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STRUCTURAL CHANGES OF A PANNONIAN GRASSLAND PLANT COMMUNITY IN RELATION TO THE DECREASE OF WATER AVAILABILITY

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Climate change and other local factors in Central Hungary resulted in a severe water table drawdown during the last few decades. Several studies with different methodical approaches have already been conducted in the region to examine the reaction of the vegetation to the new conditions. In this paper we report the results of a unique, long-term vegetation study of a permanent site, which was also suffering from the loss of its original water supply. The site consisted of a drier section with sandy steppe communities and a wetter one located in an interdune depression. By using diversity measures, relative ecological indicators, flora element classifications, Raunkiaer's life-form categories and Borhidi's social behaviour types we could show that both sections were influenced by the water table drawdown, though most shifts were more prominent in the wet section. According to the results the vegetation of the wet section was in a drying phase, it was getting more thermophilous and its continental character was getting stronger. We found that the vegetation of both sections had undergone a transitional degradation before the study was started and during the study it was in a regeneration phase towards a new natural state. This fortunate process proves that these communities have a potential to adapt to drier conditions, but beside the decrease of the overall habitat diversity we could also detect an obvious negative trend in the productivity, which we consider a severe general trend for the entire region.

Key words: Central Hungary, dry sand vegetation, ecological indicators, water table

INTRODUCTION

Southwestern Europe, including Hungary, is facing a severe climate change according to several studies. In the last 110 years the mean annual temperature of Hungary increased with approximately +1 °C and the mean annual precipitation decreased with 100 mm (Kertész and Mika 1999). Beside these undesired tendencies the frequency and severity of climatic extremes, such as record temperatures, prolonged droughts or unusually intense rainfall events, are also expected to increase (Bartha *et al.* 2008).

One of the most affected areas is Central Hungary, where the processes can be considered as an intensive aridification (Kertész and Mika 1999, Kovács 2004), therefore, the Food and Agriculture Organization of the United Nations classified the region into the semi-desert zone (Kovács 2006).

Climatic changes in Central Hungary, along with several local factors, like the extraction of groundwater for irrigation, the high evapotranspiration rate of hybrid poplar plantations, and the drainage of low-lying wetlands have resulted in a dramatic water table drawdown in the entire region. The first signs of the decreasing groundwater level were observed in the 1970s and 1980s, and by now, the water table has dropped to 2–4 m below the original level (Zsákovics *et al.* 2007).

One of the biggest concerns about any manifestation of climate change is the impact on living organisms (Foody 2008), including the members of natural ecosystems (Hughes 2003), as well as those that are produced for agricultural purposes (Reidsma *et al.* 2010). There is a growing literature on possible species extinctions and biodiversity declines owing to climate change in Europe (e.g. Bakkenes *et al.* 2002). Several studies have been carried out to predict shifts in the distribution areas of certain plant species, such as northerly migrations (Preston *et al.* 2002) or migrations towards higher altitudes in high mountain ranges (Parolo and Rossi 2008). However, even if the climatic shifts are well-described, the structural changes of plant communities are more difficult to forecast (Brooker *et al.* 2007, Chesson 2000). There are at least three different approaches to cope with the problem: simulations, climate manipulation experiments, and long-term observations (Esther *et al.* 2010). The latter includes two types of methods: it is possible to study large areas with remote sensing techniques (e.g. Mucsi 2004), or to make fine-scale vegetation surveys. Vegetation surveys provide the most detailed information about plant communities, however we have to be very cautious, when drawing conclusions or making generalisations because the study areas are small, hence they are subject to local processes without large scale importance. Therefore, the more studies with different approaches are made in a region the better general idea we can develop of the real processes.

The staff of the Ecology Department of the University of Szeged – including the authors of this paper – monitored the vegetation of a permanent transect for various purposes between 1999 and 2009 (e.g. Torma and Körmöczi 2009, Zalatnai 2008). Thus, having a long-term dataset, the opportunity to evaluate the fine-scale effects of water table drawdown on the vegetation of a Central

Hungarian grassland was readily available, and we aimed to find answers for the following questions: (i) What basic structural changes can be detected in the higher plant communities of the study site during the given time period? (ii) To what extent do our results agree with the conclusions of other studies with different or similar approaches, and what common conclusions can be drawn if combining these results?

MATERIALS AND METHODS

Study site

The study site is located on the sandy ridge of the Danube–Tisza Interfluve in Central Hungary (46° 41′ 46–48″ N, 19° 36′ 08–09″ E, 110 m.a.s.l.). The region has a continental climate with some sub-Mediterranean influence and belongs to the forest steppe zone (Borhidi 1993*a*). The mean annual temperature and precipitation values of the region are 10.8 °C and 540 mm, respectively (Iványosi Szabó 1979). We have the temperature (Fig. 1) and precipitation (Fig. 2) data of the study site for years 1989–2009. The mean annual values were 547 mm and 11.3 °C, so they did not differ much from the literature. In spite of the large interannual fluctuations, neither of the two parameters showed any special tendency. It should be noted that the first year of the study (1999) was an extremely wet year.

The soil of the area is sandy with poor water-holding capacity and with low to moderate organic matter content (Körmöczi 1983). The surface of the area can be characterised with sand dunes, and the difference between the highest and lowest points of the study site is 2.8 m.

