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HUNGARIAN AGRICULTURAL RESEARCH

June 2018

Environmental management, land use, biodiversity

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A kiadványban megtalálható az összes hazai faj minden igényt kielégítő bemutatása, amely teljes körű tájékoztatást nyújt a szakembereknek és a lelkes természetbúvárok számára is. A több mint háromszázötven részletes illusztrációt tartalmazó kötet értékét tovább növeli a képanyaga, amely kétszáz művészi igényű színes fotót tartalmaz, ezzel felveszi a versenyt a hasonló tárgyú angol, német és francia nyelvű európai munkákkal. Hiánypótló a kétszázkilencven oldalas kötet abból a szempontból is, hogy részletesen tárgyalja a kifejlett állatok mellett a lárvákat is, jól használható határozókulccsal ellátva. A könyv további célja, hogy minél szélesebb körben népszerűsítse a rovarcsoport megfigyelését és megbecsülését.

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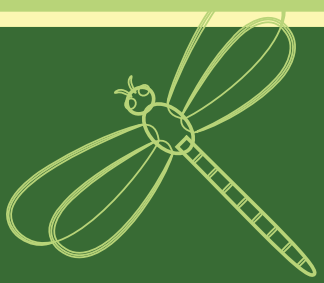

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RESULTS OF THE SURVEY FOR THE INVASIVE *RHAGOLETIS COMPLETA* CRESSON, 1929 (DIPTERA: TEPHRITIDAE) IN HUNGARY

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ABSTRACT

Although there have been positive changes in the walnut production in Hungary for the past few years, the recently introduced walnut husk fly (*Rhagoletis completa*) means a new challenge for growers. Since 2012 a national survey has been carried out on the walnut husk fly to reveal its occurrence in walnut orchards and to monitor its spread as well as to obtain relevant information on its biology in the country. During our study we found that following the first record of the pest in Hungary in 2011, *R. completa* appeared in high numbers in Vas and Zala counties in 2012, and it invaded new sites in Somogy county in 2013. In 2014, the pest appeared in an orchard located in the central region of Győr-Moson-Sopron county. The pest reached Baranya and Veszprém counties by 2015. In 2017, *R. completa* was recorded in further counties, namely Fejér, Komárom-Esztergom, Nógrád and Pest, and it appeared in Budapest, too. Our results show that *R. completa* may fly from mid-July until early October under Hungarian climatic conditions. The prolonged migration makes the control of the pest rather complicated.

Keywords: walnut husk fly, *Rhagoletis completa*, walnut, distribution, Hungary

INTRODUCTION

Walnut husk fly (*Rhagoletis completa* Cresson 1929) (Diptera: Tephritidae) is a new invasive species for the European fauna that was first introduced in 1983 in Switzerland (Merz, 1991) and later in the northeastern part of Italy (Duso, 1991). However by now, it has been established in many countries of the continent, including countries in Hungary's immediate neighbourhood, such as Slovenia (1997) (Seljakand Zezlina, 1999), Croatia (2003) (Budinščak et al., 2005) and Austria (2008) (EPPO, 2008). In Hungary, the larvae of walnut husk fly were found for the first time, in October 2011, in Kőszeg and Nagycenk (Tuba et al., 2012), then in 2012, Orosz et al. (2012) also reported its occurrence from certain locations of Vas and Zala counties. In parallel, Voigt et al. (2012a) reported on the presence and damages of *R. completa* in some locations in Zala and Somogy counties, close to the border. In 2013, Voigt and Tóth (2013) following their observations confirmed that this pest spread all over Zala and Somogy counties (Fig. 1). It can be assumed that this species could be naturally transmitted from Austria to Hungary (Tuba et al., 2012). However the transports of infested nuts are the major means of movement and dispersal to previously uninfested areas. There is also a risk from the transport of pupae in the soil or packaging of plants which have already fruited (EPPO, 2008). *R. completa* is the key pests of nuts (*Juglans regia* and *J. nigra*) (Olson and Buchner, 2002; Boyce, 1934) in its original area, in North America. Numerous studies have been conducted on the biology and ecology of this pest (Boyce, 1934; Duso and Dal Lago, 2006; Kasana and AliNiazee, 1996; Riedl and Hoying, 1980; Yokoyamata et al., 1992). Based on the obtained data, walnut husk fly has one generation, very good flying capacities, is characterized by obligate diapauses, and overwinters in pupa stage close to the surface of the soil. Based on other data, it can be observed in Europe from July to September (Barić et al., 2015; Duso and Dal Lago, 2006; EPPO; 2011; Tuba et al., 2012; Voigt et al., 2012 b). Eggs are laid below the skin of the nuts and hatch after 3-7 days; the larvae usually feed for 2-5 weeks; pupation is in the soil under the host plant and the peak of oviposition is in late August (Kasana and Aliniazee, 1996). Damaged nuts are pitted by oviposition punctures, around which some discoloration usually occurs. Later, because of the

larvae feeding inside the husk, the entire surface of the fruit will be covered with sagging, soft patches that can start very quickly to rot. This sign can easily be confused by untrained eyes with other diseases of bacterial and fungal origin, including infections caused by *Xanthomonas arboricola* pv. *juglandis* or damages caused by a native Chloropidae species, namely *Polyodaspis ruficornis* (Diptera Chloropidae). The main difference between the damages of *P. ruficornis* and *R. completa* is that while *R. completa* damages only the husk, *P. ruficornis* causes damages both in the husk and inside the nuts. *P. ruficornis* is able to penetrate into the walnut by a major bacterial infection or by damaging of *Cydia pomonella*. Due to the damage of *R. completa* larvae, the dark patches appear on the shell of the kernel, which further degrades the quality of the nuts. The consequence of the damage is that the kernel becomes wrinkled and rusty, furthermore premature crop loss can be observed (Tuba et al., 2012; Duso and Dal Lago, 2006). The presence of solitary walnut trees with frequent occurrence of the pest can promote the rapid propagation and spread of walnut husk fly throughout Hungary and also in Europe (Voigt and Tóth, 2013).

MATERIALS AND METHODS

The Directorate of Plant Protection, Soil Conservation and Agri-environment has been conducting national surveys for detecting walnut husk fly since 2007. Between 2012-2017, the plant protection inspectors carried out these official surveys of *R. completa*, furthermore in 2013 and 2014 walnut producers were invited by the Szent István University to participate in the surveys at several points in the country from the beginning of July to the end of October. Between 2012-2017, *R. completa* monitoring was carried out in two walnut plantations in every county all over the country The aim of this monitoring was to clarify the spread and biology of *R. completa* in Hungary. During the monitoring green-yellow Csalomon® PALz traps were used. Most fruit flies are attracted by the slight differences of yellow colour, so yellow sticky traps are used worldwide for their observation and detection (Voigt et al., 2012b). As fruit flies are looking for protein-rich food sources, a special attractant should be attached to the sticky trap. The traps are usually located in 2-4 m high. In each plantation four PALz traps (23x36 cm) were installed. The traps were changed on a 10-day basis in every investigation places in each counties throughout Hungary

RESULTS AND DISCUSSION

Based on the survey carried out by the Directorate of Plant Protection, Soil Conservation and Agri-environment, in 2012, *R. completa* occurred only in Vas and Zala counties. A total of 609 *R. completa* specimens were identified in PALz traps in Hungary (Orosz et al., 2012). In 2013 the pest appeared in Somogy county. In 2014 walnut husk fly did not spread to new areas of the country. However, in 2015, in the traps from Zsira (Győr-Moson-Sopron county), a large number of *R. completa* adults were found. Zsira is very close to Kőszeg and Nagycenk, the locations of *R. completa*'s first appearance in 2011.

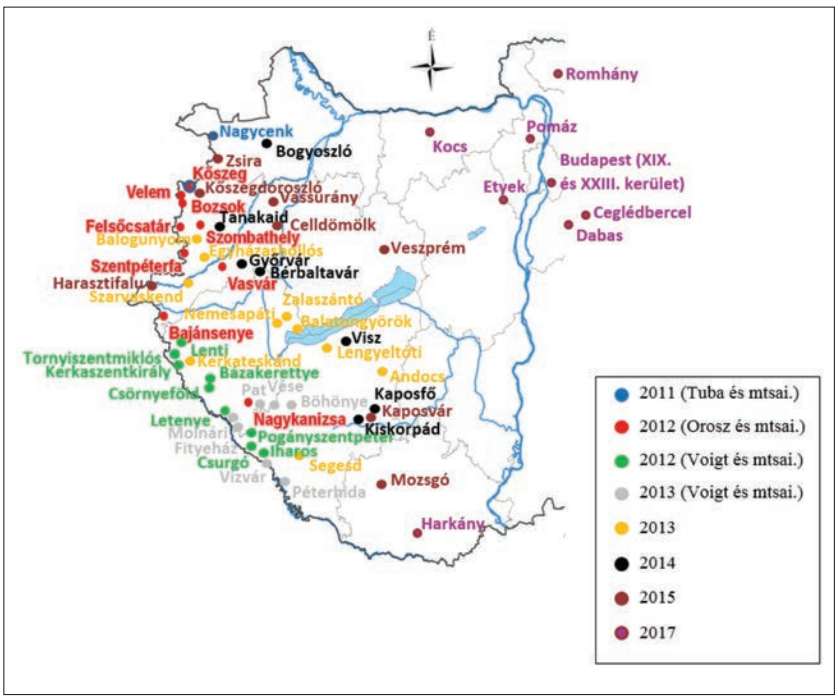

Figure 1: Occurrence of *Rhagoletis completa* captured by traps in Hungary according to Tuba et al., 2012; Voigt et al., 2012a, 2013 and the official monitoring data

Furthermore, in 2015 the species appeared in Baranya and Veszprém counties, too. In 2016, walnut husk fly was not detected in new areas in Hungary. However in 2017 *R. completa* reached new places in Fejér, Komárom-Esztergom, Nógrád, Pest counties and in Budapest (district XIX) and, at the same time, it crossed the Danube line (Table 1, Figure 1). In 2017 the detections of this fruit fly in Dabas, Harkány, Pomáz and district XXIII of Budapest were occasional, as we have been informed by residential notices. We do not know about concrete capturing data, but during visual examination in district XXIII of Budapest, severe crop damages were observed in the investigated walnut trees. In the last few years, the mostly damaged area was Kőszeg and its surroundings. According to Duso and Dal Lago (2006), *R. completa* adults migrate from the beginning of July to the end of August. However according to the official catching data in 2012in two

Table 1: Occurrence of *Rhagoletis completa* captured by traps in Hungary according to the official survey of National Food Chain Safety Office Directorate of Plant Protection, Soil Conservation and Agri-environment

Year	County	Number of specimens
2012	Vas	609
	Zala	1
2013	Vas	257
	Zala	28
	Somogy	2
2014	Vas	303
	Somogy	18
	Zala	15
	Győr-Moson-Sopron	1
2015	Vas	444
	Győr-Moson-Sopron	216
	Zala	35
	Somogy	5
	Baranya	4
	Veszprém	3
2017*	Komárom-Esztergom	86
	Fejér	4
	Nógrád	1
	Pest	1
	Budapest	163

Legend: * = Before the manuscript was completed, catches had come from the counties indicated

different investigation places (named 'a' and 'b'), walnut husk fly specimens were captured until mid-October, probably due to the extremely hot, dry summer periods. Most of the specimens were captured by the traps from early August to mid-September (Orosz et. al, 2012) (Figure 2).

