Preslia 98: 265–280, 2026
doi: 10.23855/preslia.2026.265

Preslia

Vegetation succession in abandoned fields in the Bohemian Karst: repeated sampling over nearly half a century

Karel Prach[1,2,*], Kamila Vítovcová[1], Alexandra Klaudisová[3], Alena Lepší[1] & Jindřich Prach[4,5]

We dedicate this article to the 80th birthday of Marek Rejmánek

[1]Department of Botany, Faculty of Science, University of South Bohemia, Branišovská 1760, CZ-37005 České Budějovice, Czech Republic; [2]Institute of Botany, Czech Academy of Sciences, Dukelská 135, CZ-37982 Třeboň, Czech Republic; [3]Štichova 640/24, CZ-14900 Prague, Czech Republic; [4]Center for Theoretical Study, Charles University and the Academy of Sciences of the Czech Republic, Jilská 1, CZ-11000 Prague, Czech Republic; [5]Nature Conservation Agency of the Czech Republic, Český kras Protected Landscape Area Administration, Karlštejn 85, CZ-26718 Karlštejn, Czech Republic
[*]corresponding author: prach@prf.jcu.cz

Abstract: Understanding long-term vegetation dynamics is crucial for effective ecological restoration and landscape management. This study evaluates succession on abandoned fields spanning a 1–100-year chronosequence that was repeatedly monitored over nearly half a century in the Bohemian Karst Protected Landscape Area, Czech Republic, central Europe. By combining the space-for-time substitution approach with repeated sampling of semi-permanent plots, we assessed whether successional stages converge towards reference vegetation – specifically, thermophilous oak and mesophilous oak-hornbeam woodlands. Our results demonstrate a general directional trajectory towards the reference natural vegetation. Over the decades, we observed a significant increase, as expected, in woody species cover and richness, coupled with a decline in grassland species. Concurrently, the richness and cover of alien, synanthropic, and annual species decreased. Overall species diversity and the representation of Red List species declined between sampling events. However, both may increase again as succession proceeds towards the reference vegetation. These findings highlight the value of integrating chronosequences with long-term plot monitoring to capture complex successional dynamics. Based on these insights, we provide recommendations for nature conservation and management strategies within the protected landscape area.

Keywords: chronosequence, natural vegetation, old fields, semi-permanent plots, reference sites, space-for-time substitution, vegetation change, long-term monitoring, secondary succession

Introduction

Abandoned fields are widespread sites for studying succession, given that agricultural activities occur throughout most of the world. Succession in abandoned fields represents the most frequently studied type of succession (Prach & Walker 2020). Such studies have been crucial to the development of ecological concepts because old-field succession represents

Received: 29 Jun 2026; Revised: 25 Sep 2026; Accepted: 6 Oct 2026; Published: 26 Nov 2026

a classic example of secondary succession (Cramer & Hobbs 2007). Besides contributing to successional theory, this research has practical applications for nature conservation, ecological restoration, and landscape management (Walker et al. 2007). Furthermore, abandoned fields can provide refugia for endangered plants and animals, and may also serve as buffer zones for valuable natural habitats (Osbornová et al. 1990, Cramer & Hobbs 2007).

Succession on abandoned fields has typically been studied at a limited number of sites (see Rejmánek & van Katwyk 2004). Investigations at a landscape or national scale remain less common (e.g. Prach 1985, Benjamin et al. 2005, Otto et al. 2006, Ruprecht et al. 2007, Holz et al. 2009, Szabó & Prach 2009, Verburg & Overmars 2009, Wright & Fridley 2010), yet they can reveal broader variability in successional trajectories than local studies (Prach & Řehounková 2006). Succession can be studied using two main approaches: the chronosequence approach (space-for-time substitution) and permanent-plot studies (Pickett 1989). Conducting repeated permanent-plot studies across large spatial scales presents obvious logistical obstacles. Consequently, researchers frequently rely on chronosequences (space-for-time substitutions) to infer successional dynamics from sites of varying ages (Walker et al. 2010). Nevertheless, these sites often differ in local environmental conditions and historical land use, which can confound the interpretation of temporal trends (Johnson & Miyanishi 2008, Damgaard 2019). The primary advantage of the chronosequence approach is that it enables the analysis of numerous sites within a reasonably short period. Integrating the two methodological approaches therefore offers an ideal strategy. Comparing trends derived from chronosequences with those from permanent or semi-permanent plots (i.e., unmarked plots not exactly relocated) can provide deeper insights into vegetation dynamics (Walker et al. 2010, Blois et al. 2013). This combined approach was applied in the present study by resampling plots from an earlier chronosequence baseline (Klaudisová 1976). While the results of a previous survey after 33–34 years were published by Jírová et al. (2012), we now add a new resampling dataset spanning another decade. A similar approach has been applied to abandoned fields, e.g. by Meiners et al. (2015) and Csecserits et al. (2021).

Arable land in the Czech Republic, as in other central- and eastern-European countries, underwent widespread abandonment in the 1990s due to post-communist political and economic transitions (Brouwer & van der Straaten 2002). However, agricultural marginalization had also occurred earlier for various reasons. Most small arable fields, and likewise many hay meadows, were gradually abandoned; abandonment of the latter coincided with a decline in mowing and extensive grazing. These shifts primarily triggered the encroachment of woody species – an ongoing process that has caused profound landscape alterations in many parts of the world (Cramer & Hobbs 2007). In the Bohemian Karst Protected Landscape Area, the setting of this study, land abandonment has been a major landscape-forming factor, particularly throughout the second half of the 20th century (Fig. 1). This territory is designated under IUCN categories IV (Habitat/Species Management Area) and V (Protected Landscape), with the overarching conservation goal of maintaining a diverse and dynamic landscape mosaic.

