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ENVIRONMENTAL CONSEQUENCES OF THE RURAL ABANDONMENT – A PILOT SURVEY OF GARDENS IN A HUNGARIAN GHOST VILLAGE

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Abstract: This study aims to detect the environmental changes subsequent to village abandonment in a hilly region with the investigation of vegetation. The examined village has been deserted over a 40-year period; so it is observable how the vegetation, mainly trees and shrubs reclaim the former human-used sites. The impacts of the rural abandonment on the environment are discussed, there are scenarios which emphasize the negative effects of these processes e.g. the homogenization of traditionally diversified landscapes, whilst others characterize it as a possibility to restore the natural conditions of a given area. In our study 14 sites (ruined buildings with their surrounding gardens) were subjected to detailed botanical survey in May 2018. In each site, woody vegetation was recorded in three categories: a) cultivated fruit, b) ornamental and c) wild-growing trees and shrubs. Spontaneous reforestation did not happen following abandonment, but a long term survival of certain cultivated fruit trees were striking, and the immigration of wild-growing berry shrub species was also remarkable.

Introduction

Rural abandonment has become one of the most important trends in land use and land cover change in most industrialized societies (Lambin et al. 2001). This phenomenon embraces the termination of the use of farmlands, rural houses, the abandonment of former cultivated agricultural land (Nelson 1990; Poyatos et al. 2003), the abandonment of villages (Filipe and Mascarenhas 2011), gardens etc. The structural changes of the agricultural production and the depopulation of rural areas can be found in the background of these processes.

Over the past five to six decades depopulation has appeared as an uninterrupted process in the rural areas around Europe. This problem is very complex and occurs in regions where current land use is not economically viable anymore. It sinks its roots in the development policies, industrialization, urbanization and the agricultural changes of the last century. In general geographical marginality causes low income, poor housing, unemployment and inequality of access to services. Mediterranean areas encounter the most serious losses; these areas contain some of the most depopulated areas in Europe – it is well known from the literature. Similar processes have occurred in Central and East European countries (Müller and Munroe 2008; Mladenov and Ilieva 2012; Moldovan et al. 2016).

In the former socialist countries rural exodus began in the mid-twentieth century, driven by rapid industrialization, but it accelerated after the political transitions mainly during the first decade of the 21th century. Domestic and international emigration of rural inhabitants has been intensifying since the beginning of this century, and the demographic structure of the resident population is aging fast. These processes have resulted in a growing rural abandonment, one of the most important spatial problems of these states. 198 depopulated settlements can be found in Bulgaria in 2018. In Hungary there are no officially empty settlements but the number of the settlements which have less than 50 inhabitants was 16 in 1991 and 38 in 2016. However, there are settlement parts (mainly residential areas away from the centres of the villages) and group of farmsteads which have already lost their total population (Pándi 2017a). Dozens of villages are now threatened with serious decrease in number of inhabitants and are at the margin of abandonment.

The environmental effects of the rural depopulation and abandonment are one of the most widely discussed topics in recent decades. Abandonment is defined as a total termination of the use and management of soil including a change towards a less intensive pattern in land use: i.e. agricultural fields are left to their own spontaneous dynamics (Baudry 1991; Weissteiner et al. 2011). Two main directions can be characterized concerning the effects on the environment, landscape and biodiversity (Otero et al. 2015).

A large number of papers dealing with the abandonment (mainly European examples) emphasize the negative effects of these processes. Landscape ecologists declare that the traditional agricultural landscape has always been extremely rich in diversity, and this is a quality which still persists despite obvious moves towards a more homogenous landscape (Nelson 1990). The reduction in land-use intensity, including land abandonment of agricultural practices at the extreme is defined as an environmental degradation (Navarro and Pereira 2012).