It is also worth mentioning that in 2013 a large number of another fruit fly species were captured by PALz traps that were very similar to *R. completa*. This fruit fly was *Carpomya schineri* Loew, 1856 (Diptera: Tephritidae).. *C. schineri* is a pest of Rosaceae (Martinovich, 1961). It is very difficult to distinguish the two species by untrained eyes. The wing pattern is quite similar; although that of *C. schineri* has a faint brown tone. The main difference between the two species is the pattern of thorax. Namely the centre of the thorax in the case of *C. schineri* is bloomy, the lateral and the rear part and also the scutellum are spotted by bright dark patches, and brownish yellow in the other areas of the thorax. On the contrary the whole throrax of *R. completa* is brown with light brown scutellum (Papp, 1994). It is not possible to completely eradicate the walnut husk fly population. The safest way to limit the further spread of the pest is to prevent the larvae falling from the damaged nuts into the ground. An effective method could also be to cover the soil under walnut trees by foil, and to eliminate all the fallen nuts by burning them. The overwintering pupae could be destroyed by disturbing the soil under the trees (Daniel, 2013). Since no natural enemies of the walnut husk fly have been observed in Hungary, and the literature has reported about only very few parasitoids that can be efficiently used against this pest (Legner and Goerda, 1987), the National Food Chain Safety Office, as competent authority granted emergency use permits for the following insecticides: Decis, Karate Zeon 5 CS, Calypso 480 SC and Mospilan 20 SG. In this way, the number of pests can be reduced, even if it not possible to provide complete management of *R. completa* due to the prolonged migration (Orosz et al., 2012).

ACKNOWLEDGMENTS

Authors sincerely thank the plant protection inspectors and other colleagues of the county plant protection and soil conservation departments for carrying out the sampling and reporting processes and to Mr Norbert Nagy for preparing the spreading map. The authors are also thankful to Dr. Gábor Vétek for his suggestions and critical reviewing of the paper. The studies were conducted in the framework of the official survey of National Food Chain Safety Office.

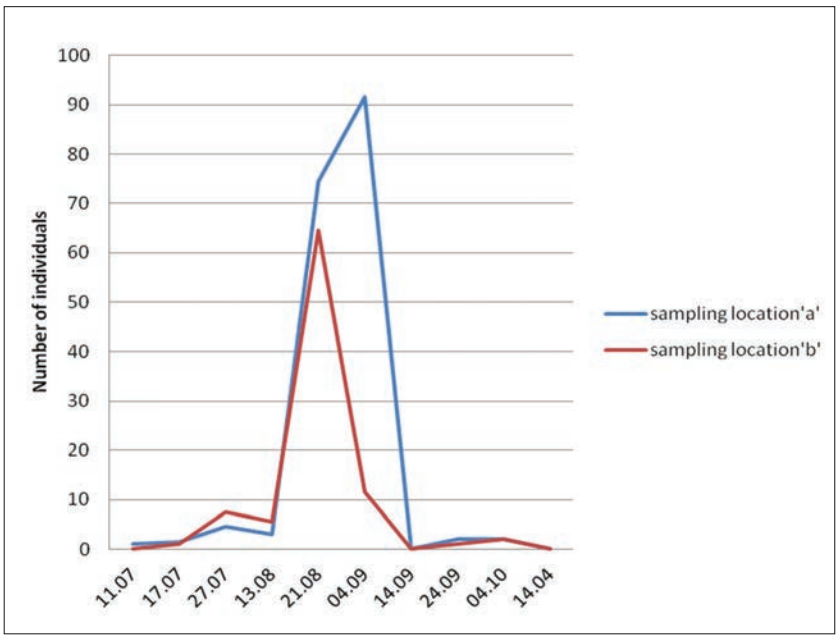

Figure 2: Phenology of *Rhagoletis completa* according to the catching data of the official traps in two different locations in Kőszeg (Vas County) (Orosz et al., 2012)

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FRUIT GENETIC RESOURCES AT NARIC FRUITRESEARCH INSTITUTE

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Globalisation has considerable effect on world fruit production: limited number of fruit cultivars are grown in specialised orchards and available for consumers that leads to reduced diversity. However, for sustainable fruit growing it is important to have a basis where genetic variability is maintained, which helps facing climate change, threats of new pests and pathogens, new consumer demands, etc. Thus, preserving fruit genetic resources is a highlighted task among fruit breeders, research institutes and supported on different national and international levels (e.g. FAO, European Union).

In Hungary, establishment of first conscious fruit collection orchards dates back to 1950s, when the former Horticultural Research Institute (the predecessor of present NARIC Fruitresearch Institute) was born. These collections served as selection basis of cultivars for commercial production and comprised of local and foreign cultivars, landraces.

Realising the loss of genetic variability led to the efforts of individual countries. In 1975 the Hungarian Ministry of Agriculture decided to establish a collection of fruit genetic resources. The task had been addressed to our institute to find and collect valuable landraces, traditional cultivars around Hungary and start a genebank collection. This work had been performed by a group of experts (12 researchers specialised in pomology)– they have been travelled through Hungarian villages and surroundings and designated 13,000 core trees that had been labelled *in situ*. Finally, 9,000 accessions of 19 fruit species have been collected, propagated and distributed among the research stations of the institute according to their ecological needs and specialisation of each stations. Thus, pome fruits (apple, pear, quince, medlar) were transferred to Újfehértó, stone fruits to Érd, apricot and plum accessions to Cegléd and soft fruits went to Fertőd. The collections at each stations developed more or less independently.

Due to frequent re-organisation of the institute and orchard replanting the number of genebank accessions have been reduced. The actual number of preserved accessions among different research stations in NARIC Fruitresearch Institute can be found in Table 1. As sources for collecting trips are limited, only acquisition of few new items is possible.

Maintaining the collection of fruit genetic resources is a national obligation that has been regulated by international and Hungarian laws and conventions.

According to them, our main tasks are as follows: 1. Maintenance of the accessions 2. Re-propagating collections regularly 3. Characterisation of the accessions 4. Keeping database 5. Utilisation, ensure accessibility to public

1. Maintenance of the accessions: Taking into account that most of our accessions are woody fruit trees, our most important task - maintenance of the accessions in good condition– is performed in *ex situ* collections. It means that we keep our accessions in regular orchards, at least two trees each and treat it with normal orchard management (agro- and phytotechnical duties, plant protection, etc.). At present the area of the collection altogether is 66 hectares.

2. Re-propagating collections regularly: When the trees become older, or a serious infection attacks the trees, the genebank orchards should be replanted with all of its tree nursery work. The old plantation is kept until the new turns into bearing. Our aim is making safety duplications from each accessions: maintaining an accession at least two locations.

3. Characterisation: For utilisation of genetic resources in the near or far future it is important to know their characteristics. Basically, phenological and morphological characters are described, according to international common descriptors – UPOV, or ECPGR. These descriptors usually assign numbers to each characters - some

examples can be found in Table 2. According to climate change and consumer demands new points become important when describing an accession, e.g. drought tolerance, resistance to pests or diseases.
Molecular characterisation is going to be initiated in the near future in order to discriminate accessions, screen synonims, duplicates, fingerprint data will be included in our database.
4. Keeping database: Each genebank orchards have a map with the location of accessions and the collection is documented also on accession level: the condition of the trees, propagation actions, locations, etc. Recording passport and characterisation data is continuous from the acquisition of the accessions. Recently a harmonisation effort started among research stations regarding data collection and a common database has been initiated.
5. Utilisation, research, ensure accessibility to public: In some cases accessions from the genebank collection can be emerged and get into the national variety list as registered landrace varieties.
Utilisation primarily takes place in our research institute. Selected accessions can be involved in breeding programmes or can be the subjects of scientific research such as studying pests, diseases, analysing health-protecting components of fruits or post-harvest research. Some current research works are determining winter- and spring frost tolerance of almond accessions, or utilisation of molecular markers in identifying sweet cherry fruit size, flowering and ripening time and their correlation with phenotype.
Since 1985 we take part in international genebank activities coordinated by IPGRI (today: Bioversity International), a sub-organisation of FAO. Passport and description data of our accessions are sent to crop specific databases. Our experts of the institute participate in the activity of *Malus/Pyrus* and *Prunus* Working Group and represent the national collection. We do joint research projects with Bioversity International, the current aim is preparing case studies and analysing accessions to be offered into the European collection.
Upon request we provide sample propagation materials from our accessions. From this year on open days are organised regularly at our stations for the public as well as for school groups and professionals (for details see our website at: https://fruitresearch.naik.hu/)

In the above detailed information of our most important species are described:

Apple:
Cultivated apple is a domesticated pome fruit species resulted of multiple cross-breeding of several native wild apple species of Eurasia. Almost all of the accessions are located in the Újfehértó genebank collection. More than half of the accessions are traditional cultivars and

Figure 1: Húsvéti rozmaring (photo: T. Szabó)

chance seedlings from the Carpathian Basin, while the rest are bred cultivars of Hungarian and international origin and cross-breeds from local scientific work. The current genebank is a result of several years collecting work in gardens, farms and abandoned orchards of Hungarian settlements, especially traditional fruit growing regions, as well as international exchange programs with other research institutes and collections. The first collection was established in 1981, since then it has been extended continuously, currently the complete apple genebank is available in three separate plantations. Regular data collection of the accessions includes phenology and pomological characterisation.