The high concentration of abandoned arable fields in close proximity to Prague, the Czech capital, stimulated early ecological research in the region. In the 1970s, Marcel (Marek) Rejmánek initiated a comprehensive research project on succession, the results of which were later summarized by Osbornová et al. (1990). These fields were originally

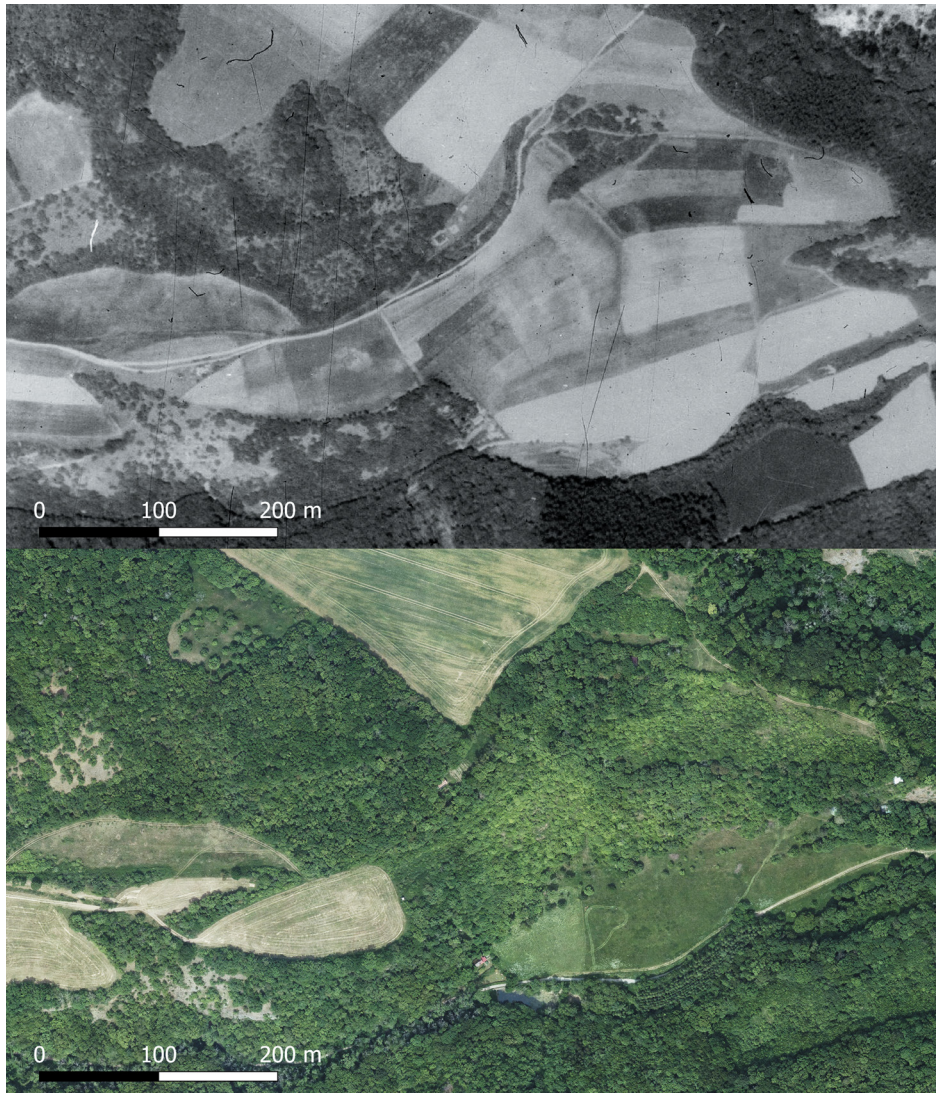

Fig. 1. An example of landscape change in the Bohemian Karst involving abandoned fields, illustrated by photographs taken in 1951 (above, source: Historical orthophotomap ©CENIA 2010 & ©GEODIS BRNO, spol. s r.o. 2010, source aerial photography provided by VGHMÚř Dobruška, ©MO ČR 2009, CC BY 4.0) and 2023 (below, Orthophotomap 2023 © Czech Office for Surveying, Mapping and Cadastre (ČÚZK), CC BY 4.0).

sampled using phytosociological relevés (Klaudisová 1976); subsequently, a subset of them was resampled in 2008–2009 (Jírová et al. 2012) and again in 2019. Here, we present the results of this long-term resampling.

We addressed the following questions: (i) To what extent have the successional communities converged towards their respective natural reference vegetation over nearly half a century? (ii) How have the proportions of different ecological species groups shifted

over time? (iii) What temporal trends can be observed in species diversity? (iv) What are the practical implications of these dynamics for landscape management and nature conservation?

Methods

The study was conducted in the Bohemian Karst Protected Landscape Area, Czech Republic (49°52'–50°00' N, 14°03'–14°21' E; altitude 251–488 m a.s.l.). The protected area covers 128 km^2, with a landscape predominantly formed by limestone. The climate is temperate and transitional between oceanic and continental. The region has a relatively warm, dry climate with mild winters, a mean annual temperature of 8–9 °C and mean annual precipitation of ~530 mm (Tolasz et al. 2007).

In the mid-1970s, a total of 110 abandoned fields, covering 0.7% of the protected area, were recorded (Klaudisová 1976, Osbornová et al. 1990). Among these, Klaudisová (1976) sampled 58 fields in 1975 that were distributed across almost the entire area of the Bohemian Karst. Subsequently, 41 of these fields were resampled in 2008–2009 by A. Lepší (Jírová et al. 2012) and again in 2019 by K. Prach and J. Prach. In 1975, the successional age of the fields ranged from 1 to 56 years, corresponding to 45 to 100 years by 2019. In 1975, there were 6 young (1–10 yrs), 33 middle (11–40 yrs) and 2 late (>40 yrs) successional stages; the corresponding numbers for the subsequent surveys were 0, 3, 38 and 0, 0, 41, respectively. Because some fields were converted back to arable land, managed as hay meadows or pastures, or affected by construction activities, not all original fields could be resampled in later periods. To facilitate plot relocation, maps from the initial survey were digitized and georeferenced; however, pinpointing the exact historical plot locations was impossible because GPS technology was unavailable during the initial baseline study. Consequently, these sampling units are hereafter referred to as semi-permanent plots. In 2008–2009, all plot positions were recorded using a high-precision GPS, enabling exact relocation in 2019. One phytosociological relevé per field was recorded in a 4 × 4 m plot during the earlier surveys and in a 5 × 5 m plot during the last survey to ensure compatibility with the current Database of Successional Series (DaSS, Prach et al. 2014). Plot locations were selected within homogeneous vegetation patches to avoid edge effects, taking into account the slope and aspect described in the original relevés; their locations were also verified through field consultations with the author of the initial 1975 survey. Species abundance was estimated as percentage cover using a direct percentage scale (r, +, 1–100%) during the 2008–2009 and 2019 sampling events, whereas the Domin scale was originally applied in 1975 (Kent & Coker 1992). For comparison with target ecosystems, reference phytosociological relevés representing natural vegetation were extracted from the Czech Vegetation Database (https://czechveg.github.io; Chytrý et al. 2026). We selected reference relevés from the same geographical region as our old fields, specifically targeting mesophilous oak-hornbeam (*Carpinion betuli*) and thermophilous oak (*Quercion pubescenti-petraeae*) woodlands based on the Map of Potential Natural Vegetation (Neuhäuslová et al. 1998). The selected relevés were recorded between 1985 and 2011. Relevés recorded within plots exceeding 100 m^2 were excluded. Taxonomic concepts and vascular plant nomenclature follow Kaplan et al. (2019).