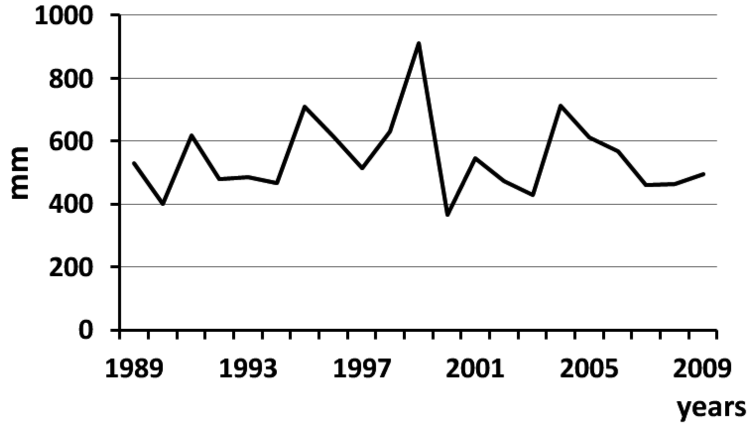

Fig. 1. The annual precipitation amounts of the study area between 1989 and 2009

The study site and the surrounding areas belong to the Kiskunság National Park, and neither artificial fertilisers, nor excess plant nutrients of any kind entered the soil in the last four decades, so the soil nutrient regime has not been altered in a direct artificial way. We are not aware of any recent or past human disturbances in the area apart from the research activities. Natural disturbances, like the grazing of herbivores and the diggings of small mammals, contribute to the dynamics of the area.

Unfortunately accurate water table measurements have not been performed in the area. What we know is that the spring ground water level was only a few centimetres below the surface of the interdune depressions until the early 1980s, but since the late 1990s it has never reached the lowest scale of the groundwater measurer located two meters below the surface of the deepest depression.

The surveys were carried out on a 55 m long and 1 m wide transect, which appropriately represented the plant communities of the area, both in terms of species composition and physiognomy. The surface and therefore the microclimate and the vegetation of the transect were very heterogeneous, therefore we found it more appropriate to divide the transect into smaller, but more homogeneous sections and to evaluate them separately. To determine the borders of each sections, we used the results of the moving split window vegetation border analyses of the transect (Torma and Körmöczi 2009). These analyses revealed two massive and constant borders dividing the transect into three parts. The first, 12.5 m long part is a relatively flat and dry steppe patch. It is followed by a 9 m wide depression covered with a severely desiccated fen, which used to belong to the *Molinio-Salicetum rosmarinifoliae* association. The rest of the transect is a 33.5 m long dry steppe, but compared to the first part, its

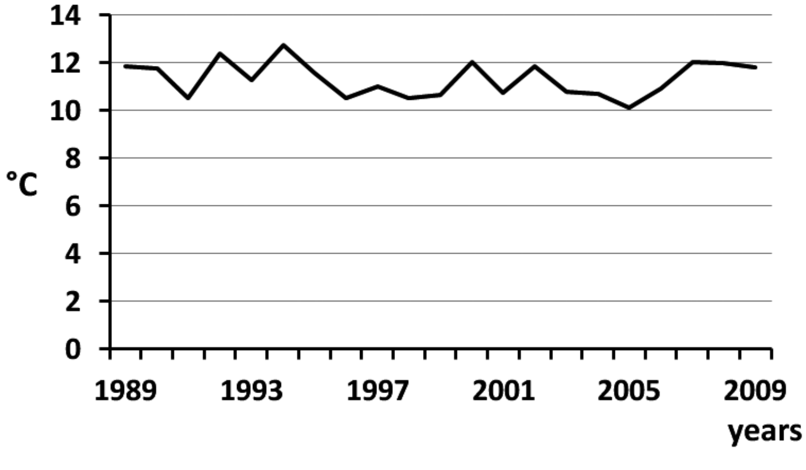

Fig. 2. The mean annual temperature values of the study area between 1989 and 2009

surface is more structured, though lacking any further discrete borders. The plant communities of the two dry parts are a mosaic of *Festucetum vaginatae*, *Secali sylvestris-Brometum tectorum* and *Cynodonti-Festucetum pseudovinae* associations. So there are two types of vegetations, a dry one, which is the combination of parts 1 and 3, and we will refer to it as the "dry section", and a wet section, which equals the second part.

Data collection and data processing

The transect was surveyed in late springs and in early autumns between 1999 and 2009. Unfortunately there were no surveys in the autumns of 2007 and 2008, but the rest of the datasets is complete. Therefore, autumn results are shown only, when spring results are not illustrative owing to interannual fluctuations.

The transect was handled as a grid made up from 880 small quadrates (736 in the dry section and 144 in the wet section) with a size of 25 cm × 25 cm each, and the presence/absence data of species were assigned to them, i.e. the abundance of a species could range from 1 to 880 in the complete transect.

We examined the datasets for compositional changes first, and then we made calculations on the diversity of the vegetation. We used two ways to describe diversity: the species number and the Shannon index. Ecological spectra were drawn from each field datasets by using the Syndata 1.6.1 software (Horváth 2006) regarding the following attributes: Borhidi's relative ecological indicator values for heat supply (TB), soil moisture (WB), nitrogen supply (NB), soil reaction (RB), and the continentality of the climate (KB); Raunkiaer's life-form categories (LFO); flora elements (FLE), and Borhidi's social behaviour types (SBT). The categories and values of the species followed the FLORA Adatbázis 1.2 (Horváth *et al.* 1995).