Pear:
The Hungarian pear collections were especially rich in the 1950s when first collections were established at several places: Fertőd, Kamaraerdő, Érd, Cegléd, Kecskemét. génbankok 1980as évek Due to re-organisations some of them could be saved and then distributed to Újfehértó, Fertőd and Keszthely (today: Pannon University, Georgicon). From that time on collections were developed independently. Later some new places started pear collections, such as Mosonmagyaróvár, Érd and Budapest.
The original pear collection at NARIC was established in Újfehértó and recently the accessions were safety duplicated in Fertőd due to erwinia infection. The collection cosists of mainly Hungarian landraces from different

Figure 2: Csokros muskotály körte (photo: E. Pallai)

parts of Hungary – from Transdanubian region to Hungarian plain. In Érd, most of the the accessions originate from the precious collection of Dr. András Terpó, Hungarian botanist. Our pear sortiment is very diverse regarding morphological and phenological characteristics – there are summer pears as well as winter pears, different fruit shapes appear and you can find fruits from white fruit flesh to red.

Researchers of Fertőd are active in collecting trips: they get material from Transylvania, from the scattered vineyards of Kőszeg and Zala region, and from the Fertő Hanság National Park.

Medlar:

The medlar genebank was planted in 1981, with 33 varieties. It was improved with some accessions in 1990s, later the number of supported accessions decreased. In 2002 the whole medlar and quince genebanks were propagated for establishing new, screenhouse genebanks because of the hypersensitivity of the species to fire blight (*Erwinia amylovora).* Most of the medlar accessions were collected from Transdanubia and some others were acquired from highlands of Hungary. In the genebank we can find accessions as trees, grafted on quince rootstocks, applying strict pruning in the case of trees in the screenhouse.

Quince:

Quince grows in Eurasian temperate zone areas from Western Europe to India, though it is supposed to be native only in a smaller territory near Caucasus. Although the number of varieties with peculiar appearance and content characteristics is less than the number of apple and pear varieties, its diversity is remarkable. In the Újfehértó genebank collection there are 61 traditional varieties from the Carpathian Basin (including local varieties of certain widespread cultivars), 1 wild variety, 18 bred cultivars and 62 cross-breeds (from an open pollinated breeding experiment). Traditional varieties were collected from all around Hungary, especially from established pomiculture areas, like Budatétény, Dunabogdány, Noszvaj or Telkibánya. Majority of the plantation was seriously damaged by fire blight (*Erwinia amylovora*), therefore all remaining trees were propagated and planted in screenhouse in 2002.

Figure 3: Quince genebank accessions under screenhouse in Újfehértó (photo: E. Pallai)

Sweet cherry:

Majority of the sweet cherries in our genebank are foreign varieties from Italy or Ukraine and hybrid accessions from our former breeding program. Landraces represent around one fourth of our entire sweet cherry genebank collection. The origin of the landraces are mainly Kiskunság region, Pilis, and Heves county. Many clones of 'Germersdorfi óriás' ('Schneiders Späte Knorpelkirse') and 'Badacsonyi óriás' are also presented in the collection. All these sweet cherries carry very diverse characteristics: from wild cherries with very small fruits to accessions with very large fruit sizes are present. Sweet cherries with yellow skin colour, yellow with blush, brownish-red, or almost black can be found too. Notable accession is a landrace that flowers few days earlier than 'Müncheberger Frühernte', or the accession that still has ripe fruits even in September.

Sour cherry:

The sour cherry accessions in our genebank have various origin. In Érd, most of them were collected in the 1950s in different parts of Hungary, mostly Jászság and Csengőd region. We preserve also many hybrids with interesting properties from our breeding program and some Ukrainian and Russian cultivars can also be found in our collection. The different clones of the cultivar 'Pándy', and the many 'Cigány' type sour cherries are valuable accessions of our collection, also a wide range of amarella and morello phenotypes can be found. One of the unique accessions is the "ever-flowering" sour cherry, that flowers and mature fruits can be observed at the same time on the tree.

In Újfehértó, at Szabolcs-Szatmár region where sour

Figure 4: Késői cigánymeggy (photo: D. Ujfalussyné Örsi)

cherry appears to have the highest variability in Hungary, the collection consists of local landrace selections.

Apricot:

The conservation of genetic diversity of apricots has a very long history at Cegléd. Collection of landraces started in the early '50s with the aim of selecting the most suitable varieties for the Hungarian apricot production. As a result, more than 500 accessions were collected in Hungary, especially around Cegléd, Kecskemét, Nagyk rös, Tiszakécske. Discarded but still valuable hybrids from the apricot breeding programmes also took place in the collection. In 2001 the collection was renewed and enriched with foreign cultivars from 10 different countries (e.g. Romania, Serbia, Ukraine, Russia, Spain, Italy, Canada, USA). Selected apricot accessions were also distributed to Érd.

Plum:

The plum genebank collection was founded also in the 1950s. The base of plum research is located at Cegléd research station. In the total area of 5.8 hectares accessions from English, Belgian, Czech, French, Italian, German, Serbian, Romanian, Ukrainian, American and Hungarian origin can be found. The collections include the varieties of past and present orchards, and notable plant materials arrived from tours all around of the country, and from collections of universities, the Plant Variety Office, Ukrainian, Serbian and German research institutes.

Figure 5: Beregi datolya (photo: Sz. Kovács)

Different Besztercei plum types represent the largest number of cultivated varieties. However, there are many items of gage plums (eg. Sermina, Althann Ringló, Bavay Ringló) and their selected types as well as landrace selections planted only on orchards (eg. Vörös szilva, Bódi szilva, Lószemű szilva, Nemtudom szilva).

Beside annual phenological and pomological studies at each stations suitability of the accessions are tested for manufacturing purposes (dried plum, pie, jam, pálinka). Landrace selections from Upper- Tisza region are studied in the Újfehértó Research Station. A joint research program was launched with the NARIC Food Research Institute, where the chlorogenic acid content, important for human nutrition is examined.

Peach:

Although some local cultivars were described by Ferenc Entz in the 1800s, peach is not an endogenous fruit species in Hungary. From the beginning of 20th century American cultivars appeared and spread quickly in gardens. The peach collection initiated in Érd, together with other fruit collections in the 1950s and comprised mainly of American cultivars. In the present genebank collection most of the cultivars are of American origin. During the establishment of the peach genebank Hungarian local cultivars were collected, mainly from Csongrád county (especially the so called "Parasztbarack" types) and around Budapest. Some of the accessions came from the collection of National Plant Variety Office (today: National Food Chain Safety Office) and the University of Horticulture. The latter source is especially precious as these accessions are Chinese cultivars (some of them have flat fruit shape) and some came from the famous Nikita Botanical Garden.

Almond:

Almond was a marginal fruit species in Hungary located especially in vineyards until the phylloxera infection. Later French and Italian cultivars were introduced and their

Figure 6: Sóskúti mandula (photo: D. Ujfalussyné Örsi)

seedlings spread in the country. The first almond collection was established in Balatonakali and consisted of accessions selected from Balaton region. Some years later another collection was started in Érd, based on almond types originating from Budatétény region. This collection was extended with seedling populations of labelled trees from the breeding programme. When the Balatonakali collection was terminated, some of the accessions were transferred to Érd. Together with landrace selections from 1970s and foreign cultivars the collection in Érd is the basis of our almond genebank. In Cegléd a collection of 479 accessions suitable for seed production is located and used for generative rootstock selection.

Soft fruits (berries):

The genebank collection of soft fruit species is located in Fertőd and always served breeding as well as research activities. It is attributed to researchers who collected local cultivars from domestic orchards or through active material exchanges from the surrounding research institutes, especially from Poland.

Our strawberry genebank contains foreign cultivars from the USA, England and Poland as well as Hungarian selections and hybrids.

Raspberry and blackberry accessions – cultivars or even different species - originate from Poland, United Kingdom, USA and China, or collected inland from Mátra region, Kőszeg region.

Red- and blackcurrant accessions originate from Poland, Germany, the Baltic States and the Altai region in Russia.

The elderberry collections include Danish, Austrian and Norvegian accessions.

A unique gooseberry collection comprising 40 items is located at Újfehértó.

Walnut:

Walnut genetic resources are related primarily to Érd where foreign cultivars, accessions around Mezőföld and upper Tisza region and hybrids from the breeding programme are maintained. In Újfehértó walnut accessions mostly collected from the region of Szatmár and Bereg.

MOLECULAR WORKS AT NARIC GENEBANK

The molecular genetic lab of the NARIC Fruticulture Institute in Érd was established in 2015 in order to improve the selection of valuable genotypes of the genebank collection, and to support the fruit breeding processes of the institute. We use DNA markers to determine the S - genotype of sweet and sour cherries, a key trait governing self- and cross-compatibility. S-allele studies also can be used to distinguish similar genotypes, and to clarify pedigree relationships.

Certain SSR markers can predict the fruit size of sweet cherries. We used two of these markers, BPPCT038 and CPSCT034 on 24 accessions and compared the PCR results with the measured fruit sizes and weights. Accessions carrying certain allele combinations have the potential of inheriting bigger fruit size to their offsprings, so

Table 1: Number of registered genebank accessions at NARIC Fruitresearch Institute according to fruit species and research stations (the total number of accessions including not registered items is around 8,000)

	Érd	Újfehértó	Cegléd	Fertőd	Total
apple	40	1137			**1177**
pear	154	457		483	**1094**
quince	14	122			**136**
medlar	12	30			**42**
sweet cherry	261				**261**
sour cherry	215	113			**328**
apricot	358		531		**889**
peach	271				**271**
plum	348	131	195		**674**
almond	234		479 (rootstocks)		**713**
walnut	83	11			**94**
gooseberry		48			**48**
strawberry				311	**311**
red currant				105	**105**
black currant				137	**137**
blackberry				40	**40**
raspberry				265	**265**
elderberry				40	**40**
Total	**1990**	**2049**	**1205**	**1381**	**6625**

this method can have a good use in breeding processes. Genebank collections may provide a wide range of disease resistant genotypes. Molecular markers have been developed in recent years to study the virus resistance of many fruit species. We use three lately published DNA markers to screen resistance of raspberry genotypes against Raspberry Bushy Dwarf Virus (RBDV), a serious pollen born pathogen. More than 50 genebank accessions grown in the Fertőd Research Station of NARIC was genotyped by PCR so far. RBDV resistant accessions are used in the raspberry breeding program of the institute. Our further aim is to develop marker sets in fruit species in order to fingerprint genebank accessions and utilise data in distinguishing and characterising them.