Data analysis

To address our primary objective, we compared the vegetation of abandoned fields between the three surveys: 1975, 2008–2009, and 2019. To facilitate comparison with the later resampled datasets – where cover was estimated directly – the baseline abundance data (Klaudisová 1976) were converted from the Domin abundance–dominance scale to percentage values following Currall (1987). Species were classified by life form into annuals, perennial forbs, perennial graminoids, and woody species according to Kaplan et al. (2019). Based on Ellenberg et al. (1991) and Chytrý (2007–2013), species were further categorized by phytosociological affiliation into four broad vegetation units: (i) mesic grasslands, (ii) dry grasslands, (iii) woodlands, and (iv) synanthropic (ruderal and segetal) vegetation. Additionally, conservation status was assessed using the national Red List (Grulich 2017), while invasion status was determined according to Pyšek et al. (2022). Alpha diversity was quantified using the Shannon–Wiener index.

Community data were analysed using detrended correspondence analysis (DCA) on log-transformed species abundance data in CANOCO 5 (ter Braak & Šmilauer 2012). The choice of a unimodal ordination method was justified by a gradient length of 8.6 standard deviation (SD) units, which indicates substantial species turnover along the first ordination axis.

Because plot sizes differed, species richness was standardized to a plot size of 25 m^2 using species–area curves derived from our data (Divíšek & Chytrý 2018, Barandun et al. 2026). Because the same plots were repeatedly sampled across the three surveys and the data were non-normally distributed, the non-parametric Friedman test was used to evaluate differences in the number of species and the proportions of specific species categories between sampling years and the natural-vegetation reference plots. Significant overall effects were followed by post-hoc pairwise comparisons using the paired Wilcoxon signed-rank test with Bonferroni correction for multiple testing. All univariate statistical analyses were conducted in R software (version 4.6.0; R Core Team 2026).

Results

Across all three surveys, a total of 259 vascular plant species were recorded. Among these, 64 were classified as annuals, 135 as perennial forbs, 24 as perennial graminoids, and 36 as woody species (including seedlings). The total number of recorded species across surveys declined (1975: 164; 2008–2009: 136; 2019: 122) as the vegetationally distinct early successional stages gradually disappeared. In terms of phytosociological affiliation, 86 species were affiliated with synanthropic (ruderal and segetal) vegetation, 103 with grassland vegetation (including 63 typical of dry grasslands), and 59 with woodland vegetation. Regarding conservation and invasion status, 26 species were listed on the national Red List, while 48 species were identified as non-native to the national flora, 12 of which were classified as neophytes.

Temporal shifts in species composition are illustrated in Fig. 2 and detailed in Supplementary Table S1, which lists species attaining a mean cover of at least 1% in at least one dataset. Based on the table, historical literature, and field observations, the successional trends spanning 100 years can be reconstructed. Succession begins with a common pool of weeds dominated by annuals, which are replaced within a few years by perennial forbs


A


B



Fig. 2. Examples of successional stages on the studied abandoned fields: (A) 1-year-old stage dominated by arable weeds (49.9508° N, 14.1272° E); (B) ~20-year-old stage dominated by *Arrhenatherum elatius*, with initial establishment of woody species (49.9443° N, 14.1329° E); (C) forest-steppe vegetation on a dry site (~90 years old; 49.9436° N, 14.1329° E); and (D) closed forest on a mesic site (~45 years old; 49.9823° N, 14.1594° E). Photographs by K. Prach.

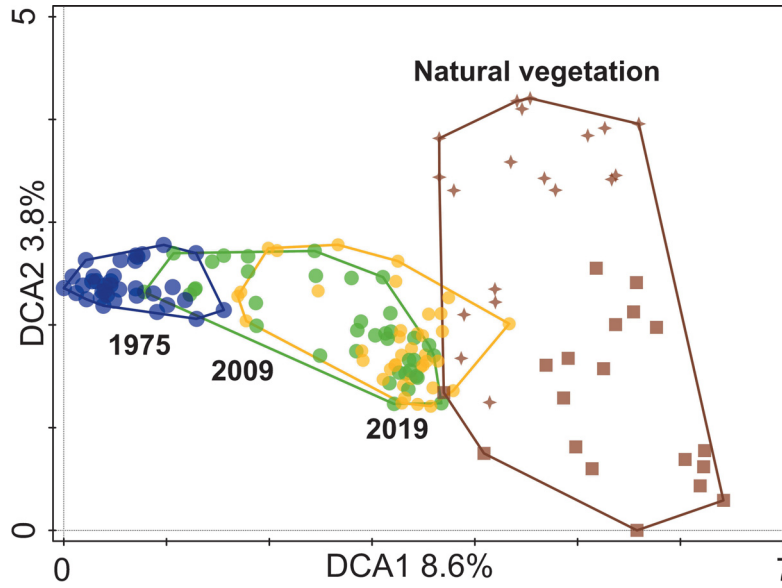

Fig. 3. DCA ordination of phytosociological relevés recorded in the same abandoned fields across three sampling events, displayed alongside reference natural vegetation data. Within the reference dataset, asterisks represent thermophilous oak woodlands (*Quercion pubescenti-petraeae*), and squares represent mesophilous oak-hornbeam woodlands (*Carpinion betuli*).

and graminoids. Gradually, grasses typical of dry and mesic habitats, specifically *Festuca rupicola* and *Arrhenatherum elatius*, expand and dominate. In mesic sites, woody species (especially *Prunus spinosa*, *Rosa* spp., *Crataegus* spp., *Fraxinus excelsior*, and *Acer campestre*) begin to encroach after ~15 years. On drier sites, grasses such as *F. rupicola* persist to some extent. Under these comparably dry conditions, woody colonizers establish much more slowly and rarely achieve full dominance. In the oldest successional stages, late-seral woody species typical of natural woodlands emerge, including *Cornus mas* on dry sites and *Carpinus betulus* on mesic sites, alongside characteristic forest understory herbs such as *Galium odoratum*, *Hepatica nobilis*, *Primula veris*, and *Lathyrus vernus*. As this successional sequence has been documented in detail previously (Osbornová et al. 1990, Prach et al. 2007, Jírová et al. 2012), we outline it here briefly to provide necessary ecological context.