On the other hand, several scholars focus on the opportunities arising from termination of human use and agricultural disturbance of the natural ecosystems. Navarro and Pereira (2012) argue that, contrary to common perception, traditional agriculture practices were not environmentally friendly (most deforestation in Europe occurred before the industrial revolution) and that the standards of living of rural populations were low. Consequently, these changes are necessary and give possibility to a "rewilding" of European landscapes. Examples of rewilding also mentioned from Hungary (Szilassi 2017; Stefán 2018). Forest transition theory describes a reversal in land-use trends for a given area, from a period of net forest area loss (due to the expansion of agricultural lands, or the increasing level of underground mining, especially that of coal mining in the last century), to a period of net forest area gain (shrinking of agricultural use, or closure of mines) (Robson and Berkes 2011; Otero et al. 2015; Sütő et al. 2017). In the East Borsod Coal Basin the extension of forest has spontaneously increased after the closure of coal mines

No consensus can be detected on the environmental impacts of the abandonment. The ecological, environmental results of these processes depend on the geographical, social, economic conditions of the examined area. However, according to Robson and Berkes the relationship between population and the environment is neither linear nor deterministic. It is a myth that depopulation necessarily results a provision of the conservation of biodiversity (Robson and Berkes 2011).

Our aim in this pilot study was to investigate the effects of abandonment on the woody vegetation of a ghost village focusing on both the surviving cultivated species and the spontaneously establishing species.

Materials and methods

The investigation was conducted in an abandoned village, called Zsörk, situated in the north-west part of Hungary, approximately 140 km from Budapest (Figure 1). Zsörk belongs to the municipality of Pápateszér but it is located at a distance of 3 km from the central settlement. Its geographical environment can be characterized by a foothill region of the Bakony Mountains, which hardly exceed the 700 m above mean sea level, and it consists mainly of Triassic and Jurassic limestone. The foothill is shaped by numerous streams coming from the mountains, and it is built up from Eocene limestone and marl, whilst the streams have built alluvial fans. In the proximity of Zsörk sandy soils (originating from the last glacial period) can be found as well. This region is relatively rich in forest, oaks (*Quercus robur*, *Q. petraea*, *Q. cerris*) and hornbeam (*Carpinus betulus*) being the dominant tree species. The sandy area is covered by a postglacial relict association with Scots pine (*Pinus sylvestris*) forests.

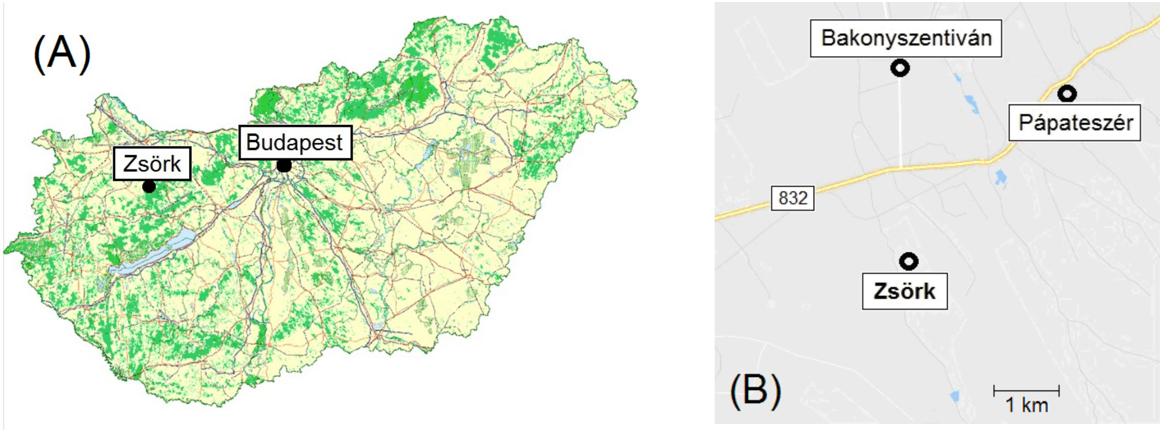

Figure 1. Geographical location of Zsörk in Hungary (A), and its position to the neighbouring villages (B)
1. ábra Zsörk elhelyezkedése Magyarország térképén (A), és a szomszédos falvakhoz viszonyított helyzete (B)

The foothill region has a dense settlement network originating from the Mediaeval ages. The landscape has been formed by agricultural production, but the share of forest remained high in land use, and a large number of mills utilized the energy of water streams to process the grain production of the nearby lowland. Recently the whole micro-region has been suffering from depopulation and the peripheral geographical situation.