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THE HUNGARIAN KURGANS AS PART OF THE EUROPEAN LANDSCAPE HERITAGE

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ABSTRACT

Ancient burial mounds, so-called 'kurgans' have a great importance in the history of the Carpathian Basin. They are considered as significant elements of the cultural and natural heritage, and moreover they represent unique landscape, archaeological, botanical and zoological values. We can meet them in many areas of Eastern Europe. Unfortunately, the different agricultural activities resulted in their continuous degradation and their number also decreased over the past centuries. There were remarkable changes in agricultural regulation concerning the mounds in the EU – and in Hungary, too – in 2010. They were declared protected landscape elements and therefore they became part of cross-compliance. In our research, we checked the results of the new regulation in relation to the changes in the state of the mounds in Békés County (SE Hungary) between 2010 and 2015 and in 2018. There have been significant change in the state of the kurgans, because at the end of our research the areas of 180 mounds were in an abandoned, undisturbed condition, and 5 were still subject to disturbance.

keywords: common agricultural policy (CAP), landscape protection, kurgan, national heritage

INTODUCTION

Kurgans are part of the cultural history of the Carpathian Basin. By examining them, not only archaeological science can benefit, but we can gain better knowledge on botany, palaeoecology, landscape ecology and soil science, as well. In Hungary, the different types and ages of prehistoric mounds are called 'Cumanian mounds'. This name (which is inexact) suggests that it is only about the man-made mounds that were built by the Cumanian ethnic group in the 13th century. On the contrary, archeological excavations and dating have proven that most of them are older than the tumuli built by the Cumanians. These human-made formations play a significant role in nature conservation, landscape architecture, and they are

part of the archaeological, botanical, zoological, cultural history heritage of the Great Hungarian Plain in the Carpathian Basin (Tóth A. 1999). The archaeological excavations revealed that most of the mounds were built for burial purposes either in the Late Copper Age or Early Bronze Age. Moreover they formed the basis for settlements throughout the prehistory and history of the Carpathian Basin. Today, Sarmatian, German and Hungarian Conquest period cemeteries, churches and tombs from the Árpád Age can be found on some of these mounds. The outstanding botanical value of the mounds is that it is the last shelter and natural habitat for the non-cultivated, rarefying plants of the steppe. The mounds that detach as islands are the places that keep the biological diversity (Sudnik et al. 2008; 2009). As plough-land cultivation has become more intensive, the country (chernozem) lands – that are of excellent quality – have been cultivated, hence only a small part of the indigenous flora has remained. Today, we can hardly find a habitat where the loess flora has not been affected through the past millennium. The kurgans are the last island-like, ancient habitats and shelter, which is why they are botanically and zoologically valuable. The areas that have dry and hot climate – sometimes with rare associations – also cre-

ate proper conditions for animal habitats. Beside their botanical and archeological values, these areas also have landscape, soil science and palaeoecological values (Hejcman et al. 2013). As landscape values, they belong to the scene of our Great Hungarian Plain. The imposing mounds that stand out of the flat land serve as a locality point and also give amazing scenery for those who travel around the area (Tóth A. 1999). The mounds are also valuable considering soil science. The detailed examination of the once buried and the soils that have been formed in the past millennia can broaden – moreover they can augment new results – the body of knowledge of the Holocene environmental changes, like climatic changes (Alexandrovskiy 2000, Khoklova et al. 2001, Barczi et al. 2006a; 2006b, Barczi 2009), it also helps evaluate the human-made, anthropogenic soil formations (Puskás-Farsang 2008).

Although the human-made mounds had raised people's attention, researches on mounds have only started to boom in the past few decades. In Hungary, the examination of these constructions and their environment started in the beginning of the 20th century, but a complex archeological and environmental research has only been in progress in the past few years. The examinations were professionally divided and the archaeological aspects were dominant. Archaeological researches mainly dealt with the ethnical and chronological classification of the mounds and also with the people's lifestyle in the Copper and Bronze Ages (Ecsedy 1979, Raczky et al. 2002, Csányi 2003, Dani-M. Nepper 2006).

Among the researches related to kurgans, there are some new ones that are based on natural science approaches. The analyses carried out on soil science, palaeobotany and geology can not only give an answer to the circumstances of how these mounds were built or the ancient environment of the mounds, but they also provide us with valuable data on how the land has changed since the mounds were built.

Researches carried out on the ancient environment of the mounds started with the geoarchaeological examination of the Testhalom kurgan (Sümegi et al. 1998). Tóth A. (1999) and Sümegi et al. (1998) carried out geomorphological and stratigraphic researches on Büte-halom kurgan. It has become possible to clarify the building circumstances of the mounds and to reconstruct the ancient environment of three kurgans: the Csípő-, the Lyukas – and the Bán-halom by soil morphological, soil chemical, malacological and phytolith analyses of the buried soil (Barczi et al. 2006a; 2006b, Barczi 2009; Barczi-Joó 2009, Molnár 2004). Island biographical researches carried out on loess fields that remained on some of the mounds and are rich in different species of animals and plants concentrated on the description of some valuable animal and plant species and beside the examination of their isolation dynamics they also focused on the threatening environmental impact on symbiotic unions (Novák 2009). Based on map sources, there were approximately ten thousand mounds in Hungary but by the mid-20th century they significantly decreased in number and their condition drastically deteriorated. During the 19th and 20th centuries, hundreds of mounds were eroded and ploughed mainly by the river regulations and then by the developing agriculture. The names of those remained have been forgotten by today. Although the I. Josephian military map-sheets show a large number of mounds in the Carpathian Basin and by gleaning the old maps we can see almost forty thousand mounds, today we can hardly ever see an untouched, undamaged mound in the Great Hungarian Plain that we could be proud of. Because of these, the map and terrain record and the census of the mounds have started in the last decades of the 20th century. In the area of Tiszántúl, 3724 pieces of mounds – most of them are burial mounds – have been counted by using different sources of maps (Virágh 1979). The mound cadastre in Hajdú-Bihar County was compiled in the beginning of the 1980's. In the same decade, the mounds in Jász-Nagykun-Szolnok County were assessed and categorized by their condition. According to the database assembled in 2002, after the countrywide cadastre, the mounds have been in very bad condition. Almost half of the mounds are under intensive plough cultivation, 40 % of them are damaged and a fifth of them have no landscape value, they are forested and weedy mounds (Szelekovszky 1999, Tóth Cs.-Tóth A. 2011). Although making the cadastre – which is maintained by the assessment and data supply of National Parks – was successful, the assessment itself did not protect the mounds efficiently. Although the memorandum of the 22nd February 1847 Hungarian Academy of Sciences general assembly and then the Budapest Prehistoric Congress of 1876 dealt with their archaeological values and the necessity of their record, and took the protection of the mounds as a high priority case, the first significant result was due to the

Act LIII of 1996 about nature conservation. Under this regulation, the mounds became ex lege protected. However, the biggest problem of the regulating aim was that there was no enforcement order, and it only said that the mounds must not be abused. In other words, the regulation did not forbid agricultural cultivation, only eroding the mounds was forbidden.

There was a remarkable step in the common agricultural policy (CAP) reform of 2009 (Hart 2015). The basis of today's work is the communal order that came into force by the reform, the relating local laws and their impact on the growers and the country land. The new regulation has two basic elements: Statutory Management Requirements (SMR), which are governed by the law, and the required standards in the agricultural and environmental conditions (GAEC). Cross-compliance was introduced by Council Regulation (EC) No. 73/2009 owing to the reform in Common Agricultural Policy in 2003 (Somai 2014, Veysset et al. 2005). The cross-compliance is related to the following issues: nature conservation, environmental protection, animal marking, animal- and plant health, and animal welfare. These regulations were due to be introduced between 2009 to 2013. The later one, which is related to the right agricultural and environmental condition, was introduced by Council Regulation (EC) No. 1782/2003, and came into force by 4/2004. (I.13.) FVM in Hungary, in 2004. At present, Hungary complies with the corresponding EU regulations by 50/2008. (IV.24.) FVM about the Good Agricultural and Environmental Condition enforcements. It contains nine elements as the other basic pillars of cross-compliance. These elements determine the regulations which are related to the healthy and sustainable agricultural environment, agricultural environmental protection, rural development, landscape ecology, mosaicism, landscape, and the required criteria to observe them. There were continuous changes in the regulation owing to the amendments. It contained six regulations until 2010 such as terrace cultivation rules, crop rotation rules, criteria of weed-free zones, soil protection against erosion, burn bans, protection of soil structure, and observation of grazing rules. The regulation was modified by the Regulation No. 32/2010 (III.30.) FVM in 2010 in accordance with the Council Regulation (EC) No. 73/2009 – establishing common rules for direct support schemes for farmers under the common agricultural policy – and two new criteria were involved into the regulatory system. One of them is the irrigation rule, owing to which the number of conditions in regard to the agricultural environment increased. During the modification, another criterion was passed into law, which – besides the environmental factor – designated the notion of landscape as sites to be protected. As a result of this, sweep-pole wells and kurgans also became protected sites in Hungary. In accordance with the modified regulation, the farmers who have kurgans on their lands are obliged to protect these sites and give up some cultivation methods such as ploughing and disking, both of which may cause soil disturbance in kurgan bodies (Ministry of Rural Development, 2011). The introduction of the regulation started with a survey of their state. In order to carry out the survey, we used the national mound cadastre as a background database. The survey was performed by the Ministry of Rural Developement (MRD) and the Agricultural and Rural Development Accredited Paying Agency (ARDA). After the EU regulations, the modification of GAEC order and after this order had come into effect (1st November 2010) – except for reseeding works – any agricultural cultivation is forbidden on the mounds (Rákóczi-Barczi 2015, Rákóczi 2016; 2017, Rákóczi-Tóth 2017). All in all, there have been such changes in the protection of the mounds that it is worth assessing, investigating and putting it into the centre of a research theme.