These spectra are given as frequencies in each categories/values of an attribute. In the case of LFO, FLE and SBT, the frequency values were standardised as the percentages of the total number of entries of the given survey, thus the spectra of different years became comparable.

Performing mathematical and statistical operations with relative indicator values is debatable owing to the ordinal nature of their scales, but several studies have showed that mean indicator values can significantly correlate with the actual values of the indicated physical parameters (Käfer and Witte 2004), and averaging can be theoretically correct (ter Braak and Barendregt 1986). Therefore, we also calculated the weighted averages of the relative ecological indicator values. The formula for the averaging was as follows:

$$A = \frac{\sum_{i=1}^{k}(i \times n_i)}{\sum_{i=1}^{k} n_i} \quad ,$$

where "A" is the weighted average of the relative ecological indicator, "i" is a value of the indicator, "n_i" is the number of entries for the ith value of the indicator, "k" is the highest value on the scale of the indicator.

RESULTS

Compositional changes

A total of 87 higher plant species were recorded throughout the study. Species with the highest number of entries in the dry section were *Arenaria serpyllifolia*, *Carex liparicarpos*, *Cerastium semidecandrum*, *Falcaria vulgaris*, *Festuca pseudovina*, *Kochia laniflora*, *Secale sylvestre* and *Polygonum arenarium*. In the wet section these were *Achillea pannonica*, *Calamagrostis epigeios*, *Carex liparicarpos*, *Euphorbia cyparissias*, *Falcaria vulgaris*, *Galium verum*, *Poa angustifolia*, *Potentilla arenaria*, *Thymus pannonicus* and surprisingly *Stipa capillata*. These species were present in at least 50% of the quadrates in at least one survey. Fluctuations of the numbers of species were high in most cases, but the data suggest a slight increasing trend in both sections, especially in spring (Fig. 3).

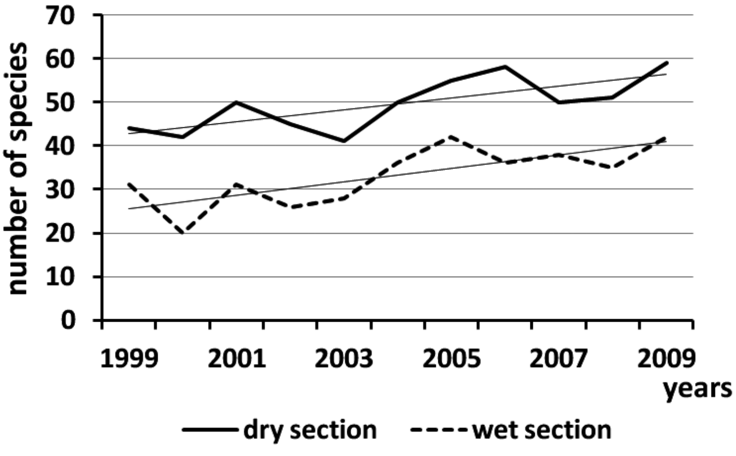

Fig. 3. The numbers of species in the dry and the wet sections in the springs between 1999 and 2009, with linear trendlines. The r^2 values for the dry and the wet sections are 0.572 (p = 0.007) and 0.553 (p = 0.008), respectively

The majority of the species showed very fluctuating abundance values and we could identify surprisingly few clear decreasing or increasing trends. Thus we did not try to explain the massive trends of the vegetation with them. Nevertheless, those few species level changes that we detected were in line with the overall trends.

Non-flowering *Stipa borysthenica* and *S. capillata* can be difficult to distinguish, therefore, to exclude errors arising from misidentification, we evaluated them together as *Stipa* spp. as well. We could detect the following trends in the dry section: *Calamagrostis epigeios* and *Verbascum lychnitis* decreased in the first few years in both seasons then they stopped to change; *Stipa* spp. increased in spring, but showed no convincing increase in autumn; *Thymus pannonicus* increased slightly but continuously in autumn; *Cynodon dactylon* had a moderate decreasing trend in both seasons. Meanwhile in the wet section, *Calamagrostis epigeios*, *Poa angustifolia* and *Verbascum lychnitis* continuously decreased in spring and the first two species decreased in autumn as well; *Festuca pseudovina*, *Stipa* spp. and *Silene otites* increased in both seasons, and *Thymus pannonicus* increased in the first half of the period in both seasons, but after that it became relatively stable.

Shannon index

The Shannon diversity indices of the dry section were not free of fluctuations, but they seemed stable and did not demonstrate any trend. Spring values were always higher than autumn ones (data not shown). The diversity values of the wet section were much closer to each other, and despite the fluctuations, they showed increasing trends, especially in spring (Fig. 4).