Zsörk was first mentioned in 1249. It was depopulated in the 16th century due to the Ottoman rule. In the 18th century the inhabitants of neighbouring villages cultivated its lands. In the first half of the 19th century it was resettled. The small church was built at that time, but the total number of the population could not have been more than 100 persons. Since the Great War the number of inhabitants has decreased permanently due to migration and ageing processes. Some lands and vineyards were and still are cultivated by proprietors living in the nearby villages. Even in the 1980s there were few residents here, but since the beginning of 1990s all houses are empty. The owners of the most sites are known, but their heirs live far away. Even if owners live in the proximity they do not cultivate the property because of their age or for economic reasons. It is shown in the historical maps and aerial photos that the shape and the structure of the village has not changed in the last 150 years, but the number of houses has decreased (Figure 2 and 3).

Figure 2. Geographic maps of Zsörk and its surroundings according to the 3rd Military Survey (1869-1887; left) and the Military Survey in 1941 (right)
2. ábra Zsörk és környékének térképe a 3. Katonai Felmérés (1869-1887; balra), valamint az 1941-es Katonai Felmérés (jobbra) szerint
(Source/Forrás: http://mapire.eu/hu/)

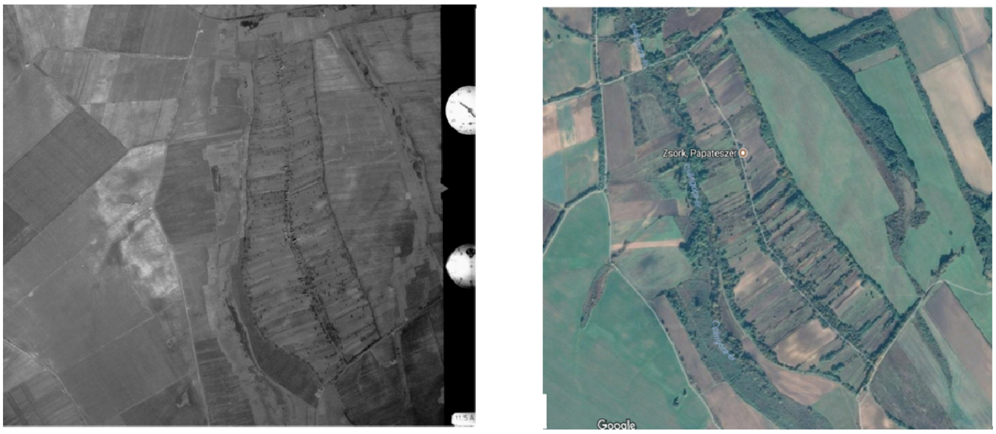

Figure 3. Aerial photographs of Zsörk in 1961 (left) and 2017 (right)
3. ábra Zsörk képe légifelvételen 1961-ből (balra) és 2017-ben (jobbra)
(Source/Forrás: http://www.fentrol.hu; https://www.google.hu/maps)

In the abandoned village 14 sites (ruined buildings with their surrounding gardens) were selected where detailed botanical survey was carried out in May, 2018. In each site woody vegetation was recorded in three categories: cultivated fruit trees and shrubs, ornamental trees and shrubs and wild-growing trees and shrubs. (Shrubs also included lianas.) Number of individuals were also recorded for cultivated fruit trees, and for this group of species old and young specimens were distinguished, too. Category of young specimens reflects spontaneous self propagation after abandonment of the site. Each fruit tree with diameter less than 5 cm were considered 'young'. Regardless of their size, those fruit trees were also considered young which grew unsuitable positions (e.g. within the walls of a roofless house). Species nomenclature follows Horváth et al. (1995).