MATERIAL AND METHODS

The methodology of the condition assessment and annual complete inspections

In the course of my research work, before the decree amendment, I performed a condition assessment work in the County, recording the initial conditions, in relation to the 185 Cumanian mounds included in the decree. I performed the assessment work in the 2010/2011 farming year, meaning between the autumn of 2010 and the autumn of 2011. In the course of my work, I used a THALES MobilMapper CE model PDA-GPS device, on which the Digiterra Hell 6.14.04.2 Geographic Information System program was installed. Based on the data in the list, I entered the coordinate data of the

mound's center into the PDA device. That is how I located each mound. After finding and identifying the mound onsite, I inspected its area data. On its center I entered a point-polygon for its Geographic Information System designation and for displaying it on a map. In the further phase of the onsite work, I also determined the correctness of the registered radius data. Following this, I also assessed its area by walking around at the bottom of the mound's superficies. Afterwards, I examined the cultivation condition of the mound, the land use conducted on it, but the condition of the mound's superficies was also recorded (intact, leveled, damaged, etc.). After this, I took photos of the mound with a digital camera from several directions and I archived the photos in the digital computer database following the unique identifiers of the mounds. I recorded the thus collected data on an assessment sheet onsite. We entered the data collected in the course of the assessment into Microsoft Office Excel 2007. The data in this database provide the initial reference data for my research work.

After the compilation of the initial database, starting from the autumn of 2011 until the end of 2015 and 2018, I conducted annual inspections corresponding to farming years, meaning from the autumn of the concerned year to the end of the summer in the following year. From a methodology aspect, these were performed by complete examination. The base population was the range of the mounds that had been disturbed in the previous year. Therefore, in the later years, the base population was a variable number. It was the number of mounds registered as cultivated in the assessment of the previous year. The onsite procedure of the annual complete examinations occurred in the manner detailed above.

The methodology of monitoring inspection

Starting in 2013, I also performed onsite monitoring inspections. The reason for this is that the annual complete examinations only included the mounds that had been cultivated in the previous year, and did not include the mounds that had been abandoned in one of the previous years. At the same time, from the aspect of the examination of the introduced regulation's effects, the mounds that had been abandoned in the past years must be examined as well, since the condition of those points out the stability of the results and effects.

From a methodology aspect, my annual monitoring inspections were conducted based on representative sampling. The base population for sampling was the mounds the cultivation of which had been abandoned in the previous years. Based on the above, the base population in 2013 was the mounds abandoned during 2012, here I determined a 7% sample. In the course of my monitoring inspections in the years 2014, 2015 and 2018, I decided on a 10% sample. The compilation of representative samples occurred with a random number generator, by means of the program Random Number Generator Pro 1.71 (version: 1.71). The onsite survey of the selected mounds took place after this, based on the onsite methodology described above. We managed the results of the annual monitoring inspections in a separate registry.

RESULTS AND DISCUSSION

Table 1: The condition of Békés County's kurgans between 2010 and 2015, and in 2018 (Rákóczi 2016)

num.	examined year	arable (pieces)	non-arable (pieces)
1.	2010	98	87
2.	2011	78	107
3.	2012	40	145
4.	2013	24	161
5.	2014	11	174
6.	2015	8	177
7.	2018	5	180

We can see the 185 pieces of Cumanian mounds of Békés County and those stated in the following map (Table 1.). Of the total of 185 mounds, 87 were non-arable in the time of the state survey. During the year 2010, when there was a change in the law, at the time of the site assessment, we found 87 nearly non-cultivated original mounds out of 185 cultivated ones. The area of these mounds has not been cultivated through history. We found 20 mounds that were used as ploughlands in the previous years and only because of the legal changes they are now non-cultivated. During our work, we found

78 Cumanian mounds that were under cultivation despite the regulations.
The annual results of our area surveys are presented in Table 1, too. We can establish that in 2012, the number of cultivated mounds further declined and the cultivation of the areas of 38 mounds was abandoned by the farmers of the County. Thus, the total number of abandoned mounds increased to 145, and the areas of 40 Cumanian mounds were still subject to soil disturbance.
By 2013, the range of abandoned mounds further increased, the cultivation of 16 mounds was abandoned by farmers in this year. Thus, 161 mounds were of abandoned condition and 24 mounds continued to be subject to disturbance. On their areas, the affected farmers mainly cultivated wheat, corn and sunflower crops.
In 2014, the affected farmers abandoned the cultivation of the areas of an additional 13 mounds. Thus, by the end of 2014 the areas of 174 mounds were in an abandoned condition, and 11 were still subject to disturbance.
In 2015 the affected farmers abandoned the cultivation of the areas of an additional 3 mounds. Thus, by the end of 2015 the areas of 177 mounds were in an abandoned condition, and 8 were still subject to disturbance.
Seeing the results of the 2018 study, it can be established that farmers abandoned agricultural cultivation on the area of 3 additional mounds, thus 180 mounds were in an abandoned condition. Agricultural cultivation continued on the area of 5 mounds. The latter may have a number of explanations, despite the cross-compliance sanctioning system that is in effect. The principal one is the selection for inspections connected to territory based subsidies, since only a certain percentage of those who apply for the subsidy are subject to onsite inspection. Within this not every applicant is subject to inspection in relation to the GAEC criteria (Figure 1.).
Our monitoring process started in 2013 and continued in 2014, 2015 and 2018. At this level of the monitoring process, in 2018 we can claim that we have not found a mound that has been cultivated since the regulations except for one kurgan (5010) (*Három-határ-halom kurgan*). In the case of kurgan 5010, there was a willful destruction by the farmer. This is another example of the conflicts of the kurgan economical regulations. There has been a criminal accusation by the authorities in this case. It can be stated that the functioning of the GAEC decree, as the implementation decree of the protection of Cumanian mounds, is stable since it guarantees the protection of the mounds in the long term.

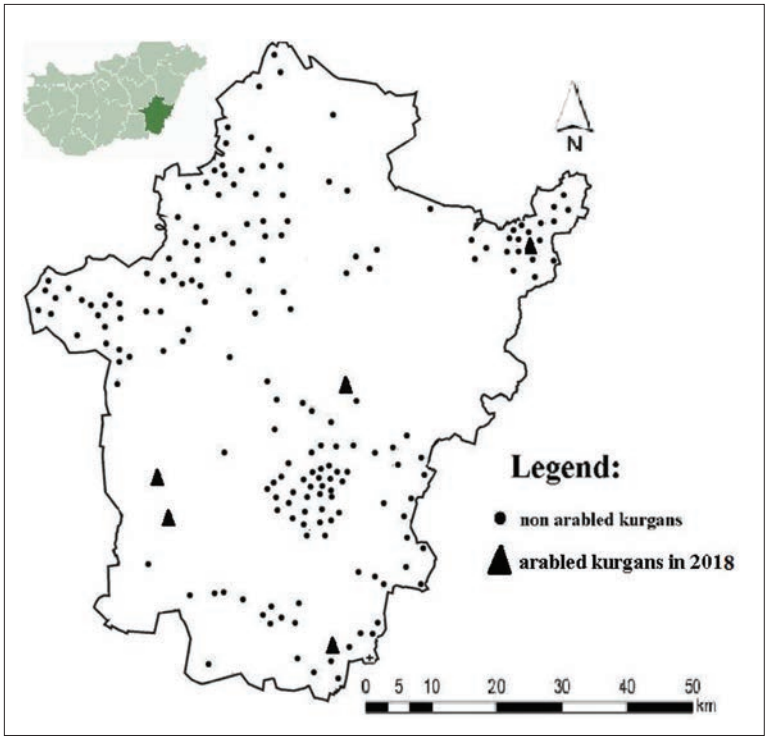

Figure 1: The condition of Békés County's 185 pieces kurgans in 2018

CONCLUSIONS

My area surveys conducted through five years have proven that the amended GAEC decree – as the implementation decree for the protection of Cumanian mounds – protects the manmade mounds with a level of effectiveness that has never been seen in their existence. I registered a significant change in the condition of Békés County Cumanian mounds. My research – as a case study – revealed that in the case of the expansion of the range of mounds included in the GAEC decree, within a short time, there would be a good chance for additional mounds to survive and be preserved. Consequently, if we wish to take any of our scenery-values under protection, their survival and preservation could be ensured through the regulation of cross-compliance connected to EU agricultural subsidies.

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SOCIAL FARMING IN EDUCATION
'Revitalise the land by revitalising people.'

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ABSTRACT

'Revitalist' is a new initiative that intends to take further the concept of Social Farming in Hungary by elaborating a new training curriculum based on a social and therapeutic method of education (Practical Skills Therapeutic Education, PSTE), by creating and collecting a pool of background materials and by establishing a network of professionals, and this way responding to several European regional and local policy needs. The target groups of the new social farming mentor training curriculum are social farm employees, and social and agricultural professionals.

keywords: social farming, social inclusion, PSTE method, mentor training

INTRODUCTION

Social integration of disadvantaged groups presents a real challenge at national and international levels. There is also a pressing need in our locality and within Europe for a deeper knowledge related to social farming as it relates to a complex re-framing of agriculture and rural areas to provide a socially and environmentally sustainable model, compared to the currently dominant agribusiness model of farming and the countryside.

What is Social Farming?

Social Farming refers to the marriage of environmental concerns (eco/sustainable agriculture), with social integration of disadvantaged minorities, through the execution of agricultural practices. These minorities can be people with physical or mental disabilities, prisoners, and homeless people, the elderly, etc. It can also focus on educational projects in the fields of agriculture for younger people in schools, kindergartens, etc. This rich model of agriculture is not only effective in terms of focusing on agricultural productivity, but it equally allows a more sustainable and socially inclusive approach, in a low-investment and cost-effective way. This can signify a hugely progressive step in terms of harmonising societies in the present and future.

Farms can provide very appropriate sites and centres for land-based social activities, which a wide range of participants can be attracted to and benefit from.
For the *individual farmers*, it represents a connection to the outside world (as farmers tend to be isolated in their time-absorbing tasks) and a way of contribution to society by extending and diversifying farming activities to vulnerable individuals whilst providing farmers with new sources of income. For the (vulnerable) *individuals,* by getting the chance to engage in farming activities, it represents a dignified way of connecting with essential

values by doing something meaningful, such as working the land to obtain top quality products. As for the *communities*, as a consequence of the two previous points, it naturally creates conditions for local expansion, that can be sustained throughout time with minimum investments.