The results of the DCA ordination are presented in Fig. 3. The ordination diagram reveals a gradual, directional shift of successional plots across the three sampling periods towards the reference natural vegetation of the area. A few abandoned fields appear already to have converged in species composition towards the reference vegetation after ~70 years. These specific plots were situated on drier sites and resembled the species composition of thermophilous oak woodlands. The ordination trajectory suggests that secondary succession is directed towards a specific part of the compositional range of the natural vegetation.

Temporal shifts in the proportions of life forms and phytosociological species groups are illustrated in Fig. 4. As expected, woody species increased, while annuals, perennial forbs and graminoids declined, a pattern that is particularly pronounced when considering species

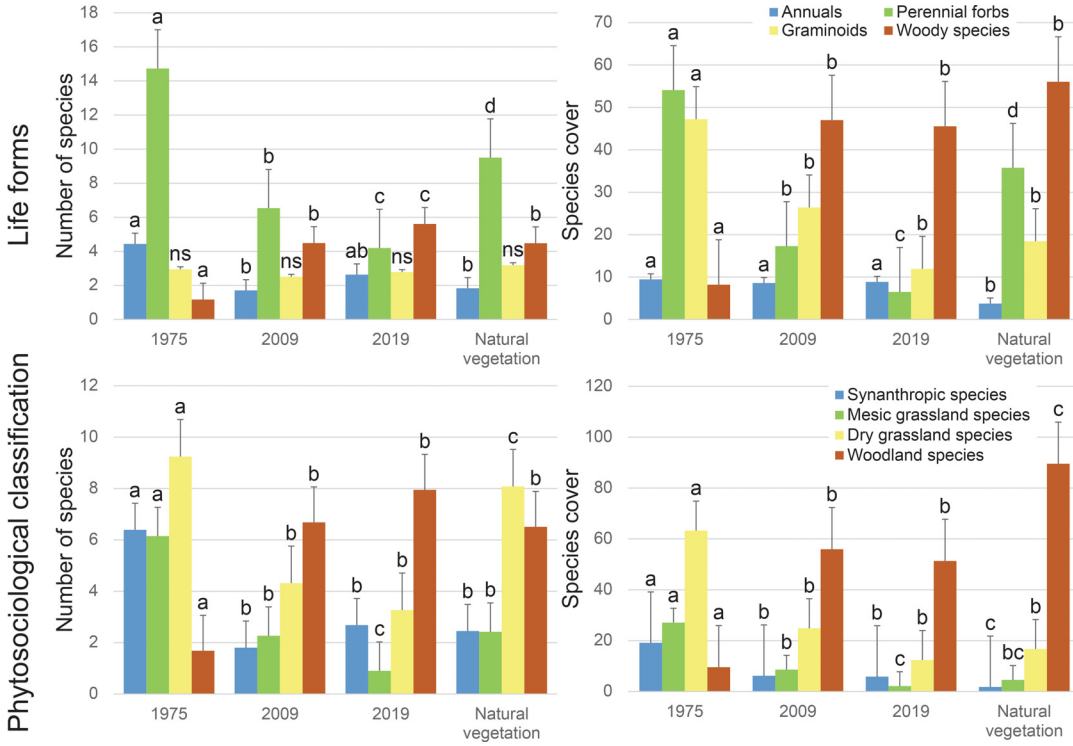

Fig. 4. Comparison of the representation of life forms and basic phytosociological species groups per sampling plot across the three sampling events and in the reference natural vegetation. Significant differences are indicated by different lowercase letters based on a Friedman test followed by post-hoc pairwise comparisons using paired Wilcoxon signed-rank tests with Bonferroni correction for multiple testing. Colours denote the different species categories. Different lowercase letters above bars indicate significant differences between sampling periods and the reference natural vegetation within each species category; ns indicates no significant difference.

cover. Concurrently, species characteristic of woodlands increased over time, progressively replacing synanthropic, mesic, and dry grassland species. Figure 5 illustrates a clear decline in species richness, alpha diversity, and both the richness and cover of Red List and alien species. This reduction was particularly pronounced between the first and second observation periods, especially when evaluating species cover. For comparative purposes, all community characteristics are plotted alongside those of the reference natural vegetation in both figures, providing a baseline to tentatively project future successional trajectories.

Discussion

Main successional trends

The results of this study demonstrate that secondary succession is generally directed towards the reference natural vegetation of the region. Several of the 41 investigated plots, 70–100 years old, already appear to be converging in species composition towards

