e.g. settlements, hydrological and geographical elements) using ESRI ArcView 3.3 software from valid hexagons of 95 quadrats. Habitat nomenclature is by MOLNÁR et al (2008), species names are by SIMON (2000).

In Külső-Somogy region 48 semi-natural habitat types of woodlands and grasslands were detected and analysed previously (SALAMON-ALBERT and HORVÁTH 2008a, 2008b). In this analysis, they were aggregated into wider categories as habitat groups (abbreviations of categories are listed in brackets, meaning of them see MOLNÁR et al 2008): euhydrophyte habitats (A1, A23, A3a); marshes (B1a, B2, B3, B4, B5, B6, BA); flushes and transition mires (C1); rich fens, eu and mesotrophic meadows and tall herb communities (D2, D34, D5, D6); colline and montane hay meadows (E1, E2); dry and semi-dry closed grasslands (H4, H5a, H5b); riverine shrublands and woodlands (J2, J5, J6);

mesic deciduous woodlands in lowlands or on hills and mountains (K1a, K2, K5); closed dry deciduous woodlands (L1, L2a, L2b, L2x, L5); open dry deciduous woodlands (M1, M2); bush vegetation and woodland margins (J1a, P2a, P2b, M7, M8); rocky forests (LY4); other treeless habitats (OA, OB, OC); other tree-dominated habitats (RA, RB, RC, RD, P45, P7). Sporadic and insignificant habitat types were missed out from the summarized analyses (e.g. C1).

Alien species was used as a binary variable (yes/no) in the database. The sum of estimated area in all hexagons and in hexagons where invasion threatens the habitats (by the presence of any alien species), results in the total area of the threatened habitats respectively. The following alien species were considered: Ail = *Ailanthus altissima*, Aneg = *Acer negundo*, Amor = *Amorpha fruticosa*, Ascl = *Asclepias syriaca*, Ast = *Aster* spp., Celt = *Celtis occidentalis*, Ech = *Echinocystis lobata*, Elae = *Elaeagnus angustifolia*, Frax = *Fraxinus pennsylvanica*, Phyt = *Phytolacca americana*, Pru = *Prunus serotina*, Rey = *Reynoutria* spp., Sol = *Solidago* spp., Rob = *Robinia pseudo-acacia*, Vit = *Vitis* spp. and Oth = some additional but unnamed species. Hardly distinguished related species were aggregated into a genus (e.g. *Reynoutria* spp.). Among the data on plant invasion collected in the MÉTA survey annual aliens of arable fields and species of cultivated (e.g. forest) plantations were not included. In the tables sum cover of habitat types threatened by plant invasion, number and ratio of invasive species in a habitat type, and the number and ratio of habitats threatened by the given species was calculated. Regional data of habitat types which are similar from the point of invasion were also especially amalgamated for the comparison with national results (see BOTTA-DUKÁT 2008).

Results

Threatened habitats and diversity of alien species

Results of the study have shown that habitats occurring in Külső Somogy region are differently referred to plant invasion (Table 1). Relative area of habitats threatened by alien plant species varies between 0 and 100%. Extremities (0 and 100) can be seen in case of fragmented or sporadic habitat types (e.g. A3a, LY4, M2) and it is according to their extensions. 29 habitat types (60.4%) have more than 50% relative area threatened by any alien species. Hardly threatened vegetation types – where areal ratio is over 50% - are in greater proportion among woody habitat types (65.4% from J1a to RD) than among non-woody ones (59.1% from A1 to OC) as well as the average of threatened areas in woodlands (60.8%) than in grasslands (56.1%). In case of euhydrophyte habitats (A1, A23, A3a) and transition mires (C1) there are no vegetation patches threatened by any plant invasion. There are no correlation between high proportion of threatened area and proportion of alien species in habitat patches.

15 most important and some additional but unnamed other alien species were detected in habitats (Table 1). Alien species occured with more than a half total number in a third of habitat types both in grasslands (31.8%) and woodlands (30.8%). Occurrence of *Robinia pseudo-acacia, Solidago* spp., *Ailanthus altissima* and some other species is the most significant. Among them *Solidago* spp. and some other species are the most frequent in patches of grassland habitats, *Robinia pseudo-acacia* and *Ailanthus altissima* are the most frequent in patches of woodland habitats. Least threatening species are *Prunus serotina, Reynoutria* spp., *Aster* spp., *Celtis occidentalis* and *Fraxinus pennsylvanica* in the habitats. It can be observable that the most threatening species in habitat groups by MOLNÁR et al (2008) are of colline and montane hay meadows, dry and semi-

dry closed grasslands, other treeless habitats, dry closed woodlands, bush vegetation or woodland margins (especially P2a, P2b) and other tree-dominated habitats.