The therapeutic value of this work is also remarkable, particularly for marginalised individuals that for many different reasons find it hard to (re)connect with society.

The social farming movement and related programs still face difficulties and challenges such as the lack of fully detailed and exact legal regulations of social farm operation, lack of comprehensive local or national strategy related to social farms, general bureaucratic obstacles or the complete lack of education related to the everyday activities and sustainability of social farms. We are convinced, as our project team's previous need assessment also confirms, that social farms, organic farms, and other social institutions would highly benefit from a social farming training, especially one that includes economic viability studies.

THE NEW INITIATIVE- THE REVITALIST PROJECT

The EU funded Erasmus+ Strategic Partnership project was launched in September 2017 and lasts for 3 years. This complex project, called *Revitalist*, aims to create a *Social Farming Mentor Training* with the collaboration of different partners from Hungary and other European countries.

The planned training focuses on the concept of social farming in Hungary to benefit disadvantaged populations identified as the project's end-users. The consortium leader, the Hungarian Quality Compost Association (HQCA) accommodates the project that proposes to train management and staff dealing with any type of end-users in an innovative method called *Practical Skills Therapeutic Education (PSTE)*.

This method was developed by the Ruskin Mill Trust in the UK that combines key elements of education, concern for nature and social action, at the service of those who are mostly in need, in order to provide them a more dignified place in the community and assist them in becoming part of the society.

Who are the Revitalist project's end-users?

All underprivileged at-risk groups are indirect beneficiaries of the project, particularly:

- Unemployed people
- People with special needs: physical or/and mental disabilities
- People with learning difficulties, School drop-outs
- People in extreme poverty
- Homeless individuals
- People who have served time in prison
- Ethnic minorities: Roma gypsies, etc.
- People suffering from mental problems or/and addictions
- Elderly people living in social institutions
- People with changed working ability
- Low-skilled people

The aim is to allow the *Revitalist* training process to grow as sustainably as possible, always seeking to establish relevant partnerships with other initiatives with similar goals, locally and internationally. The second focus of our project is to ensure the sustainability of social farms in Hungary. With the help of our experienced project partners, the project results will hopefully contribute to a deep and realistic understanding and application of the social farming concept in Hungary.

What is the *'Practical Skills Therapeutic Education'* (PSTE)?

At its core, PSTE uses local history, from a geological and anthropological perspective to withdraw vital concepts of a particular area or region and then works on creating ways to bring that ancestral knowledge back to the present. We believe that if people are able to reconnect with their roots, they can more easily gain a sense of belonging and well-being. This is done purely in a very 'hands-on' and cost-effective way, whereby personal engagement is achieved through practical skills and crafts, such as work with organic agriculture and composting. In other words, *PSTE proposes to revitalise the land by revitalising people*.

PARTNERS OF THE REVITALIST PROJECT

The main purpose of the *HQCA* as the consortium leader is to expand its range of activities towards social farms by investing in specific and appropriate trainings that address the complex needs of different target groups. One of the purposes behind this idea is to strengthen the HQCA's social role in society, by combining professional agricultural knowledge with social care. In this project, the HQCA will use its extensive network of partnerships in both Hungary and Europe, which was a vital resource to find and select the ideal partners for the *Revitalist* consortium. This association sets the standards for professional compost making in Hungary, a knowledge that will be transported to the composting module of the planned training of Revitalist. The task assigned in this project matches exactly one of the poignant aims for this association: to increase the knowledge and practice of bio composting at national and international levels.

Diversity Public Utility Foundation is an NGO in Gödöllő that mainly aims to foster equal opportunities in the labour market, to help the integration of disadvantaged people into the workplace and everyday society. They plan to set off protected education and employment, to open a Social Garden in co-operation with HQCA, where disabled and long-term unemployed people can learn, develop and work with the help of the PSTE method.

Ruskin Mill Trust is an education provision working with hundreds of underprivileged students since 1986 in the UK. They have developed the innovative PSTE programme, drawing its inspiration from Rudolf Steiner, John Ruskin and William Morris. It provides an exciting and wide range of course subjects that gives students the opportunity to learn through doing real-life and purposeful handcraft activities (from green woodwork to small-scale composting) that enhance their intellectual, emotional and physical health. RMT will play an important role in the structural module of the Revitalist project, particularly in training the respective partners.

The small *municipality of Tiszasas*, is characterised by a low living standard and a higher unemployment rate in comparison with the Hungarian average. The Revitalist project will provide Tiszasas with an opportunity to further develop their recent Municipal Social Farm initiative. The ambition is that the PSTE method may significantly increase the skills and well-being of the specific low educated, disadvantaged target group, prevalent in this village. In many ways, this partnership provides an ideal testing ground for Revitalist.

WorldWide Opportunities on Organic Farms, Hungary (WWOOF Hungary) is a non-profit organisation who maintains a vibrant partnership with 30 organic farms and about 200 volunteers every year. Their main activity is to manage the voluntary WWOOF network in Hungary, whilst maintaining an active participation in many parallel projects. They have been establishing a close partnership with Bercel municipality (Nógrad county) where a social farm initiative has recently started, with the support of many different organisations. The idea is to establish a self-sustainable social farm in Bercel with the support of the Revitalist framework and funding.

The Faculty of Agriculture is part of the *University of South Bohemia,* located in České Budějovice. The Faculty focuses on sustainability and agriculture, alternative systems of farming, including organic farming and social farming. The most recent focus is to be able to provide fully accredited bachelor courses in social farming, with the practical cooperation of external stakeholders in the sector of organic farming (social farms, NGO-s, therapists, policymakers, etc.). This is also happening in simultaneous cooperation with the Ministry of Agriculture, who actively participates in the development of social farming and is in fact pioneering the whole field of social farming education in the Czech Republic. This Faculty will contribute with their vast experience and knowledge in sustainable farming and economic viability to the Revitalist project.

Agricoltura Capodarco Società Cooperativa Sociale is an organic multifunctional farm on the outskirts of Rome. The community emerged in 1978 in Grottaferrata and started agricultural activities with a group of disabled and disadvantaged people. Capodarco is a social farm that includes disabled and socially excluded people as employees, trainers or volunteers, all engaged in occupational therapeutic activities. The farm focuses on mentally and physically disabled people, psychiatric patients, former drug-addicts and former prisoners, people affected by depression, immigrants and political refugees, asylum seekers, etc. The aim is not only to promote social inclusion of disadvantaged people but also to improve the life quality of the local community through useful services. The perfect example of this is a social café and restaurant with 200 seats, serving organic products from the farm, served by the same staff. This organisation is an inspiring model for Revitalist, particularly in the aspects of managing to remain an economically successful and sustainable social farm for decades (perhaps one of the oldest in Europe).

TOPICS OF THE PLANNED SOCIAL FARMING MENTOR TRAINING

Within the planned 72-hour training programme, the following topics will be discussed:

- Understanding what is PSTE, the theory behind the method (and the potential benefits of implementing this concept)
- The practical, theoretical and reflecting teaching of craft and land-based activities that can be developed in each place (according to social, geographical and cultural attributes of each location), also described as: The *Spirit of Place* (*Genius Loci*).
- In-depth discussion of the characteristics of the end-users (trying to understand their context)

• Economic viability and implementation strategies (for the development of new initiatives)
• Individual reflections and presentations of the work developed during the course (looking at ways to design fresh initiatives)

What is the 'Spirit of Place'?

Before implementing a project, first we need to understand the 'Spirit of Place' of the specific chosen location. Without this, serious obstacles may emerge at any point that will compromise its execution.
The 'Spirit of Place' implies a rigorous multi-step research process that involves gaining accurate information of the location, summarised in 4 points:
1. Finding the mineral and geological conditions of the place, going back, as far as possible, to its most natural state.
2. The presence of plants, in a historical perspective that may have been significant or helped shaping the characteristics of the landscape.
3. The presence of animals, as described in point 2.
4. The human or sociological transformations that dictated the evolution and present condition of the location.
Once this information is gathered and consolidated through a 'collaborative action-research', we can start forming an accurate picture of that specific location to obtain its real essence. Only then, through a full appreciation and understanding of its deep qualities, we should be able to engage and transform the 'Spirit of Place' in order to start implementing the project's concepts.

PRACTICE WITHIN THE TRAINING

The training will consist of key modules that are dedicated to handicraft and land-based activities such as willowing and compost preparation for small scale vegetable production; and will include special social farm activities such as catering. Craft and land-based activities will be taught by specialists. The specialists will also weave the practical side of teaching the craft whilst simultaneously encouraging a reflective practice on the challenges of learning that particular craft. These occupations will be carefully selected to represent particular crafts and activities that are historically well known in specific areas of Hungary. This happens with the aim

of revitalising old knowledge once practiced in certain rural communities, reinstating this way vital historical roots between the individuals and the practical crafts. Ultimately, we also expect that this can stimulate interest with the end-users to learn particular crafts and land-based activities and potentially explore these in a professional way, opening new doors for employment and strengthening local economy.
Accordingly, we propose to teach small scale organic compost preparation for vegetable production to ensure the basis for growing, consuming and selling top quality food, full of vitality and nutrients. This highlights the importance of composting as the precondition for soil fertility and preservation, and an essential part of the environmental protection and waste management. Although the practise of composting is more and more popular, still there is a strong need (even in the countryside) to learn the techniques in order to produce good quality and weed-free compost. Focusing on the natural potential of any specific farm, we aim to enhance agricultural practices that can bring fruitful results. This will happen by always dedicating particular attention to the history and geography of a particular region. This way, local communities can experience a connection between their present needs and their historical roots.

During the training, we will also work with handicraft activities and teach these to any of the target groups. This is based on two very important principles:

- Handicraft activities give people the opportunity to engage their mind and body in meaningful, practical activities. This helps developing physical and mental cognition, such as stimulating balance, coordination and dealing with depression.
- Hand-based activities promote creativity and inspire people to learn a craft which can be developed and this way find professional gratification when looking for new jobs.