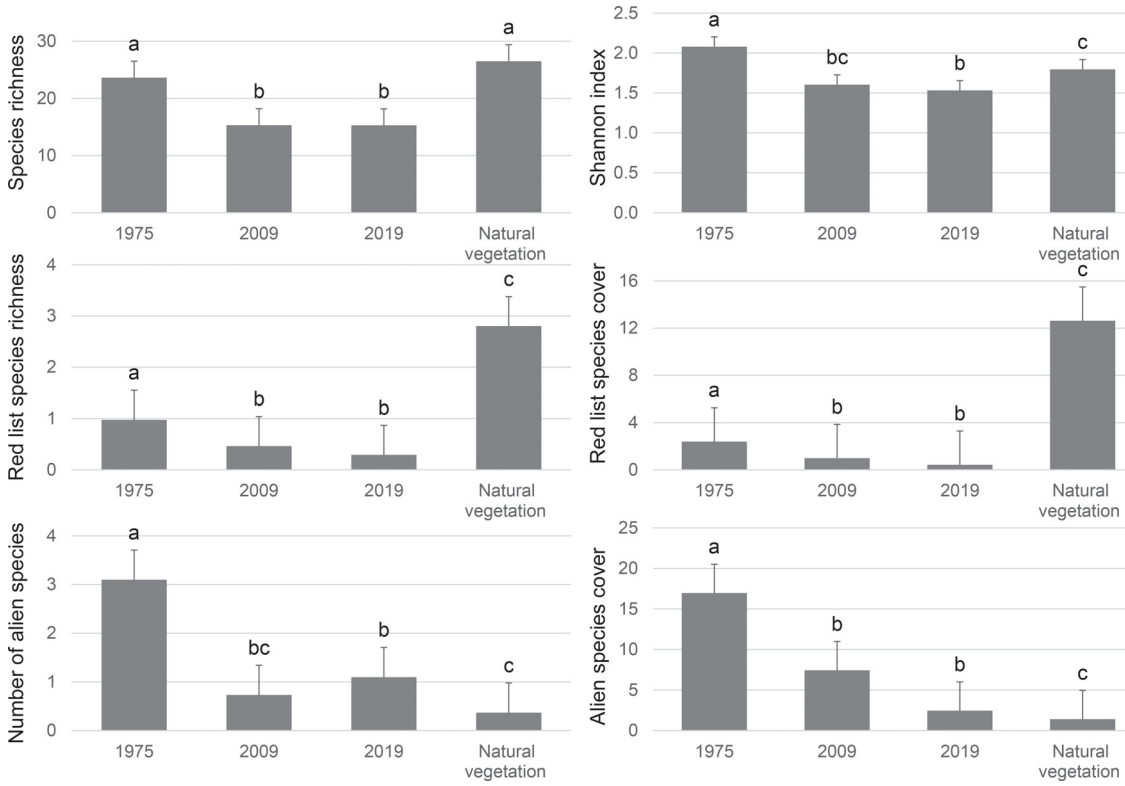

Fig. 5. Mean species richness and diversity, together with the mean richness and cover of Red List and alien species per sampling plot across the three sampling events compared to the reference natural vegetation. Significant differences are indicated by different lowercase letters based on a Friedman test followed by Wilcoxon signed-rank test with Bonferroni correction for multiple testing.

these reference communities. However, full re-establishment of natural vegetation will undoubtedly require additional time and may be further complicated by future changes in the species pool across the entire landscape. However, given that the entire landscape is protected, major land-use changes are unlikely. Based on estimates from various secondary successional series across the Czech Republic, the process of full recovery of natural vegetation is estimated to take at least 250 years (Prach et al. 2016) – a timeframe that may tentatively be applied to the abandoned fields under study. However, individual fields may also exhibit different successional trajectories. On certain isolated sites, succession can be substantially delayed, and the establishment of late-seral woody species typical of natural woodlands is further constrained by deer browsing (Osbornová et al. 1990). This phenomenon likely explains the trajectory of the few fields that still remain similar to the composition recorded during the first observation period (Fig. 3).

In this study, we did not explicitly distinguish among the three main successional subseries (dry, mesic, and wet) described in previous literature (Osbornová et al. 1990, Prach et al. 2007, Jírová et al. 2012). Wet fields were excluded from the repeated analyses due

to their rarity and because several had been recently reploughed. The remaining plots form a compositional continuum, making any subdivision between mesic and dry fields rather arbitrary. Furthermore, we slightly revised the earlier hypothesis that dry fields progressively develop towards shrubby steppes (Jírová et al. 2012). By cross-referencing our data with the map of potential natural vegetation (Neuhäuslová et al. 1998), we now consider thermophilous oak woodlands, potentially with a partially open canopy, as the most appropriate reference and likely target vegetation even for the driest fields. Notably, arable cultivation was historically absent from extremely dry sites in the region. Nevertheless, the main successional trends identified here remain fully consistent with previous research.

Our study emphasizes the value of long-term monitoring spanning multiple decades, as well as the benefits of integrating chronosequences (space-for-time substitutions) with studies of permanent or semi-permanent plots to evaluate successional dynamics (Pickett 1989, Walker et al. 2010). The validity of combining these two approaches has also been demonstrated for abandoned fields by Meiners et al. (2015) and Csecserits et al. (2021), and specifically in the Bohemian Karst by Řehounková et al. (2024), who confirmed that both methods yield highly comparable results even without the inclusion of our latest resampling dataset. The necessity of large-scale, repeated vegetation surveys was also recently emphasized by Klinkovská et al. (2025), who illustrated that synthesizing multiple resurvey studies allows for the identification of broader, more general ecological trends than individual local investigations can provide. For such macroecological synthesis, initiatives like the ReSurveyEurope database (Knollová et al. 2024) offer considerable opportunities.

Species and community characteristics

Trends in life forms correspond to well-known successional patterns in abandoned fields in temperate regions, i.e. an increase in woody species at the expense of annuals and perennial forbs and graminoids (Cramer & Hobbs 2007, Prach & Walker 2020). The slight, non-significant decrease in woody cover observed between 2008–2009 and 2019 was likely driven by the self-thinning of temporarily dense shrub canopies across some plots. Similarly, the reduction in synanthropic, mesic, and dry grassland species cover, coupled with the enrichment of woodland specialists, matches ecological expectations. Herbs typical of the mesophilous oak-hornbeam forest understory (*Carpinion betuli*) became more prominent during the most recent sampling event, suggesting further recruitment especially on mesic sites. Conversely, on drier sites successional trajectories seem to be directed towards thermophilous oak woodlands (*Quercion pubescenti-petraeae*). In these comparably dry environments, an increase in dry-grassland specialists may be expected as succession converges towards the corresponding natural vegetation, which is usually characterized by an open canopy structure (Chytrý 2007–2013).

Excluding the reference natural vegetation, the maximum species richness recorded during the initial survey can be attributed to the concurrent presence of young, middle, and late successional stages, whereas only middle and late seral stages occurred in the subsequent sampling event (Jírová et al. 2012) and only late stages in the most recent survey. Similarly, the high richness and cover of Red List species during the first sampling event is explained by the presence of endangered arable weeds characteristic of early successional stages (Osbornová et al. 1990), species that later declined or disappeared.

This also explains why alien species peaked in both number and cover during the initial baseline study, given that these pioneer weeds are frequently classified as archaeophytes (Pyšek et al. 2022). Although alien species generally make an increasing contribution to regional species pools over time (Pyšek et al. 2022), their progressive decline along a successional gradient represents a well-documented general trend (Rejmánek 1989, Ballesteros et al. 2021). Notably, certain archaeophytes are simultaneously listed on the national Red List (Grulich 2017), thereby belonging to both ecological categories considered here.

We are aware that some trends may be slightly biased by the different sizes of sampling plots during the most recent survey, despite corrections using species–area curves (Divíšek & Chytrý 2018, Barandun et al. 2026). We must also consider some slight inaccuracies in the location of semi-permanent plots and the possible influence of different observers. However, these limitations should not distort the general trends, particularly when the data were pooled across all plots (Barandun et al. 2026).