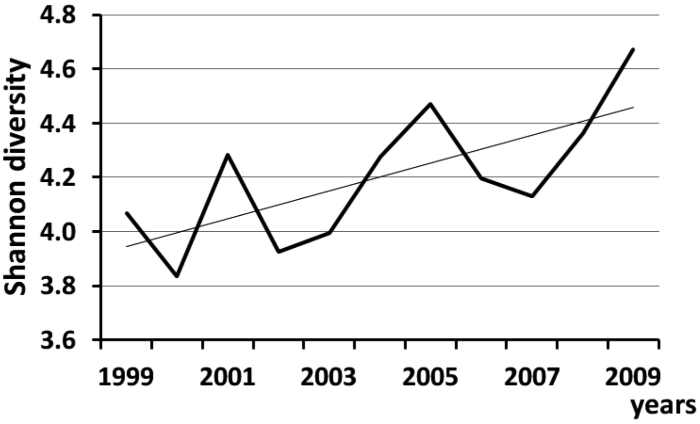

Fig. 4. The Shannon diversity values of the wet section in the springs between 1999 and 2009, with linear trendline, $r^2 = 0.483$ ($p = 0.018$)

Borhidi's relative ecological indicator values

The average WB values ranged between 3.5 and 2.2, and in general, the values of the dry section were lower with approx. 0.5, than the values of the wet section. The average values of the dry section decreased in the first 2–3 years of the study in autumn and then remained relatively constant (Fig. 5). The early decrease was not this apparent in the spring data. The wet section showed only a moderate, but constant decrease during the entire study period, especially in autumn (Fig. 5).

The average TB values ranged between 6.1 and 7.3. The spring data of the dry section were difficult to assess, but in autumn an initial increase and then a stabilisation were seen (Fig. 6). The wet section had lower values than the dry section and performed differently as it showed a convincing increase in spring (Fig. 6) and a less convincing one in autumn with a temporary drop in 2003 (data not shown).

The average KB values moved around 6, with obviously higher values in the dry section than in the wet one. We could identify no trends in either of the spring data owing to the fluctuations, but the autumn data were easier to handle: the dry section increased steeply in the first half of the study period, then it stabilised; the wet section increased only slowly, but kept it on until the end of the study period with a temporary drop in 2003 (Fig. 7).

The average NB values were between 3.3 and 2.4. In both seasons, the values of the dry section decreased in the first few years of the study, then these trends halted for 2–3 years, but later on they started to decrease again, though

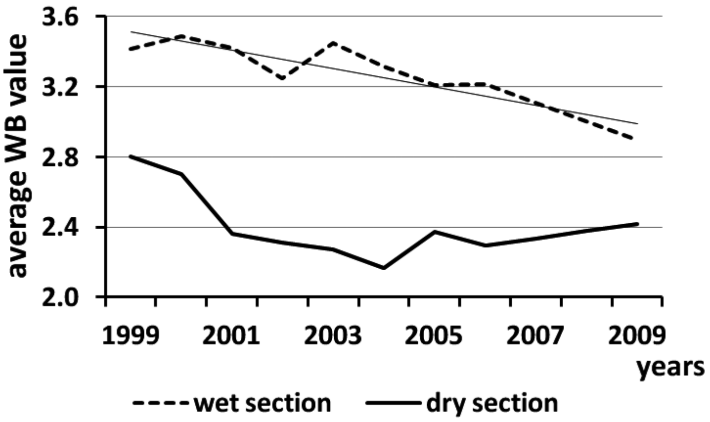

Fig. 5. The average autumn WB values of the dry and the wet sections between 1999 and 2009. The values for 2007 and 2008 were extrapolated from the values of 2006 and 2009, but were not included in the regression. Linear trendline is drawn only for the wet section, $r^2 = 0.602$ ($p < 0.014$)

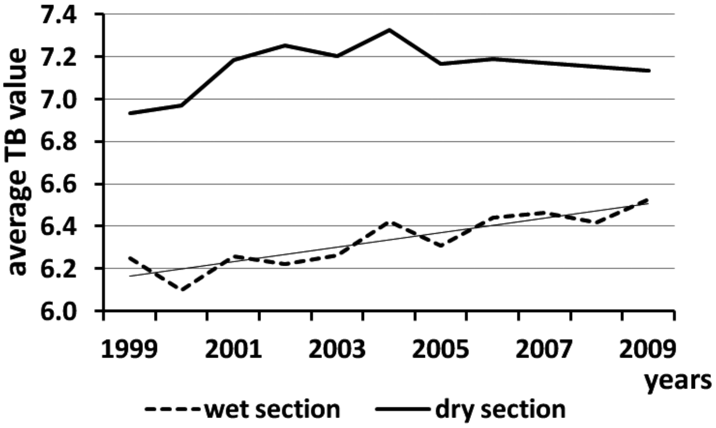

Fig. 6. The average autumn TB values of the dry section and the average spring TB values of the wet section between 1999 and 2009. The autumn values for 2007 and 2008 were extrapolated from the values of 2006 and 2009. Linear trendline is drawn only for the wet section, $r^2 = 0.776$ ($p < 0.001$)

in a slower pace than before (Fig. 8). The average NB values of the wet section were also decreasing, but the fast and slowly decreasing periods could not be distinguished (Fig. 8).

The average RB values ranged between 7.0 and 7.9. We could not detect any decreasing or increasing trends (data not shown).