Results

Altogether 33 woody species (trees or shrubs) were recorded: 14 wild-growing natural species, 13 formerly cultivated fruit-trees and -shrubs, and 6 ornamental woody species. Berry shrubs dominated the group of colonizing wild-growing woody species followed by wind dispersed shrubs and wind dispersed trees (Fig. 4).

Among the cultivated fruit trees common walnut (*Juglans regia*), plum (*Prunus domestica*), sweet cherry (*Cerasus avium*) and European pear (*Pyrus communis*) were the most frequently found surviving remnants in the abandoned gardens (Figure 5). Considering the ratio of old and young specimens, markedly different behaviour types were found among fruit tree species. Walnut, plum and sweet cherry had several offspring in several sites, thus indicating a self sustainable population in the long run, whereas pear was represented only large, very old trees that can perfectly compete with the colonizing native species, but spontaneously did not reproduce. Regarding total number of young specimens observed in all censused sites common walnut and plum were on the top of the list with 27 and 15 offspring, respectively.

Surviving ornamental woody species (mostly shrubs) were found at three sites only, of which one was the abandoned church yard (Figure 5). Spontaneous reproduction of these species did not occur.

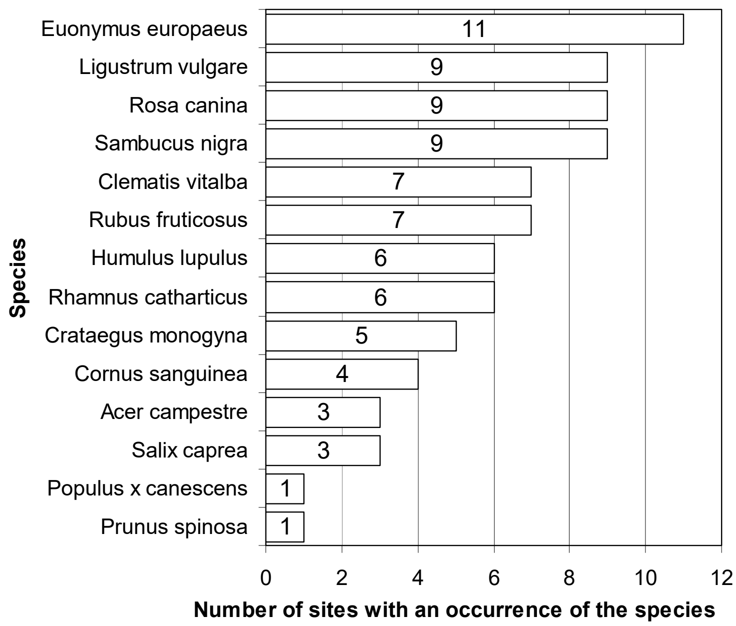

Figure 4. Natural wild-growing tree and shrub species found in the sites of Zsörk, an abandoned village of Hungary.
4. ábra A természetes módon betelepült fa- és cserjefajok előfordulási száma a megvizsgált házhelyeken, a lakosságát elvesztett Zsörkön