Implications for nature conservation and ecological restoration

Based on our findings, several implications can be drawn for restoration and conservation management of the protected landscape area. First, our results demonstrate that semi-natural vegetation is likely to establish spontaneously within a few decades (see Osbornová et al. 1990), with some older stages even converging towards the reference natural vegetation after ~70 years. Second, alien species – particularly invasive neophytes – remain remarkably infrequent and decline progressively along the successional gradient. Notably, among the 70 most common species documented across the entire chronosequence (Supplementary Table S1), only a single invasive neophyte, *Impatiens parviflora*, occurred in the late successional stages. Consequently, passive restoration represents a highly effective, low-cost management strategy for former agricultural lands in the region, as spontaneous succession successfully directs these habitats towards target forest ecosystems without substantial threats from plant invasions, at least so far.

Moreover, the initial successional stages still harbour rare and endangered archaeophytic weeds, including several Red List species (based on our recent field observations). This presence highlights the high conservation value of early seral stages. To ensure the persistence of these transient pioneer communities, targeted disturbance management could be implemented in collaboration with local landowners. From an ecological perspective, the successional closed-canopy woodlands developing on most mesic sites also have considerable conservation value, as they are composed entirely of native species. Conversely, active removal of woody species should be prioritized on sites where high-priority dry-grassland specialists, such as *Pulsatilla pratensis* and *Anacamptis pyramidalis*, have already established, or on sites close to existing permanent steppe fragments, where there is high potential for colonization by dry-grassland species. To maintain non-forest vegetation, active mowing or extensive grazing can be implemented as part of the conservation management plan. Other abandoned fields should be left to undergo passive development without any direct intervention. Leaving our study plots unmanaged is also crucial for future resampling, which will provide deeper insights into long-term successional dynamics. As already mentioned, spontaneously revegetated abandoned fields can enhance the landscape mosaic, form functional buffer zones around existing nature reserves and

Natura 2000 sites, and provide nesting habitat for birds, habitat for pollinators and shelter for wildlife (Rambousková 1990, Prach et al. 2007). These ecological services underscore the regional importance of abandoned fields within the Protected Landscape Area. Consequently, neither artificial regrassing nor active reforestation is recommended for these habitats. This study demonstrates that resampling historical chronosequences not only advances ecological theory but also yields critical data for restoration ecology and landscape management. Such repeated assessments are particularly powerful when they encompass a large number of sites across large spatial and temporal scales. At these broad spatial and temporal scales, general macroecological trends can be readily disentangled from local variations, providing a more robust foundation for evidence-based conservation strategies.

Supplementary materials

Table S1. List of the most abundant species recorded in the field.

Supplementary materials are available at https://www.preslia.cz

Acknowledgements

The study was supported partly by the GAČR grant no. 25-18351S and partly by Horizon Europe, grant number 101081177 (WILDCARD). We thank reviewers for their valuable constructive comments.

References

Ballesteros M., Vítovcová K., Řehounková K., Müllerová A., Janečková P., Pospíšilová P. & Prach K. (2021) Alien species in vegetation succession: participation, temporal trends and determining factors in various central European series. – Biological Invasions 23: 3435–3445.

Barandun M., Pauler C. M., Lüscher G., Guisan A., Knop E. & Schneider M. K. (2026) Scaling species richness: when vegetation surveys don't match in plot area. – Journal of Ecology 114: e70232.

Benjamin K., Domon G. & Bouchard A. (2005) Vegetation composition and succession of abandoned farmland: effects of ecological, historical and spatial factors. – Landscape Ecology 20: 627–647.

Blois J. L., Williams J. W., Fitzpatrick M. C., Jackson S. T. & Ferrier S. (2013) Space can substitute for time in predicting climate-change effects on biodiversity. – Proceedings of the National Academy of Sciences of the United States of America 110: 9374–9379.

Brouwer F. & van der Straaten J. (eds) (2002) Nature and agriculture in the European Union: new perspectives on policies that shape the European countryside. – Edward Elgar, Cheltenham.

Chytrý M. (ed.) (2007–2013) Vegetace České republiky 1–4 [Vegetation of the Czech Republic 1–4]. – Academia, Praha.

Chytrý M., Axmanová I., Divíšek J., Friesová K., Holubová D., Palpurina S., Řezníčková M., Večeřa M. & Knollová I. (2026) Czech Vegetation Database: an open source of vegetation-plot data for research and applications. – Preslia 98: 187–207.

Cramer V. A. & Hobbs R. J. (eds) (2007) Old fields: dynamics and restoration of abandoned farmland. – Island Press, Washington.

Csecserits A., Halassy M., Lhotsky B., Rédei T., Somay L. & Botta-Dukát Z. (2021) Changing assembly rules during secondary succession: evidence for non-random patterns. – Basic and Applied Ecology 52: 46–56.

Currall J. E. P. (1987) A transformation of the Domin scale. – Vegetatio 72: 81–87.

Damgaard C. (2019) A critique of the space-for-time substitution practice in community ecology. – Trends in Ecology & Evolution 34: 416–421.

Divíšek J. & Chytrý M. (2018) High-resolution and large-extent mapping of plant species richness using vegetation-plot databases. – Ecological Indicators 89: 840–851.

Ellenberg H., Weber H. E., Düll R., Wirth V., Werner W. & Paulissen D. (1991) Zeigerwerte von Pflanzen in Mitteleuropa. – Scripta Geobotanica 18: 1–248.

Grulich V. (2017) Červený seznam cévnatých rostlin ČR [The Red List of vascular plants of the Czech Republic]. – Příroda 35: 75–132.

Holz S., Placci G. & Quintana R. D. (2009) Effects of history of use on secondary forest regeneration in the Upper Parana Atlantic Forest (Misiones, Argentina). – Forest Ecology and Management 258: 1629–1642.

Jírová A., Klaudisová A. & Prach K. (2012) Spontaneous restoration of target vegetation in old-fields in a central European landscape: a repeated analysis after three decades. – Applied Vegetation Science 15: 245–252.

Johnson E. A. & Miyanishi K. (2008) Testing the assumptions of chronosequences in succession. – Ecology Letters 11: 419–431.

Kaplan Z., Danihelka J., Chrtek J. jun., Kirschner J., Kubát K., Štech M. & Štěpánek J. (eds) (2019) Klíč ke květeně České republiky [Key to the flora of the Czech Republic]. Ed. 2. – Academia, Praha.

Kent M. & Coker P. (1992) Vegetation description and analysis: a practical approach. – Belhaven Press, London.

Klaudisová A. (1976) Fytocenologicko-pedologická studie opuštěných polí Českého krasu [Phytosociological and pedological study of abandoned fields in the Bohemian Karst]. – Thesis, Faculty of Science, Charles University, Prague.