Analysing invasive danger in habitat patches fitted to national scale according to BOTTA-DUKÁT (2008), 11 habitat groups can be defined in Külső-Somogy region (Fig. 2). Degree of threatening in habitat groups varies between 0 and 94 percentage. The most invaded habitat groups by areal proportion, that is over 80%, are riverine shrublands and woodlands, marshes, mesic deciduous woodlands in lowlands, dry open Quercus woodlands and rocky woodlands. The high invasibility of floodplains is generally described in the literature owing to the continuous disturbance by floods and propagule spreading by the water (e.g. PYŠEK and PRACH 1994, PLANTY-TABACCHI et al 2001). Opposite to rocky woodlands belong to the most resistant habitats generally. The least invaded habitat groups, that is under 40% areal proportion, are dry closed *Quercus* woodlands and euhydrophyte habitats. Euhydrophyte habitats proved to be not threatened because the lack of species acclimated to this habitat type but originate from thermal water and present in Hungary (see KIRÁLY et al 2006).

Next see the results of threatened area in habitat groups by 15 most invasive and some other alian plant species according to national scale (Table 2). In the treeless habitat groups (marshes, wet meadows) the most important invasive species are the *Solidago* spp., and in the woody ones (especially riverine shrublands or woodlands and mesic deciduous woodlands on lowlands) *Robinia pseudo-acacia* dominates. High proportion of territories invaded by the two previous species mentioned were also revealed in dry and semi-dry grasslands, colline and montane hay meadows and dry, open and closed *Quercus* woodlands. *Ailanthus altissima* is frequent in dry and semi-dry closed grasslands, mesic deciduous woodlands of lowlands and mountains and dry open *Quercus* woodlands. *Acer negundo* in marshes, *Echinocystis lobata* in riverine woodlands, *Elaeagnus angustifolia* in dry and semi-dry closed grasslands, *Phytolacca americana* in rocky woodlands are the locally frequent species. *Reynoutria* spp. are completely absent in any habitat type or group, *Prunus serotina* is a sporadic invasive species of Külső-Somogy region by the database. Some other invasive plant exist in wet, mesic and dry habitat types and groups in the same way. The only exception in plant invasion are the euhydrophyte habitats owing to the total lack of alien species. Above all we can create a regional order of species importance by number of habitat groups with threats: *Robinia pseudo-acacia, Solidago* spp., some others, *Ailanthus altissima, Acer negundo, Asclepias syriaca* and *Phytolacca americana*.

Spatial pattern of abandoned fields and invasion

Abandoned fields were detected altogether in 86 quadrats (90.5%), habitats threatened by plant invasion were identified in 94 quadrats (99%) of Külső-Somogy region. Total territory of the abandoned fields is 6100 ha that is 2.1% to the whole territory of the region, 14.4% to the total vegetation cover. Habitats endangered by plant invasion have 15200 ha cover that is 5.2% to the whole territory of the region and 35.9% to the semi-natural vegetation cover. Areal ratio of habitats threatened by plant invasion to abandoned fields is 2.53. Areal distribution of the two attributes is mostly overlapping and dominate in the North-Western and South-Eastern parts of the region. Abandoned fields occur a tighter (1.5 to 330 ha/quadrat), alien plant species occur in a broader range (1 to 750 ha/quadrat). Minimum proportion value of abandoned fields to a quadrat territory is 0.04%, maximum value is 9.4%, and similar that of habitats endangered by alien species is 0.03% and 21.4%.

In order to display occurrence and spatial distribution of abandoned fields and plant invasion a thematic map was constructed for 95 quadrats of Külső-Somogy region (Fig.

Table 1: Areal ratio of threatening by plant invasion and proportion of alien species in percentage in habitat types of Külső-Somogy. From A1 to OC are non-woody, from J1a to RD are woody habitats according to Molnár et al (2008). All = relative occurrence of a given species in a habitat type, spec = relative occurrence of an invasive species in habitats, * = without additional species. Bold figures represent if proportion/ratio is over 50%, figures in brackets has less cases/number of records than 5. For species abbreviations (e.g. Ail) see chapter Data collection and analyses.