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EXPECTED RESULTS AND THE DIRECT BENEFICIARIES

Training courses (organised in different time scales and areas of Hungary) will be designed to equip future trainers and other professionals from relevant areas. These courses will have a practical approach with embedded theory on PSTE to help gaining full understanding of the practice and theory of the program. This will mean a practical training, based on learning specific handicrafts and land-based activities, but always reflecting on the theories behind these practical activities in order to have a deep understanding of their benefits, which are mostly educational and therapeutic. The participants of these training courses will learn all this in an individual way, so they can teach it to the clients (or end-users) they work directly with. We propose the training for those professionals.

Simultaneously, we will use in this project an *Open Education Resources* interface, where all training courses' content will be uploaded and available online, as well as strategies, explanations and practical material, such as videos and exercises. This will be available to anyone interested in learning about the PSTE method, the activities (handicraft and land-based, as well) or the principles of economic sustainability. This online resource also forms a part of what we call the *mentor-network* supporting structure. We strive to create an active supporting network, formed by relevant professionals of the field such as: social workers, NGO leaders, psychologists, municipality mayors etc. to assist the participants that undertake our training. This professionals' network is an already existing solid structure of contacts we have been developing over the years through different projects. Our main concern is to ensure that those who receive our training can always feel supported, during and after the training program. This way, we believe we can ensure that the challenging task of working with different target groups has a better chance to be successful.

The participants of this training can be any staff from any organisation that wishes to gain this unique knowledge. These are usually linked to a type of social service: farms that work with underprivileged people or are interested in developing craft activities for instance but not exclusively. We also expect to attract any other institution, company or local authority, intending to learn about our innovative method - even if they have not been previously involved with social activities - but can this way find new strategies to expand their range of services and answer to the needs of their clients. We will welcome all professionals from interested organisations, from managers to social workers, particularly those who deal directly with underprivileged people (the end-users of the project) and provide them with a fascinating training program, based on organic farming and PSTE.

More important to us is that this represents a dynamic approach that deals with crucial social issues of our time, finding a deeply constructed way of promoting solutions that care for the land, people and their communities.

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Project website: http://www.revitalist.eu/

STATUS AND TRENDS OF GRASSLAND HABITATS IN HUNGARY

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ABSTRACT

Grasslands are important habitat types that besides hosting diverse fauna and flora provide valuable socio-economic services. Their economic importance however, decreased through the centuries mostly due to the introduction of intensive husbandry and subsequently less need for pastures and hay making meadows. Loss of grassland habitats can be observed across Europe and it reached a critical level threatening the survival of plant and animal species connected to that habitat type. Hungary is especially affected by that process via its once extensive large grasslands. The problem is worsened by the fact that the country hosts the largest westernmost part of steppe habitats, thus conservation of the unique species of steppes within the European Union depends mostly on Hungary. The level of decrease of grassland habitats was assessed by using data provided by the Hungarian Central Statistical Office and the European Commission. Data shows that grassland habitats decreased by more than 70% in the last one and a half century. The loss had a significant negative effect on the flora and fauna related to those habitats. In order to ensure the long-term survival of steppe species and habitats therefore, Hungary applied for the European Union's LIFE Integrated Project in 2018. The central aim of the project is to create a long-term strategy for conserving various grassland habitats via the conservation of flagship species. In addition, the proposal includes active conservation interventions and communication.

keywords: grassland, habitat loss, Hungary, LIFE Integrated Project

INTRODUCTION

In April 2018, Herman Ottó Institute Nonprofit Ltd. submitted a LIFE Integrated Project proposal "*Long term conservation of Pannonian grasslands and related habitats through the implementation of PAF strategic measures*" (GRASSLAND-HU) proposing a range of activities to improve the conservation status of grassland habitats and species in Hungary. While the evaluation process is still in progress, it is important to know the characteristics of grassland habitats and species, to understand their significance and to recognize their conservation status and trends.

Grasslands are the most important habitats as for conservation and socio-economic aspects. They provide valuable ecosystem services, but they are the most vulnerable habitats at the same time. Europe holds a range of grassland habitats from dry grasslands through alkaline steppes to mountain and marsh meadows. One of their shared features is that almost all of them have been formed and maintained by human activities, thus they are qualified as 'semi-natural' habitats, even though the plant associations themselves are natural. Grazing and hay making are the most common management types that maintain them. Recent occurrence of natural grasslands in Europe that do not require human intervention is limited and their presence is determined by environmental factors such as climate, topography and soil type.

Grasslands provide ecosystem services highly important from a socio-economic point of view. Pastures provide food for domesticated large herbivores (e.g. cattle, horse, sheep) that give several goods for human populations (food, milk, wool, leather, etc.). Biodiversity of grasslands does not only manifest in the large number of species important from a conservation point of view, but also in the variety of grass species that were the ancestors of our grain crops – the main food source of human populations. In addition, those wild species are still contributing to the creation of new breeds better fitting extreme conditions and resistant to pests and diseases.

Grasslands play an important role also in carbon sequestration. According to World Resources Institute, in the continental ecosystems, grasslands store 34% of captured carbon. Further 39% is stored in forests, while agricultural lands store 17% (Chang et al. 2017; White et al. 2000). Grasslands contribute also to fighting erosion and desertification and play a role in recreational activities.

Despite their importance, the area of grasslands has been long decreasing. The extensive loss of grassland habitats affects not only Hungary, but all of Europe – and can be observed also globally – and it is a very worrisome phenomenon.

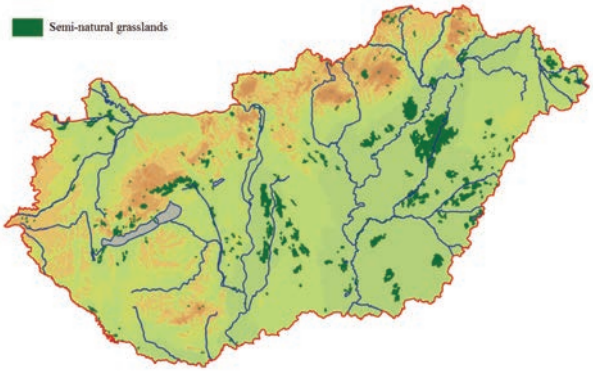

Figure 1: Grassland areas in Hungary (Source: CORINE Landcover 2012)

Grasslands play a special role in Hungary both in terms of husbandry and nature conservation. Various grassland habitats can be found across the country including lowlands and mountainous areas (Fig. 1).

The term 'grassland' refers to habitats dominated by grass species. Grasslands have the highest level of biodiversity among habitats in Europe. Grasslands formed on limestone are the most species-rich plant associations with sometimes more than 80 plant species occurring per square metre. High level of plant diversity supports diverse and partly specialized animal communities including a wide range of species from worms and insects to birds and mammals (Silva et al. 2008).

Habitats Directive implanted into the Hungarian legislation by the 275/2004 Governmental Decree classifies grasslands into the following five categories:

- *Natural grasslands* – include nine grassland habitats that thrive without direct human intervention and are limited by specific ecological, soil and climatic conditions, e.g. Alpine grasslands.
- *Semi-natural dry grasslands and scrubland facies* – include 12 grassland habitats that are to some extent managed, ranging from Mediterranean grasslands to Pannonic steppe and Fennoscandinavian grasslands.
- *Sclerophillous grazed forests* (dehesas) – include only one grassland habitat known in Portugal as montado and in Spain as dehesas – semi-natural savannalike open woodlands with scattered oak trees and extensive grazed grasslands.
- *Semi-natural tall-herb humid meadows* – include six grassland habitats that have some soil water presence.
- *Mesophyll grasslands* – include three grassland habitats comprising all meadows.

Source: LIFE and Europe's grasslands

Grasslands form two large groups considering their formation and survival. As described above, some grasslands survive without any human intervention due to the limiting environment they live in. Thus, they form climax vegetation in the given area. Arboreal vegetation cannot survive in those areas; thus, forests cannot be formed. Such grasslands are alpine grasslands, Eurasian open steppes, Pannonic salt (alkaline) steppes or fens that cannot host forest because of high water table.

Semi-natural grasslands form the other group. Those grasslands can be found in areas, where forest is the climax vegetation originally, however due to some factors, arboreal vegetation withdrew. Those factors can be natural – e.g. forest fire, storm, landslide, volcano eruption, etc. – or human induced changes. Mountain hay-making meadows – also to be found in Hungary – are good examples for the latter. They were formed via deforestation and maintained by hay-making through centuries. Abandoned meadows may turn to forest in a period of few years to a century or more depending on the factors affecting the given site. At the same time, appropriately implemented mowing or grazing can sustain grassland habitats for an indefinite time.

In prehistoric times, grasslands were formed and maintained entirely by natural (non-human) processes such as forest fires, climate change, grazing by herbivores, etc. Grasslands formed on the place of climax forests were maintained by large herbivores for some time, until the arboreal plant species – not grazed by herbivores – took over the grassland again and a new forest was formed. After the appearance of humans, domesticated large herbivores took the role of wild species and continued the 'maintenance' of grasslands.

Natural dynamics of habitat transitions in the temperate climate can be still observed in Asia and North America. Appropriate size of non-regulated ecosystems is needed however, to allow the functioning of those mechanisms – which cannot be found in Europe anymore. In Europe, natural or semi-natural habitats designated for nature conservation are small, forced between physical and political boundaries and they are very fragmented. Consequently, there is simply not enough room for the natural processes – leading straight to the conservation dilemma, whether to protect the habitat and species of a given state or rather the natural processes. Conserving an alpine species – that can even be common in the high mountains – in a semi-natural hay-making meadow at lower altitude, preventing natural afforestation is a good example for the former – and the most common – approach. Conserving natural processes in that case however, would result in a climax forest habitat and the disappearance of alpine species that are rare in the area. The dilemma would dissolve, if we consider a larger scale that provides appropriate space for the natural processes and subsequently for the co-occurrence of all habitat types and species.

MATERIAL AND METHODS

Data sets from the Hungarian Central Statistical Office (HCSO) were used to analyse trends for various habitat types. Data were available and used between 1863 and 2016. HCSO's data are based on official land use categories stated on ownership as registered at local governments on title deeds. Those do not include the sub-categories of grasslands and sometimes do not show up to date the actual land use form. However, they reflect the magnitude of various land use forms and are appropriate to establish trends. Methodology slightly changed in 2010 resulting in a jump in numbers; however that does not affect trends. In addition, publications and project reports of related Hungarian LIFE Nature projects were revised and referred in this paper. The latter provided information about the changes of certain species related to grassland habitats, as well as indicated the threats on them and on grassland habitats. Relevant publications and official reports were also reviewed.