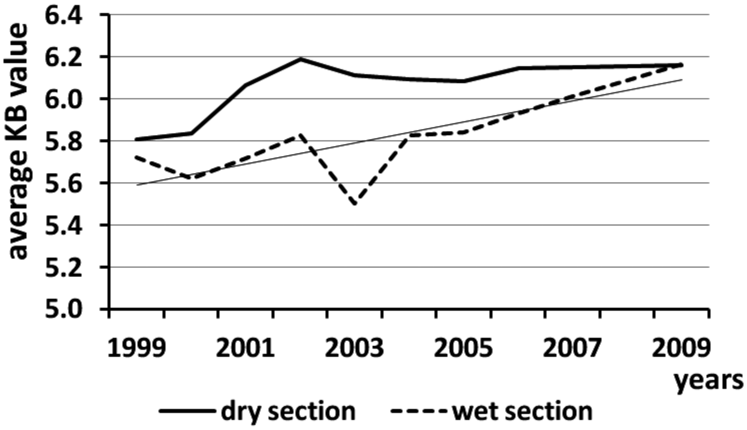

Fig. 7. The average autumn KB values of the dry and the wet sections between 1999 and 2009. The values for 2007 and 2008 were extrapolated from the values of 2006 and 2009, but were not included in the regression. Linear trendline is drawn only for the wet section, $r^2 = 0.602$ ($p = 0.014$)

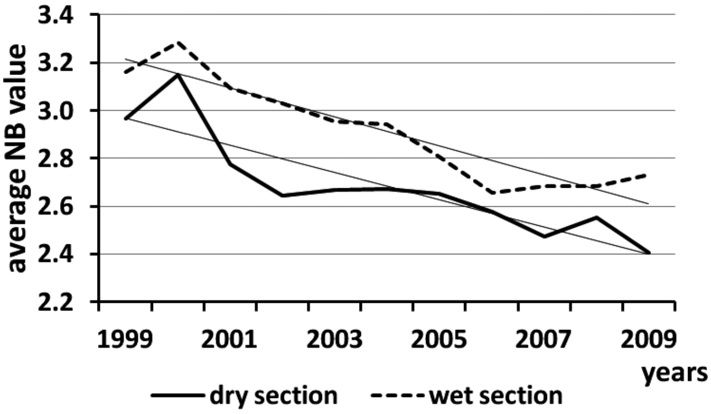

Fig. 8. The average spring NB values of the dry and the wet sections between 1999 and 2009, with linear trendlines. The r^2 values for the dry and the wet sections are 0.775 ($p < 0.001$) and 0.8726 ($p < 0.001$), respectively

Flora elements

Only the flora element groups were evaluated, because they reflected the general shifts better than the smaller categories. The dominant groups were the continentals and the Europeans, while the Mediterranean, endemic, cosmopolitan and adventive groups were subordinated. No trends could be recognised in the subordinated groups. The continental flora elements of the autumn dry section increased in the first few years, but then their share stabilised, whereas the Europeans showed the inverse of this trend (Fig. 9). Spring

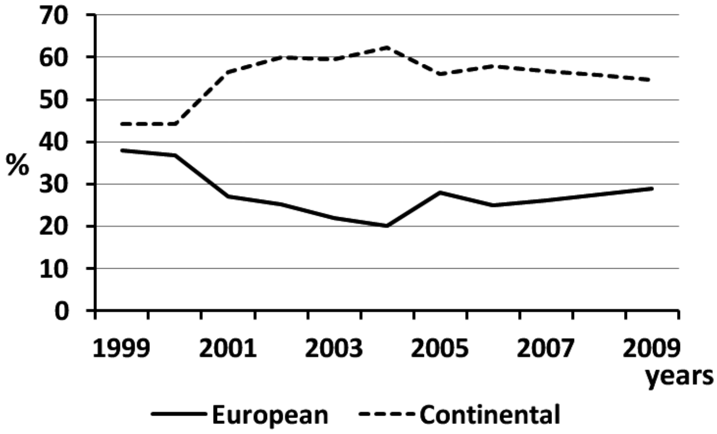

Fig. 9. The relative abundances of the continental and the European flora element groups in the dry section in the autumns between 1999 and 2009. The values for 2007 and 2008 were extrapolated from the values of 2006 and 2009

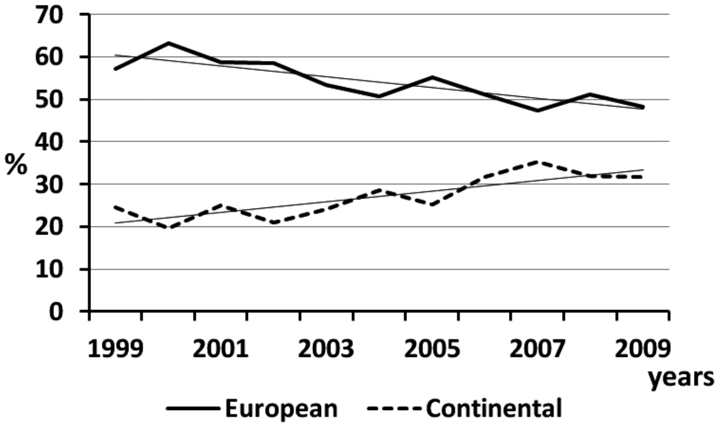

Fig. 10. The relative abundances of the continental and the European flora element groups in the wet section in the springs between 1999 and 2009, with linear trendlines. The r^2 values for the European and the continental groups are 0.775 (p < 0.001) and 0.686 (p = 0.002), respectively

data were too fluctuating to be assessed (data not shown). In spring, the continentals of the wet section increased continuously and the Europeans decreased in an inverse way (Fig. 10). The changes were similar in autumn as well, but there was a shift in 2003 towards the European group, which broke the otherwise clear tendency (data not shown).