Habitat	Habitat Group A (Molnár et al 2008)	Habitat Group B (Botta-Dukát 2008)	Area of threats	Ail	Amor	Aneg	Ascl	Ast	Celt	Ech	Elae	Frax	Phyt	Pru	Rey	Sol	Rob	Vit	Oth	All
A1	Euhydrophyte habitats	Euhydrophyte habitats	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A23	Euhydrophyte habitats	Euhydrophyte habitats	(0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A3a	Euhydrophyte habitats	Euhydrophyte habitats	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B1a	Marshes	Marshes	**84**	-	1	18	-	4	-	15	3	-	-	-	-	**78**	1	5	1	***53**
B2	Marshes	Marshes	18	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	7
B4	Marshes	Fens	(33)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B5	Marshes	Eu- and mesotrophic wet meadows	**80**	2	2	10	-	4	-	13	2	-	-	-	-	**83**	4	2	6	***60**
BA	Marshes	---	24	-	-	-	-	-	-	-	-	-	-	-	-	18	7	-	-	13
C1	Flushes and transition mires	---	(0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D2	Eu- and mesotrophic wet meadows	Eu- and mesotrophic wet meadows	**93**	-	-	-	-	-	-	-	-	-	-	-	-	**100**	-	-	-	7
D34	Eu- and mesotrophic wet meadows	Eu- and mesotrophic wet meadows	**52**	2	2	-	8	8	-	4	-	-	-	-	2	**73**	-	4	2	***53**
D5	Eu- and mesotrophic wet meadows	---	**68**	-	-	-	-	-	-	18	-	-	-	-	-	**73**	-	-	-	13
D6	Eu- and mesotrophic wet meadows	---	**91**	-	25	-	-	25	-	-	-	-	-	-	-	**100**	**50**	-	-	27
E1	Colline and montane hay meadows	Colline and montane hay meadows	42	3	3	-	8	5	-	-	3	-	3	-	3	42	26	3	18	***67**
E2	Colline and montane hay meadows	Colline and montane hay meadows	**53**	33	-	-	-	-	-	-	-	-	17	-	-	33	**50**	-	33	*27
H4	Dry and semi-dry closed grasslands	Dry and semi-dry closed grasslands	**68**	19	5	-	19	-	-	-	14	-	-	-	-	14	**57**	-	5	*40
H5a	Dry and semi-dry closed grasslands	Dry and semi-dry closed grasslands	**60**	31	5	-	28	-	-	-	21	-	-	-	-	36	**59**	3	13	***47**
H5b	Dry and semi-dry closed grasslands	Dry and semi-dry closed grasslands	**68**	20	-	-	-	-	-	-	20	-	-	-	-	**80**	**80**	-	**60**	*27
I2	Non-ruderal pioneer habitats	---	(33)	**50**	-	-	**50**	-	-	-	-	-	-	-	-	-	**50**	-	-	20
OA	Other treeless habitats	---	**78**	-	-	13	-	13	-	31	-	-	-	-	6	**94**	25	-	6	*40
OB	Other treeless habitats	---	**63**	8	1	13	10	3	-	6	4	-	3	1	-	8	34	4	25	***80**
OC	Other treeless habitats	---	**70**	2	2	3	27	-	-	-	8	-	2	2	-	**58**	**54**	3	36	***67**