Klinkovská K., Sperandii M. G., Knollová I., Danihelka J., Hájek M., Hájková P., Hroudová Z., Jiroušek M., Lepš J., Navrátilová J., Peterka T., Petřík P., Prach K., Řehounková K., Rohel J., Sobotka V., Vávra M., Bruelheide H. & Chytrý M. (2025) Half a century of temperate non-forest vegetation changes: no net loss in species richness, but considerable shifts in taxonomic and functional composition. – Global Change Biology 31: e70030.

Knollová I., Chytrý M., Bruelheide H., Dullinger S., Jandt U., Bernhardt-Römermann M., Biurrun I., de Bello F., Glaser M., Hennekens S., Jansen F., Jiménez-Alfaro B., Kadaš D., Kaplan E., Klinkovská K., Lenzner B., Pauli H., Sperandii M. G., Verheyen K., Winkler M., Abdaladze O., Aćić S., Acosta A. T. R., Alignier A., Andrews C., Arlettaz R., Attorre F., Axmanová I., Babbi M., Baeten L., Baran J., Barni E., Benito-Alonso J.-L., Berg C., Bergamini A., Berki I., Boch S., Bock B., Bode F., Bonari G., Boublík K., Britton A. J., Brunet J., Bruzzaniti V., Buholzer S., Burrascano S., Campos J. A., Carlsson B.-G., Carranza M. L., Černý T., Charmillot K., Chiarucci A., Choler P., Chytrý K., Corcket E., Csecserits A., Cutini M., Czarniecka-Wiera M., Danihelka J., de Francesco M. C., De Frenne P., Di Musciano M., De Sanctis M., Deák B., Decocq G., Dembicz I., Dengler J., Di Cecco V., Dick J., Diekmann M., Dierschke H., Dirnböck T., Doerfler I., Doležal J., Döring U., Durak T., Dwyer C., Ejrnæs R., Ermakova I., Erschbamer B., Fanelli G., Fernández-Calzado M.-R., Fickert T., Fischer A., Fischer M., Foremnik K., Frouz J., García-González R., García-Magro D., García-Mijangos I., Gavilán R. G., Germ M., Ghosn D., Gigauri K., Gizela J., Golob A., Golub V., Gómez-García D., Gowing D., Grytnes J.-A., Güler B., Gutiérrez-Girón A., Haase P., Haider S., Hájek M., Halassy M., Harásek M., Härdtle W., Heinken T., Hester A., Humbert J.-Y., Ibáñez R., Illa E., Jaroszewicz B., Jensen K., Jentsch A., Jiroušek M., Kalníková V., Kanka R., Kapfer J., Kazakis G., Kermavnar J., Kesting S., Khanina L., Kindermann E., Kotrík M., Koutecký T., Kozub Ł., Kuhn G., Kutnar L., La Montagna D., Lamprecht A., Lenoir J., Lepš J., Leuschner C., Lorite J., Madsen B., Ugarte R. M., Malicki M., Maliniemi T., Máliš F., Maringer A., Marrs R., Matesanz S., Metze K., Meyer S., Millett J., Mitchell R. J., Moeslund J. E., Moiseev P., Morra di Cella U., Mudrák O., Müller F., Müller N., Naaf T., Nagy L., Napoleone F., Nascimbene J., Navrátilová J., Ninot J. M., Niu Y., Normand S., Ogaya R., Onipchenko V., Orczewska A., Ortmann-Ajkai A., Pakeman R. J., Pardo I., Pätsch R., Peet R. K., Penuelas J., Peppler-Lisbach C., Pérez-Hernández J., Pérez-Haase A., Petraglia A., Petřík P., Pielech R., Piórkowski H., Pladevall-Izard E., Poschlod P., Prach K., Praleskouskaya S., Prokhorov V., Provoost S., Puşcaş M., Pustková Š., Randin C. F., Rašomavičius V., Reczyńska K., Rédei T., Řehounková K., Richner N., Risch A. C., Rixen C., Rosbakh S., Roscher C., Rosenthal G., Rossi G., Rötzer H., Roux C., Rumpf S. B., Ruprecht E., Rūsiņa S., Sanz-Zubizarreta I., Schindler M., Schmidt W., Schories D., Schrautzer J., Schubert H., Schuetz M., Schwabe A., Schwaiger H., Schwartze P., Šebesta J., Seiler H., Šilc U., Silva V., Šmilauer P., Šmilauerová M., Sperle T., Stachurska-Swakoń A., Stanik N., Stanisci A., Steffen K., Storm C., Stroh H. G., Sugorkina N., Świerkosz K., Świerszcz S., Szymura M., Teleki B., Thébaud G., Theurillat J.-P., Tichý L., Treier U. A., Turtureanu P. D., Ujházy K., Ujházyová M., Ursu T. M., Uziębło A. K., Valkó O., Van Calster H., Van Meerbeek K., Vandevoorde B., Vandvik V., Varricchione M., Vassilev K., Villar L., Virtanen R., Vittoz P., Voigt W., von Hessberg A., von Oheimb G., Wagner E., Walther G.-R., Wellstein C., Wesche K., Wilhelm M., Willner W., Wipf S., Wittig B., Wohlgemuth T., Woodcock B. A., Wulf M. & Essl F. (2024) ReSurvey-Europe: a database of resurveyed vegetation plots in Europe. – Journal of Vegetation Science 35: e13235.

Meiners S. J., Pickett S. T. A. & Cadenasso M. L. (2015) An integrative approach to successional dynamics: tempo and mode of vegetation change. – Cambridge University Press, Cambridge.

Neuhäuslová Z., Blažková D., Grulich V., Husová M., Chytrý M., Jeník J., Jirásek J., Kolbek J., Kropáč Z., Ložek V., Moravec J., Prach K., Rybníček K., Rybníčková E. & Sádlo J. (1998) Mapa potenciální přirozené