Raunkiaer's life-form categories

Hemicryptophytes and therophytes were the dominant categories. Therophytes were more abundant in spring than in autumn, and their fluctuations were the highest observed during the study. None of the dominant categories showed a trend, however, the abundance of a much scarcer group, the chamaephytes was increasing in both sections in autumn (Fig. 11). This trend may have been present in spring as well, but even if it was so, the massive fluctuations of the therophytes suppressed it.

Borhidi's social behaviour types

The SBT profiles of the vegetation were very diverse. Generalists, natural competitors and natural pioneers were the most abundant types in the dry section, but weeds, ruderal competitors, disturbance tolerants, as well as specialists were also present. Generalists and disturbance tolerants were the two dominant groups in the wet section, whereas the other groups were scarcer.

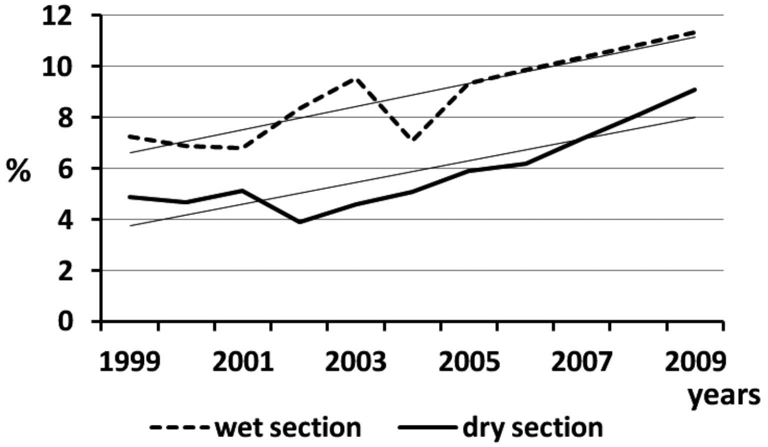

Fig. 11. The relative abundances of chamaephytes in the dry and the wet sections in the autumns between 1999 and 2009, with linear trendlines. The values for 2007 and 2008 were extrapolated from the values of 2006 and 2009, but were not included in the regression. The r^2 values for the dry and the wet sections are 0.674 ($p = 0.007$) and 0.733 ($p = 0.003$), respectively

Ruderal competitors seemed to decrease in the dry section in both seasons (Fig. 12). Ruderal competitors showed a decreasing trend in the wet section as well (Fig. 13) though in 2008 and 2009 their share increased a little, which can probably be the result of stochastic processes, like the fluctuations in other cases. Specialists increased in the dry section in both seasons (Fig. 12). This could not be detected in the wet section, where specialists were very scarce,

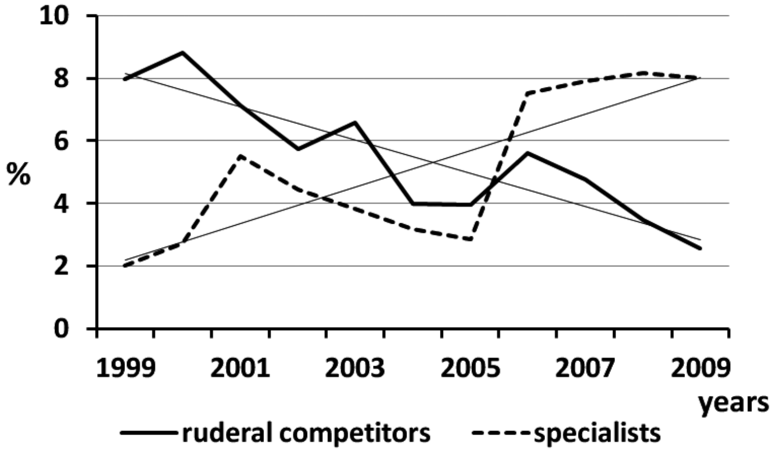

Fig. 12. The relative abundances of specialists and ruderal competitors in the dry section in the springs between 1999 and 2009, with linear trendlines. The r^2 values for the specialists and the ruderal competitors are 0.649 ($p = 0.003$) and 0.798 ($p < 0.001$), respectively

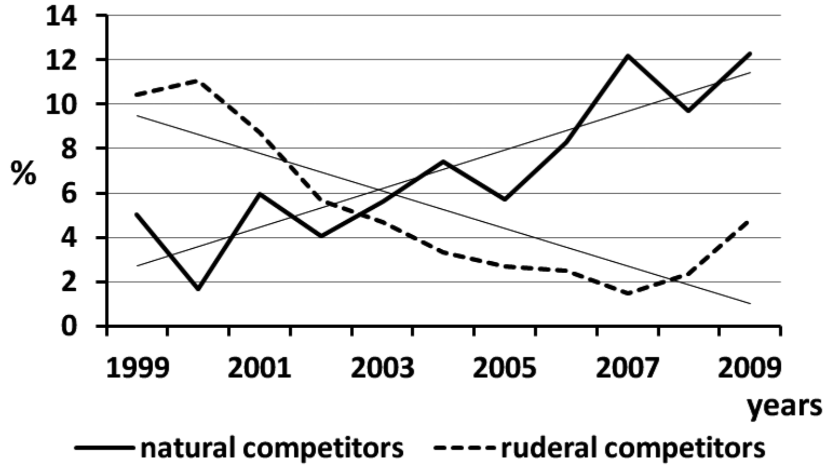

Fig. 13. The relative abundances of natural and ruderal competitors in the wet section in the springs between 1999 and 2009, with linear trendlines. The r^2 values of the natural and ruderal competitors are 0.762 ($p < 0.001$) and 0.693 ($p = 0.001$), respectively

but instead of them, the natural competitors exhibited a clear increasing trend (Fig. 13). Disturbance tolerants decreased in the wet section in autumn (Fig. 14), but no such trend could be seen in the dry section or in the spring dataset of the wet section.