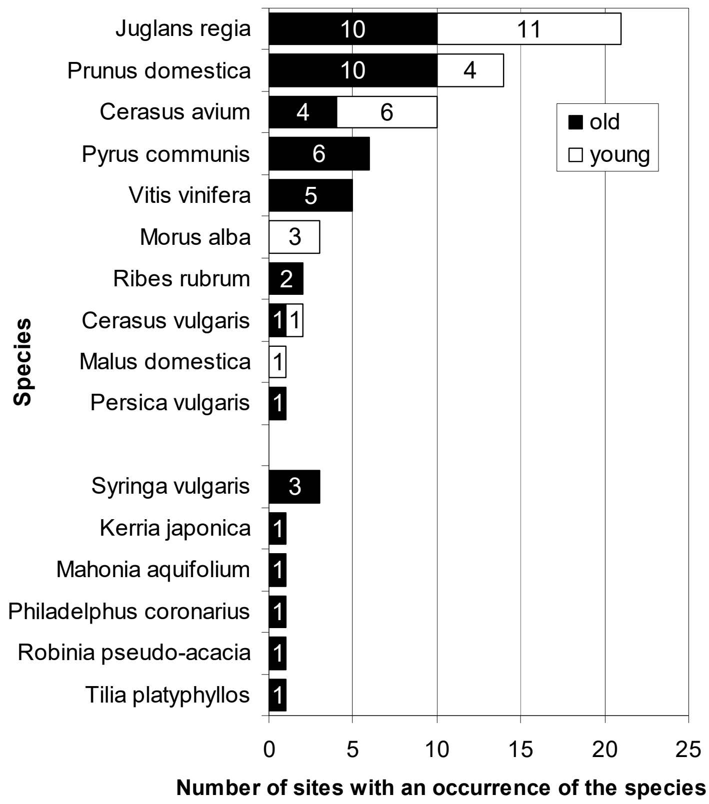

Figure 5. Cultivated fruit trees and shrubs (upper section of the diagram) and ornamental woody species (lower section of the diagram) found in the studied sites of Zsörk, an abandoned village of Hungary; presence of old and young individuals were distinguished
5. ábra A termesztett fa- és cserjefajok (a diagram felső részében), valamint a fásszárú dísznövények (a diagram alsó részében) jelenlétével jellemezhető házhelyek száma, a lakosságát vesztett Zsörkön; az egyes házhelyeket az idős és a fiatal példányok megléte szerint is feltüntettük

Discussion

The high ratio of berry shrubs among the colonizing native woody species indicates the dominance of avian introduction over wind supported (anemochorous) establishment of species (Howe and Smallwood 1982). In this respect, the vegetation succession at Zsörk differs remarkably from the general pathways of secondary succession observed in abandoned agricultural fields or other disturbed areas, since in the latter cases wind dispersed species dominate in the first period following the abandonment then zoochorous species advance in the later stages (Chang et al. 2014, Knapp et al. 2016).

The driving force behind the berry shrubs advancement is obviously the high density of frugivorous birds that visit the abandoned sites of Zsörk to feed on the remaining fruit trees, and it corresponds the facilitation model of succession (Connell and Slatyer 1977, Debussche et al. 1982). Since seeds of wild-growing berry shrubs generally survive passage in digestive system of birds the seeds ingested in the surrounding forested areas can easily be transported to Zsörk by birds (Levey et al. 2001).

Surprisingly, invasive alien tree and shrub species did not occur at the studied sites. This observation contradicts the results of previous studies of abandoned fields and farmsteads (Csontos and Tamás 2005, Pándi et al. 2014, Ivajnšič et al. 2012, Pándi 2017b), therefore, the underlying causes of the phenomenon should be further explored. It is also notable that forest forming trees which characterize the surrounding woodlands (mainly oaks and hornbeam) played rather limited role in the post abandonment succession of the vegetation at Zsörk. Consequently, the abandoned villages of the region cannot be considered as places where spontaneous reforestation takes place quickly.

Common walnut, sweet cherry and pear were the most successful survivors among fruit trees in the abandoned sites. Their large sizes enabled them to cope with the invasion of wild-growing shrubs and suppress them by shading. Although, they are shorter in size, plum trees survived in many sites, too. Survival of plum trees was also reported by Pándi (2017a) from abandoned farmsteads, and we suppose that plum's success is partly due to its perfect fit to the region's climatic conditions. It is also indicated by the self propagation rate of plum that enables it to survive for long time in spite of abandonment. Occurrences of young specimens reflects ability of spontaneous establishment of the given species following abandonment. Common walnut and sweet cherry also expressed high rate of spontaneous self reproduction, whereas pear, common grape vine and peach did not produce any offspring, so thus the extinction of the latter group can be guaranteed in the long term. Step by step changes of the fruit tree species' composition in the sites of Zsörk could be successfully predicted by modelling tools, e.g. Markov-chain modelling.