J1a	Bush vegetation/woodland margins	---	4	-	-	17	-	-	-	-	-	-	-	-	-	17	-	-	-	13
J2	Riverine woodlands	---	53	-	-	-	-	-	-	-	-	-	-	-	-	4	2	-	-	13
J5	Riverine woodlands	Riverine shrublands and woodlands	**94**	-	-	4	-	-	-	15	-	-	8	-	-	46	46	-	-	33
J6	Riverine woodlands	Mesic deciduous woodlands of lowlands	**69**	25	-	-	-	-	-	-	-	-	-	-	-	-	**75**	-	-	13
K1a	Mesic deciduous woodlands	Mesic deciduous woodlands of lowlands	**87**	23	-	18	-	-	-	-	-	-	-	-	-	10	**86**	5	23	*33
K2	Mesic deciduous woodlands	Mesic deciduous woodlands of hills	**53**	28	-	7	7	-	-	-	-	-	2	-	-	1	**72**	-	14	*40
K5	Mesic deciduous woodlands	Mesic deciduous woodlands of hills	13	-	-	-	-	-	-	-	-	-	7	-	-	14	29	-	21	*20
L1	Dry closed woodlands	Dry closed Quercus woodlands	45	33	-	-	17	-	-	-	-	-	-	-	-	-	5	-	-	20
L2a	Dry closed woodlands	Dry closed Quercus woodlands	32	18	2	-	5	-	5	-	-	5	5	-	-	10	**73**	-	16	***53**
L2b	Dry closed woodlands	Dry closed Quercus woodlands	**84**	10	-	10	-	-	18	-	-	10	18	10	-	18	**64**	-	-	***53**
L2x	Dry closed woodlands	Dry closed Quercus woodlands	48	**57**	-	-	-	-	-	-	-	-	-	-	-	29	43	-	14	*20
L5	Dry closed woodlands	Mesic deciduous woodlands of lowlands	**(91)**	**50**	-	-	-	-	-	-	-	-	-	-	-	-	**50**	-	-	13
LY1	Rocky woodlands	Rocky woodlands	**91**	-	-	-	-	-	-	-	-	-	**67**	-	-	-	**67**	-	**67**	*13
LY4	Rocky woodlands	Rocky woodlands	(0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M1	Dry open woodlands	Dry open Quercus woodlands	**(100)**	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	13
M2	Dry open woodlands	Dry open Quercus woodlands	**(100)**	1	-	-	-	-	1	-	-	-	-	-	-	1	1	-	-	27
M6	Bush vegetation/woodland margins	Dry open Quercus woodlands	**77**	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	7
M8	Bush vegetation/woodland margins	---	**70**	-	-	-	14	-	14	-	-	-	-	-	-	-	43	-	-	20
P2a	Bush vegetation/woodland margins	---	**75**	1	5	37	3	-	-	18	5	3	3	-	2	**65**	**53**	13	2	***80**
P2b	Bush vegetation/woodland margins	---	**76**	18	3	3	13	-	3	2	7	2	2	-	2	21	**72**	8	2	***87**
P45	Other tree-dominated habitats	---	**94**	29	-	-	14	-	-	-	-	-	-	-	-	-	**57**	-	-	20
P7	Other tree-dominated habitats	---	**60**	-	-	-	7	-	-	-	-	-	7	-	-	36	**57**	7	21	*33
RA	Other tree-dominated habitats	---	37	7	-	36	-	-	-	10	-	5	-	-	-	32	43	7	5	***47**
RB	Other tree-dominated habitats	---	**73**	9	1	**52**	4	3	1	19	9	4	-	-	7	**67**	52	3	7	***87**
RC	Other tree-dominated habitats	---	**76**	24	1	11	11	-	1	-	-	1	1	-	-	17	8	6	10	***67**
RD	Other tree-dominated habitats	---	27	23	4	16	6	-	6	2	6	4	4	-	-	17	47	2	9	***80**
Spec				**56**	31	33	38	17	17	27	25	17	31	6	13	**67**	**77**	31	**50**	