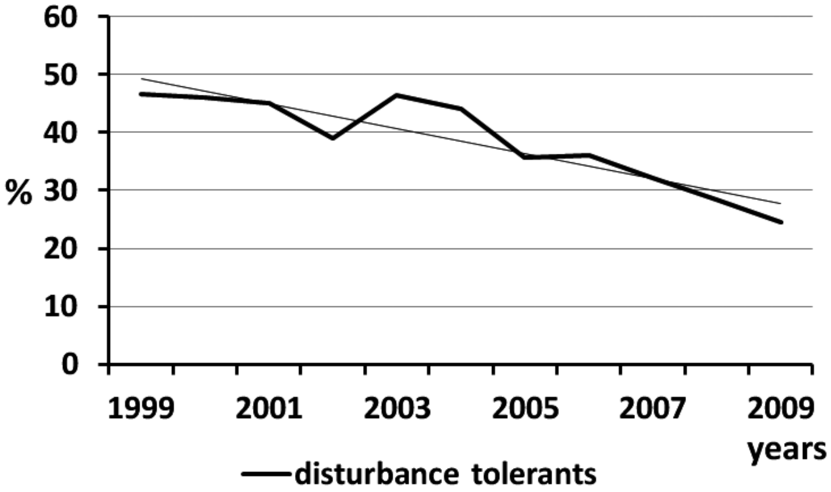

Fig. 14. The relative abundances of disturbance tolerants in the wet section in the autumns between 1999 and 2009, with linear trendline, $r^2 = 0.773$ ($p = 0.002$). The values for 2007 and 2008 were extrapolated from the values of 2006 and 2009, but were not included in the regression

DISCUSSION

In our study we examined a mosaic of different grassland plant communities in Central Hungary for basic structural changes after a severe water table drawdown. The study site was constituted of a dry and a wet section. Due to its higher position, the dry one had to rely on falling precipitation more than the wet, low-lying section, which used to be in close contact with the groundwater.

We could detect two types of trends with different kinetics. Certain values showed a rapid change in the first years of the study, but later on they reached an equilibrium level (type 1 change). Other parameters, however, were changing less rapidly but in a constant pace, without reaching a stable level (type 2 change). Type 1 changes occurred in the dry section mostly, and we found it most probable that the reason for this type was the extremely high amount of precipitation in year 1999 and the following drier years. Type 2 changes were more characteristic of the wet section, and can be explained only with the water table drawdown.

It is true for both environmental effects, that they influenced the water supply of plants, therefore the first attribute that should be dealt with is the WB value. It showed a type 1 decrease in the dry section, so we can conclude that the water table had completely lost its effect on the dry section before the study period and in terms of water supply, its vegetation was influenced solely by the falling precipitation during the study period. In contrast to this, the wet section showed a type 2 decrease, so it was not really affected by a single wet year, but suffered from the loss of its original water source, the groundwater, and was in a transitional phase towards a drier vegetation type.

The average TB values changed inversely, that is, there was a type 1 increase in the dry section and a type 2 increase in the wet section. This can be explained by the general trade-off between the WB and TB values of the plants of the transect. The average KB values changed similarly to the average TB values, so it can be stated that if conditions get drier because of whatever reasons, the plant communities of the transect tend to turn into more continental.

Kovács-Láng *et al.* (2008) also forecasted that the vegetation would become more continental in Hungary due to aridification, but they assumed that Mediterranean species would also become more abundant. Our results confirmed the first assumption, but were not in line with the latter one. The abundance of the Mediterranean group remained low, though there were seven species in this group (*Cerastium semidecandrum*, *Crepis setosa*, *Onosma arenaria*, *Silene conica*, *Teucrium chamaedrys*, *Tragopogon dubius* and *Veronica praecox*).

Raunkiaer's life-form categories also carry information about the climatic adaptations of plants. According to Borhidi *et al.* (2001) a more continental climate may increase the abundance of therophytes in Hungary. This process is called therophytisation, and was observed on rocky steppes. Kovács-Láng *et al.* (2008) called attention to this process on sandy steppes as well. Our 11 years long study, however, was not sufficiently long enough to detect this process owing to the high fluctuation rates. Interestingly, a subordinated group, the chamaephytes demonstrated an increasing trend. There were 4 chamaephytes in the transect (*Alyssum tortuosum*, *Teucrium chamaedrys*, *Thymus pannonicus* and *Veronica prostrata*), but we could identify increasing trends only for *Thymus pannonicus*, and the others had very few entries and were not present in every year, so based on our results we cannot state that chamaephytes would have any special advantages owing to the desiccation.