RESULTS AND DISCUSSION

Data showed significant decrease in the area of grasslands in Hungary due to various causes. In addition, several threats were identified in the study and some of them are interrelated.

Decrease of grassland areas - The area of grasslands has been decreasing continuously in the last 150-200 years. In the beginning, the main reason for that was the transformation of grasslands into arable land to provide food for the increasing human population. Later, as industrialization proceeded, infrastructural development and urbanization required ever increasing areas that could not be fulfilled on the expense of the more valuable arable land or forests, but on the grasslands considered as less valuable. This process was amplified by the intensive husbandry that decreased the importance – and economic value therefore – of pastures. In addition, linear infrastructures did not only decrease grassland areas, but resulted in significant fragmentation of the remaining habitats.

Based on the data of the Hungarian Central Statistical Office, considering the recent area of Hungary, the extent of grasslands decreased from 2 681 600 ha (1853) to 784 200 ha (2016), which is more than 70% decrease in 163 years. In the same period, the area of uncultivated (mostly built-in areas) land increased from 1 476 700 ha to 1 890 300 ha (+28%), partly due to the methodological changes described above. Forested areas increased from 1 266 000 ha to 1 939 500 ha (+53%) (Fig. 2). The lowest extent of grassland areas (758 900 ha) was in 2011-2012 and a slow increase can be observed since then. In 2016, 784 200 ha were classified as grassland and the increase is probably due to the agri-environmental support schemes. The overall decrease of grassland areas is significant, even if we consider that about 240 000 ha grassland 'disappeared' due to changes in calculation methods – actively not managed (not grazed or mowed) areas previously classified as 'grassland' were re-classified into 'unmanaged land' category. In addition, the extent of grasslands continued to decrease after the re-classification affecting all types of grassland. For example, according to data of the Hungarian Ministry of Agriculture, 21 000 ha of grassland disappeared from the region between the Danube and the Tisza rivers, of which 60% was fen, 25% pannonic salt (alkaline) grassland, 8% sand grassland, 1% loess steppe and 5% marsh meadow.

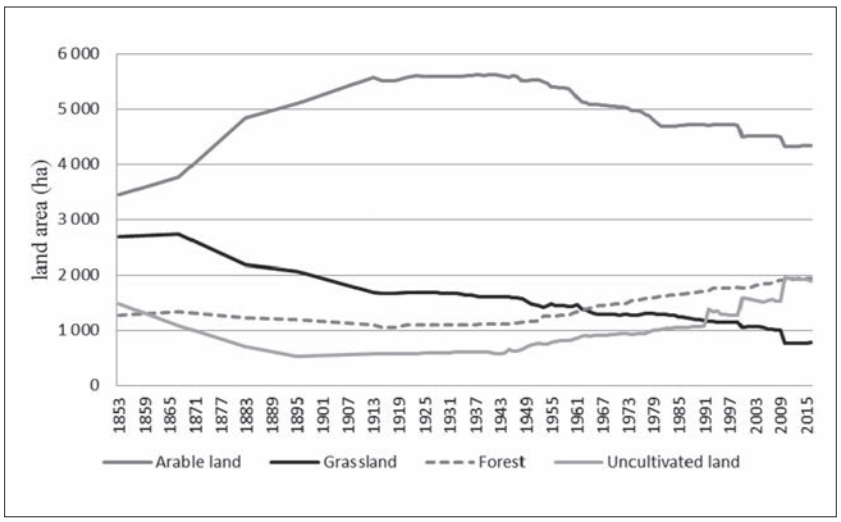

Figure 2: Land use changes in the period between 1853 and 2016 (Data source: Hungarian Central Statistical Office)

Those changes observed in Hungary are not unique in the continent, but they are in line with the European trend. For example, in the European Union in 1999, 60% of new forestations occurred on grassland areas and only 40% of them were planted on former arable land or other cultivated land (Silva et al. 2008). Both international and national trends clearly indicate that decision-makers consider grasslands less valuable than other areas providing more profit. Apart from area loss and fragmentation, other factors also negatively affect the grassland habitats.

Uses of chemicals - In the 2nd half of the 20th century, chemicalising agriculture (pesticides and fertilizers) had significant negative impact on the conservation status of grassland habitats and species (Dicks et al. 2018; Kirkham et al. 2008; Mountford et al. 1996). In some areas, ferti-

lizers were used for higher yield and additionally, chemicals used on arable land affected also the species of the neighbouring grasslands. In addition to direct chemicalising, nitrate sedimentation from the atmosphere – resulted from emission from a range of sources – have fertilized the grassland areas indirectly, thus launching changes in plant associations as some species manage nitrate-rich soil better than others.

Shrub encroachment and afforestation - Regime changes in Central and Eastern Europe in the end of the 20th century resulted in the abandonment of agricultural practices used at that time, which affected grasslands negatively. In many regions, non-intensive husbandry and thus grazing and hay-making ceased resulting in shrub encroachment and afforestation (Fig. 3). Disappearance of grassland habitats was accompanied with the disappearance of related species. Habitat transformation was especially well-visible in foothill areas in northeast Hungary, where abandonment of grazing was followed by shrub encroachment and subsequently made the European Ground Squirrel (*Spermophilus citellus*) – a species dependent on short-grass habitats – and one of its main predator, the Saker Falcon (*Falco cherrug*) disappear. Unfavourable management of grasslands does not necessarily result in the disappearance of the habitat itself, but it can change the composition of plant and animal communities significantly. Most commonly, the number of species, subsequently the biodiversity decreases, and the conservation status becomes unfavourable as a result. In addition, vegetation structure also changes that has an impact on microclimate and soil parameters that initiate further changes.

Spread of invasive species - It was also in the end of the 20th century, when colonization of grasslands by invasive alien species, like *Solidago canadensis* or *Asclepias syriaca* became widespread and clearly visible. Their spread is clearly related to the 'non-management' of grasslands: the abandonment of grazing or hay-making. Invasive alien species, once occurring in mass, significantly change native plant associations, vegetation structure, consequently the habitat of related animal species and even environmental factors closely linked to vegetation, such as microclimate and soil conditions.

Impacts of climate change - Global climate change has an impact also on grasslands. Increasing mean temperature, changes in temporal and spatial patterns of precipitation may result in more frequent fires, spread of invasive alien species, changes of plant associations and thus vegetation structures answering the challenges of the changing environment. That affects also the survival and the conservation status of individual species. Population changes of affected species generate feedback on the habitat and other species inducing further changes. In Central Europe, for example, growing and breeding season is getting longer due to ever milder winters and herbivores can feed on fresh vegetation for a longer period. At the same time, also due to mild winters, dormant species – like marmots and ground squirrels – use their winter fat at a faster rate. As a result, individuals of these species may wake up in spring earlier than they supposed to, when there is not enough fresh growth yet. Even if they survive, they may be weaker and more exposed to diseases and predators. The situation of the European Ground Squirrel is even more unfavourable in Hungary, as the distribution area of the species overlaps with the most drought affected areas, thus in years of drought it is more difficult to build a fat reserve for the winter. Marmots and ground squirrels dwell in self-built burrows and thus they are considered as ecosystem engineers. Their activity forms the habitat and species composition considerably. Therefore, their disappearance induce further changes.

Figure 3: Remains of Eurasian steppes form isolated islands in agricultural areas and are threatened by shrub encroachment mostly due to abandonment of grazing (*Photo:* Mátyás Prommer)

Changing water regime - Change of water regime is partly linked to global climate change. It manifests in changing water storage capacity of soil and lowered water table. Increasing mean temperature, changing precipitation patterns, as well as extreme weather phenomena contribute to those changes. Direct human intervention, like earlier and recent regulation of small water bodies also fuelled those processes. Lowered water table affects vegetation through availability of water and favouring species more tolerant to dryer habitats. Shifting plant species composition will change also vegetation structure and fauna.

Direct impacts of human activities - Some technical sports – if carried out inappropriately or illegally – may affect grassland habitats negatively and should be considered as threat, such as motocross, mountain biking, quad and off-road driving, use of snow cannons, etc. Those activities may open way to invasive species by causing mechanical damages in the vegetation structure or may lead to the disappearance of sensitive species.

CONCLUSIONS

Loss of grassland habitats directly results in loss of related plant and animal species subsequently worsening their conservation status. It is typical that 235 animal species out of the more than one thousand plant and animal species listed in the Habitats Directive of the European Union are linked to grasslands. Out of those, 28% of the amphibians, 12% of the reptiles and 16% of the mammals are threatened by extinction in the European Union. As for invertebrates, populations of grassland butterflies have decreased by 50% since 1990 (Silva et al. 2008). In Hungary, 27% of SPAs and 33% SCIs are grasslands. In addition, in Hungary 30% of species of Community interest is related to grassland habitats. According to the 2013 country report based on Article 17 of Habitats Directive and evaluating the period 2007-2012, the conservation status of one-third of grasslands is 'unfavourable-declining' and 'unfavourable-stable' in case of the remaining two-third. The evaluation shows that there is a lot to do for the conservation of grassland habitats and species in Hungary.

The European Union – and Hungary within – fights against the negative trends in multiple ways. The most valuable grassland areas in Hungary are owned by the State and managed by national park directorates. It is the purpose of the Hungarian government that the most important areas in term of nature conservation must be owned by the State thus ensuring their appropriate long term conservation management.

The European Union supports the implementation of conservation projects through the LIFE programme. The programme supports the conservation of the threatened habitats and species including various targeted or more general conservation actions, dialogue with stakeholders and raising public awareness. Further tool for grassland conservation are the various support mechanisms in the frame of the Common Agricultural Policy. The Hungarian state and civil organisations have been using those and other tools to improve conservation status of grasslands, however there is still a lot to do in that field.

Hungarian conservation organisations took part in such projects and recently Herman Ottó Institute Nonprofit Ltd. submitted a LIFE Integrated Project aiming to ensure the long-term conservation of grassland habitats in Hungary. The project's central aim is to create a long-term strategy for conserving various grassland habitats via conservation of flagship species. In addition, the proposal includes active conservation interventions and communication. Once it is awarded, the work will start involving more than a dozen of project partners representing key stakeholders like farmers, governmental and civil conservation organisations and science.

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