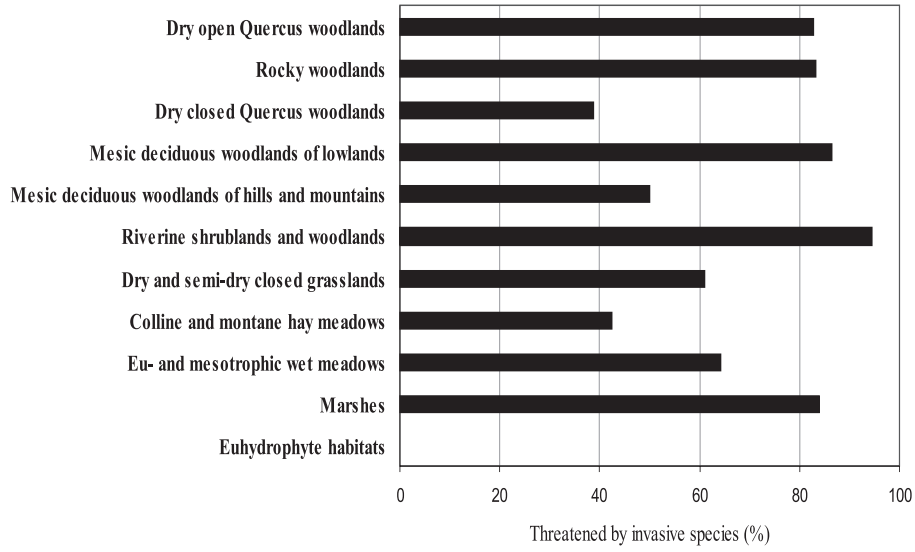

Fig. 2: Area of habitat groups threatened by alian plant invasion in percentage in Külső-Somogy. For habitat aggregation see Table 1 and BOTTA-DUKÁT (2008). Number of cases less than 5 and missing habitat groups are excluded.

3). This map emphasizes spatial variation of two series of target attributes: cover and areal distribution of abandoned fields and sum of habitats threatened by alien plant species. In the first step territorial extension of them were added by a previously standardized consensus scale (<2 ha, 2-15 ha, 15-200 ha, 200-500 ha, >500 ha). Data analyses were based on valid hexagons, spatial covering maps were displayed at quadrat level referred to the MÉTA SQL database. Spatial distribution and summarized covering of abandoned fields and alien species are displayed and compared to each other and to main associated habitat groups and types of woodlands and grasslands.

We can compare territorial distribution of abandoned fields and invasive species to semi-natural habitat types (see Fig. 3 and SALAMON-ALBERT and HORVÁTH 2008a, 2008b). Selected vegetation groups are significant to abandoned fields and/or set of alien species: dry and semi-dry grasslands (especially E habitats) to abandoned fields; mesic deciduous woodlands (especially K2), dry and rocky woodlands (especially L2a) and bush vegetation (especially P2a and P2b) to the centres of plant invasion. According to occurrence and frequency of alien species pool, stands of mesic K2 and dry L2a woodlands could be planted and originated from one-time grassland habitats. Overlapping with P2a and P2b bush habitats makes one-time clear-cuttings probable.

Table 2: Area of habitat groups in percentage where selected invasive species occured in Külső-Somogy. For habitat aggregation see Table 1 by Botta-Dukát (2008). Number of cases less than 5 and missing habitat groups are excluded (e.g. fens). Bold figures represent if proportion is over 50%.

	Ail	Amor	Aneg	Ascl	Ast	Celt	Ech	Elae	Frax	Phyt	Pru	Rey	Sol	Rob	Vit	Oth
Dry open Quercus woodlands	25	-	-	-	-	25	-	-	-	-	-	-	25	25	-	-
Rocky woodlands	-	-	-	-	-	-	-	-	-	43	-	-	-	43	-	43
Dry, closed Quercus woodlands	10	-	-	1	-	4	-	-	4	5	3	-	8	34	-	6
Mesic deciduous woodlands of lowlands	35	-	28	-	-	-	-	-	-	-	-	-	25	**86**	-	25
Mesic deciduous woodlands of mountains	25	-	8	2	-	-	-	-	-	1	-	-	6	38	-	2
Riverine shrublands and woodlands	-	-	**77**	-	-	-	**51**	-	-	2	-	-	5	**77**	-	-
Dry and semi-dry closed grasslands	39	8	-	26	-	-	-	28	-	-	-	-	31	49	2	7
Colline and montane hay meadows	5	1	-	7	-	-	-	-	-	5	-	-	31	20	-	13
Eu- and mesotrophic wet meadows	1	-	5	5	9	-	8	-	-	-	-	-	**58**	1	-	2
Marshes	-	-	31	-	9	-	16	5	-	-	-	-	**73**	1	1	10
Euhydrophyte habitats	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Habitat groups with threats	7	2	5	5	2	2	3	2	1	5	3	-	9	10	3	8