It is known, however, that chamaephytes are more abundant in habitats with high levels of stress, like semiarid and dry areas with poor nutrient supply (Soó 1964). This statement is in accordance with the decreasing trend of the average NB values. However, the interpretation of nitrogen supply values is a rather complex issue. The available nitrogen contents of the soils and the average nitrogen supply values of the vegetations are not in close correlation. Instead, the nitrogen supply values reflect the biomass production of the habitats (Melman *et al.* 1988, Schaffers and Sykora 2000), so nitrogen supply values correlate with the productivity of the habitat (Schaffers and Sykora 2000). For similar reasons Hill and Carey (1997) suggested the renaming of the value to "productivity index".

According to our results, the average NB values showed a decreasing trend, which allows for the assumption that the productivity of the study site was becoming lower. But compared to the WB, TB and KB values or to the flora element groups, the trends of the dry section also carried the features of type 2 decreases, since they did not stabilise until the end of the study. This means that beside the possible effects of a single wet year, the productivity of the entire community was in a constant declining phase and the reason for this cannot be else but the water table drawdown. This proves that the groundwater used to have an influence on the dry section as well, but after its level had declined and lost its role as a water supply, the water and heat demand, as well as the continentality level of the community could adapt to the new conditions much faster than its productivity. To sum up, the water table drawdown triggered a slow decline in productivity, and its time lag proved to be the longest of all the attributes so far.

According to the literature, it is known that drying conditions can have negative effects on the productivity of the vegetation of Central Hungary. In a climate manipulation experiment Lellei-Kovács and Kovács-Láng (2008) came to the conclusion that the exclusion of precipitation and the application of extra heat load can decrease the rate of nitrogen mineralisation, which is an important factor of the nutrient supply of plants. Moreover, Kovács (2006) showed with remote sensing techniques that, as a result of climate change, the primary production is decreasing in the region. However, it should be noted that studies carried out in temperate grasslands in other regions of the Earth forecast a different scenario. Based on remote sensing and experimental methods and on observations in the field, increasing productivity levels are expected with climate change in Australia (Esther *et al.* 2010), in China (Piao *et al.* 2006), in North America (Ham *et al.* 1995, Li *et al.* 2004), as well as in Switzerland (Finger *et al.* 2010). This is explained by the fact that although the increasing evapotranspiration adversely affects the productivity, the increasing carbon dioxide level in the atmosphere can offset this effect by decreasing the stomatal conductance (Graham and Nobel 1996), and can even increase the productivity. It should also be mentioned that Riedo *et al.* (1997) emphasise that if climate change is accompanied by droughts, and the soils have poor water holding capacities, the productivity is not expected to increase, but it may decrease. Based on our results and on the results of the other studies performed in Central Hungary, it seems that the dry sandy grasslands of Central Hungary are behaving in the above-mentioned way. This may cause problems not only in natural grassland communities, but if it is based on a general deterioration of the soil, a wide range of agricultural activities may be affected.

As we have seen, the drying conditions induced severe transformations in the vegetation, so it can also be interesting to check the community for degradation. According to the literature aridification results in degradation in the Central Hungarian sandy grasslands (Bartha *et al.* 2008, Kertész and Mika 1999). Based on Borhidi's social behavioural types, our results do not support this theory directly. Borhidi (1993*b*) classified the plants into three main groups: natural competitors, stress tolerants (specialists and generalists) and ruderals. The latter one is represented in the transect by natural pioneers, disturbance tolerants, weeds and ruderal competitors. Natural competitors and stress tolerants can be associated with natural conditions and ruderals with degradation. None of the ruderal groups was found to be increasing during the study period, and none of the non-ruderal groups were decreasing. Instead, all the tendencies showed an opposite direction, which massively contradicts to the literature. Nevertheless, it would sound surprising to conclude that desiccation made the communities of the transect more natural. First, the kinetics of the trends should be looked at. Basically, they followed type 2 changes in both sections, indicating that their trends were in connection with the changes of the groundwater level. Secondly, the initial shares of the changing groups should be interpreted. The high amount of disturbance tolerants and generalists, and the low amount of specialists and natural competitors in an originally unique and highly specialised natural plant community like the wet section are very surprising, and in addition, the dry section, which is obviously a more stressful habitat had, e.g. more natural competitors. Taking these into consideration we can assume, that after the onset of the water table drawdown the vegetation did start to degrade, but it was only a transitional phase and by the beginning of the study it had already reached its peak and during the study we found the community in a recovering phase. The consequences of the water table drawdown were less severe in the dry section, therefore the competitors had already reached their equilibrium (or maybe, they had not changed at all), and this might also be why the disturbance tolerants were not especially abundant. As far as the specialists are concerned, they were increasing in the dry section, indicating that this section was not free of the transitional degradation either, and this is further confirmed by the decreasing trend of the ruderal competitors.

As a summary it can be said that the complete transect suffered a transitional degradation, which was more severe and more prolonged in the wet section. In this sense, the increasing diversity values of the wet section and the increasing numbers of species are not the results of pseudo-diversity, but a real increase of natural biodiversity.

It is a promising fact that the entire community seemed to be able to recover and to shift to a new but still natural state. On the other hand, losing the original community of the wet section reduces the habitat (beta) diversity of the study area, which is an undesirable process. Moreover, it is also doubtful whether similar but more fragmented, less species reach or originally more degraded grasslands would be able to show the same recovering processes.

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