vegetace České republiky. Textová část [Map of potential natural vegetation of the Czech Republic. Explanatory text]. – Academia, Praha.
Osbornová J. M., Kovářová J., Lepš J. & Prach K. (eds) (1990) Succession in abandoned fields: studies in central Bohemia, Czechoslovakia. – Kluwer, Dordrecht.
Otto R., Krüsi B. O., Burga C. A. & Fernández-Palacios J. M. (2006) Old-field succession along a precipitation gradient in the semi-arid coastal region of Tenerife. – Journal of Arid Environments 65: 156–178.
Pickett S. T. A. (1989) Space-for-time substitution as an alternative to long-term studies. – In: Likens G. E. (ed.), Long-term studies in ecology: approaches and alternatives, p. 110–135, Springer, New York.
Prach K. (1985) Succession of vegetation in abandoned fields in Finland. – Annales Botanici Fennici 22: 307–314.
Prach K., Lepš J. & Rejmánek M. (2007) Old field succession in Central Europe: local and regional patterns. – In: Cramer V. A. & Hobbs R. J. (eds), Old fields: dynamics and restoration of abandoned farmland, p. 180–201, Island Press, Washington.
Prach K. & Řehounková K. (2006) Vegetation succession over broad geographical scales: which factors determine the patterns? – Preslia 78: 469–480.
Prach K., Řehounková K., Lencová K., Jírová A., Konvalinková P., Mudrák O., Študent V., Vaněček Z., Tichý L., Petřík P., Šmilauer P. & Pyšek P. (2014) Vegetation succession in restoration of disturbed sites in Central Europe: the direction of succession and species richness across 19 seres. – Applied Vegetation Science 17: 193–200.
Prach K., Tichý L., Lencová K., Adámek M., Koutecký T., Sádlo J., Bartošová A., Novák J., Kovář P., Jírová A., Šmilauer P. & Řehounková K. (2016) Does succession run towards potential natural vegetation? An analysis across seres. – Journal of Vegetation Science 27: 515–523.
Prach K. & Walker L. R. (2020) Comparative plant succession among terrestrial biomes of the world. – Cambridge University Press, Cambridge.
Pyšek P., Sádlo J., Chrtek J. Jr., Chytrý M., Kaplan Z., Pergl J., Pokorná A., Axmanová I., Čuda J., Doležal J., Dřevojan P., Hejda M., Kočár P., Kortz A., Lososová Z., Lustyk P., Skálová H., Štajerová K., Večeřa M., Vítková M., Wild J. & Danihelka J. (2022) Catalogue of alien plants of the Czech Republic (3rd edition): species richness, status, distributions, habitats, regional invasion levels, introduction pathways and impacts. – Preslia 94: 447–577.
R Core Team (2026) R: a language and environment for statistical computing. – R Foundation for Statistical Computing, Vienna.
Rambousková H. (1990) Abandoned fields in the landscape. – In: Osbornová J. M., Kovářová J., Lepš J. & Prach K. (eds), Succession in abandoned fields: studies in central Bohemia, Czechoslovakia, p. 149–150, Kluwer, Dordrecht.
Řehounková K., Tichý L. & Prach K. (2024) Succession in abandoned fields: chronosequence data verified by monitoring of semi-permanent plots. – Journal of Vegetation Science 35: e13303.
Rejmánek M. (1989) Invasibility of plant communities. – In: Drake J. A., Mooney H. A., di Castri F., Groves R. H., Kruger F. J., Rejmánek M. & Williamson M. (eds), Biological invasions: a global perspective, p. 369–388, John Wiley & Sons, Chichester.
Rejmánek M. & van Katwyk K. P. (2004) Old field succession: a bibliographic review 1901–1991. – URL: http://botanika.bf.jcu.cz/suspa/pdf/BiblioOF.pdf.
Ruprecht E., Bartha S., Botta-Dukát Z. & Szabó A. (2007) Assembly rules during old-field succession in two contrasting environments. – Community Ecology 8: 31–40.
Szabó R. & Prach K. (2009) Old-field succession related to soil nitrogen and moisture, and the importance of plant species traits. – Community Ecology 10: 65–73.
ter Braak C. J. F. & Šmilauer P. (2012) Canoco reference manual and user's guide: software for ordination version, 5.0. – Microcomputer Power, Ithaca.
Tolasz R., Míková T., Valeriánová A. & Voženílek V. (eds) (2007) Atlas podnebí Česka [Climate atlas of Czechia]. – Český hydrometeorologický ústav, Praha & Univerzita Palackého, Olomouc.
Verburg P. H. & Overmars K. P. (2009) Combining top-down and bottom-up dynamics in land use modeling: exploring the future of abandoned farmlands in Europe with the Dyna-CLUE model. – Landscape Ecology 24: 1167–1181.
Walker L. R., Walker J. & Hobbs R. J. (eds) (2007) Linking restoration and ecological succession. – Springer, New York.
Walker L. R., Wardle D. A., Bardgett R. D. & Clarkson B. D. (2010) The use of chronosequences in studies of ecological succession and soil development. – Journal of Ecology 98: 725–736.
Wright J. P. & Fridley J. D. (2010) Biogeographic synthesis of secondary succession rates in eastern North America. – Journal of Biogeography 37: 1584–1596.

Sukcese vegetace na opuštěných polích v Českém krasu – opakované analýzy po téměř půl století

Opuštěná pole různého sukcesního stáří (1–100 let) byla opakovaně snímkována v průběhu několika dekád v Chráněné krajinné oblasti Český kras. Byl prokázán postupný posun sukcesních stádií k referenční, tj. přirozené vegetaci v dané oblasti, reprezentované teplomilnými doubravami (sv. *Quercion pubescenti-petraeae*) nebo mezofilními dubovo-habrovými lesy (sv. *Carpinion betuli*). Během desetiletí byly nejzřetelnějšími, zároveň však očekávanými trendy nárůst pokryvnosti a počtu dřevin a úbytek travních druhů, stejně jako pokles počtu synantropních druhů. Počet a pokryvnost nepůvodních druhů během sukcese klesaly. Druhová rozmanitost během sukcese sice klesala, ale lze očekávat opětovný nárůst při předpokládané pokračující obnově potenciální přirozené vegetace. Ukázalo se, že kombinace chronosekvenčního přístupu a opakovaných analýz trvalých ploch je ideální pro postižení dlouhodobých sukcesních změn. Pro praktickou ochranu přírody doporučujeme, aby většina opuštěných polí byla ponechána spontánní sukcesi a jen tam, kde se uchytily význačné stepní druhy, byly dřeviny potlačovány částečným vykácením, nebo bylo jejich uchycení a šíření blokováno sečí nebo pastvou.

How to cite: Prach K., Vítovcová K., Klaudisová A., Lepší A. & Prach J. (2026) Vegetation succession in abandoned fields in the Bohemian Karst: repeated sampling over nearly half a century. – Preslia 98: 265–280.

Preslia, a journal of the Czech Botanical Society
© Česká botanická společnost / Czech Botanical Society, Praha 2026
https://www.preslia.cz

This is an open access article published under a CC BY license, which permits use, distribution and reproduction in any medium, provided the original work is properly cited (Creative Commons Attribution 4.0 International License, https://creativecommons.org/licenses/by/4.0).