We found rather few ornamental woody species in this survey. Most of them were shrubs and the two trees from this group (*Robinia pseudoacacia* and *Tilia platyphyllos*) were found in the church yard. On the one hand, their lack can be explained if we suppose that former inhabitants of the settlement did not really prefer planting ornamental shrubs. On the other hand it is also possible that the ornamental shrubs were suppressed by the large number of immigrating native shrubs. Worth for mentioning that Pándi (2017b) found long survival of some ornamental shrubs in abandoned farmsteads in the Hungarian Great Plain. It underlines the need for further comparative studies of survival of ornamental species with special attention to their plant strategy types as well as experimental studies of interactions between native and ornamental woody species in order to more fully understand the mechanisms of competition between these groups.

Conclusions

In case of Zsörk, considerable spontaneous reforestation did not happen during the 30-40 years following abandonment, therefore the settlement can only partly be considered as a re-wildening area. In contrary, in spite of abandonment the long term survival of certain cultivated fruit trees were striking. This raises the possibility of extensive orchard cultivation in Zsörk by the inhabitants of the surrounding villages. Low-maintenance fruit tree species such as walnut, sweet cherry and plum should receive special attention and their ratio could be further increased by both direct planting and self reproduction. Thus, by minimizing care work, it become possible that the declining population of the region can still carry out the necessary work. The delivery of harvested crops at today's motorization level seems to be an easy task. Of course, the preferred fruit tree species vary among geographic and climatic regions, therefore in the next few years a research programme should be launched to find locally appropriate species in wider geographic scale.

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A VIDÉK ELNÉPTELENEDÉSÉNEK KÖRNYEZETI KÖVETKEZMÉNYEI – ESETTANULMÁNY EGY MAGYARORSZÁGI „SZELLEMFALU" FELHAGYOTT TELKEIN

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Kulcsszavak: botanikai felmérés, elnéptelenedés, felhagyott gyümölcsös**,** környezeti hatás, visszavadulás

Jelen tanulmány a vegetáció megváltozásának vizsgálatára fókuszálva elemzi egy dombvidéki régióban a település-felhagyás környezeti hatásait. A nemzetközi irodalomban a települések, illetve vidéki körzetek

elnéptelenedésének a környezetre gyakorolt hatásáról megoszlanak a vélemények. Egyes szerzők szerint ez a hatás eredőjét nézve negatív aminek az a fő oka, hogy a korábban térben és időben is sokféle módon kezelt földterületek, azaz a diverz tájhasználat, a felhagyást követően homogenizálódik; míg más kutatók inkább azt emelik ki, hogy a felhagyott területeken lehetővé válik a természetes élőhelyeknek (és azok sokféleségének) regenerálódása. A kiválasztott falu (Zsörk, Veszprém megye) mintegy 40 éve tekinthető elnéptelenedettnek, így jó lehetőséget nyújt annak megfigyelésére, hogy a természetes növényzet, elsősorban a fák és cserjék milyen módon hódítják meg a korábban lakott ingatlanokat, illetve azok kertjeit. Vizsgálatainkhoz 14 házhelyet jelöltünk ki (ezek 1-1 romos épületből és a körülötte fekvő kertből álltak), és 2018 májusában részletesen felmértük a rajtuk előforduló fásszárú növényzetet. A feljegyzett fajokat három kategóriába csoportosítottuk: a) gyümölcsükért termesztett fajok, b) fásszárú dísznövények és c) vadon élő fák vagy cserjék. A település felhagyását követően jelentős spontán visszaerdősödést nem tapasztaltunk, a környékbeli erdők társulásalkotó fafajai nem, vagy alig fordultak elő. Ugyanakkor feltűnő volt egyes termesztett gyümölcsfa fajok (különösen a dió, a cseresznye és a házi körte példányok) kiváló túlélőképessége a telkeken. A természetes flórából betelepülő fásszárú fajok közül a bogyós termésű cserjék részesedése kimagasló volt, ami a madarak általi terjesztés elsődlegességére utal a széllel terjedő fajokkal szemben. Valószínűleg legalább részben ennek is köszönhető, hogy inváziós fásszárú fajokat gyakorlatilag nem találtunk a felmérés során.