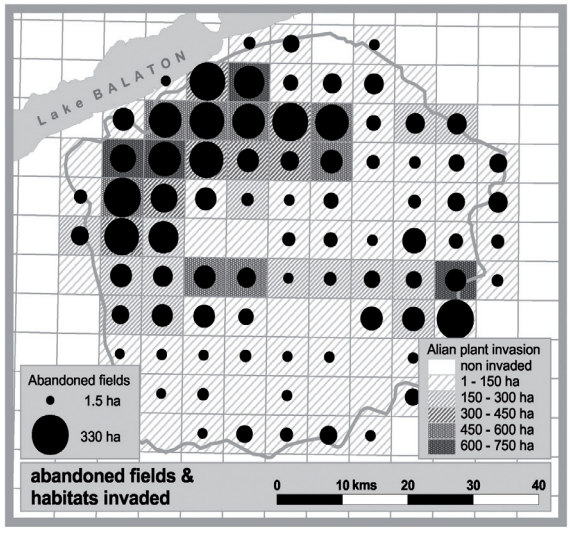

Fig. 3: Territorial proportion of abandoned fields and plant invasion in Külső-Somogy region

Discussion

In our study we have discussed the areal proportion and distribution patterns of abandoned fields and plant invasion by threatened habitats and diversity of alien species at landscape scale. Analysing regional extension data, there are some definite conclusion that is characteristic for Külső-Somogy. Threatened habitats occur among grasslands and woodlands as well, both in wet, mesic and dry habitat types and groups. There was an evidence in case of riverine woodlands and marshes with high proportion of threatenings. Some striking was revealed in case of dry open *Quercus* woodlands and rocky woodlands with hard threatening also in contrast with their high potencial resistance. Comparing regional data to national scale according to corresponding habitat types and groups, average threatening of patches are greater in Külső-Somogy. Threatened habitats of marshes, dry and semi-dry closed grasslands and dry open or closed and rocky woodlands have more than twice proportion in the region than in Hungary overall. Land use practice or threatening state of habitat types can be likely interpereted by spatial overlapping with plant invasion or location of abandoned fields.

Generally occuring invasive species are *Ailanthus altissima, Solidago* spp., *Robinia pseudo-acacia* and besides them some unnamed species that need to be validated. Invasive species that are specific for habitat groups are *Acer negundo, Echinocystis lobata, Elaeagnus angustifolia* and *Phytolacca americana. Prunus serotina* is sporadic, *Reynoutria* spp. are fully absent in Külső-Somogy region, their data might be underestimated or deficient in the landscape. Among most important invasive species, 4 ones occur with greater frequency than at national scale (*Acer negundo, Ailanthus altissima, Solidago spp., Robinia-pseudo-acacia*), two species have less threatening potential, *Amorpha fruticosa* and *Fraxinus pennsylvanica*.

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Külső-Somogy vegetációja III. Parlagok és inváziós növények diverzitása és tájmintázata

SALAMON-ALBERT ÉVA & HORVÁTH FERENC

A tanulmány Külső-Somogy természetközeli fás- és fátlan élőhelytípusait érintő parlagterületek és inváziós növényfajok területi előfordulását és tájmintázatát értékeli az országos MÉTA adatbázis alapján. A parlagok és a növényi invázió területi elterjedése nagymértékben átfedőnek bizonyult, súlypontjai a régió észak-nyugati és dél-keleti részében vannak. A zárt szárazgyepek elterjedése egybeesik a parlagok és az inváziós fajok súlypontjaival, a mezofil síkvidéki erdők a száraz és sziklás erdők és a cserjések egyes típusai az inváziós centrumokkal fednek át. A veszélyeztetett élőhelyek relatív területi borítását illetve az inváziós fajok számát és arányát az országos eredmények tükrében is értékeltük. A természetközeli élőhelyek átlagos inváziós veszélyeztetettsége a régióban jelentősen nagyobb volt, mint a hasonló élőhelyek országos átlaga, különösen az erdei élőhelyeken. Legveszélyeztettebbnek a láp- és ligeterdők, a mocsarak és a lápok, a mezofil síkvidéki erdők, a nyílt tölgyesek és a sziklás erdők bizonyultak. Az inváziónak legkevésbé kitett élőhelyek a zárt tölgyesek, a dombvidéki gyepek és a hínárnövényzet. A felvételezett inváziós fajok között a *Robinia pseudo-acacia*, a *Solidago* fajok, az *Ailanthus altissima* és egyéb, később nevesítésre szoruló taxonok a legjelentősebbek. A *Prunus serotina* szórványos, a *Reynoutria* fajok hiányoznak a régióból. Az adatok alátámasztották, hogy a növényi invázió komolyabb probléma Külső-Somogyban, mint a parlagterületek nagy kiterjedése.