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Assessing the future of *Pulsatilla grandis* in the Czech Republic: long-term population trends, site conditions and management

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Abstract: *Pulsatilla grandis* is a symbolic species of dry grassland ecosystems and indicates the importance of diverse management strategies for its conservation and protection of the associated biodiversity. Despite being classified as of Least Concern on the IUCN Red List, there has been a significant decline in its native dry grassland habitats due to habitat degradation, abandonment and eutrophication. This study investigates the population dynamics and conservation status of this threatened vascular plant, focusing on data for flowering individuals, threats and site characteristics collected over 19 years from 420 Czech populations. Employing two imputation models to address missing data, this study reveals a considerable decrease in flowering plants, with 17–20% of populations experiencing complete loss of flowering individuals within the period monitored. The total loss of flowering individuals in the Czech Republic is estimated to be between 23 and 46%. Although management efforts have doubled, factors limiting species survival, like litter accumulation and dispersal and spread of invasive species, continues to have a serious effect on habitat quality. This study underscores the need for ongoing and increasing efforts in conservation and habitat management in order to prevent further decline of this and other related dry grassland species in the Czech flora.

Keywords: conservation status, endangered species, Natura 2000, population dynamics, long-term monitoring, biodiversity, dry grasslands, habitat management

Introduction

The continuous decline in natural and seminatural habitats in the Czech Republic has had a significantly negative effect on biodiversity. According to Danihelka (2013), 49% of all taxa in the Czech flora are classified as threatened. This decline, particularly pronounced in the last several decades, has placed numerous species at risk and highlighted the urgent need for conservation. Among the most affected ecosystems are dry grasslands, which have long been celebrated for their biodiversity and ecological significance (Chytrý et al. 2015). The typical forest-steppe landscape in the Czech Republic, developed over centuries, faces a significant threat of degradation due to natural succession following abandonment and eutrophication (Chytrý et al. 2019). One of the threatened yet widespread characteristic species typical of these habitats is *Pulsatilla grandis*.

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This species is designated one of the 25 priority plant species within the Czech flora listed in Annex II of the Habitats Directive (92/43/EEC), which assigns it a crucial conservation status at the European level and emphasizes its role in the national biodiversity conservation strategy (Czech Act No. 114/1992 Coll., on Nature and Landscape Protection, as amended). Despite its widespread occurrence, *P. grandis* is declining in abundance, making it a typical national Red-List species (Grulich 2012). It is recognized as a key "target species" (Ozinga & Schaminée 2005), which underscores the critical need for habitat protection.

Pulsatilla grandis primarily inhabits the Pannonian Basin in Europe, with the densest populations in northern Hungary (Bartha et al. 2019), southern Slovakia (Bertová & Futák 1982), eastern Austria (Sauberer & Panrok 2015) and south-eastern Czech Republic (Chytrý et al. 2021). Although classified as a threatened species in several national Red Lists, it is assessed as of Least Concern (LC) in the IUCN Red List of Threatened Species. This classification indicates it is of low risk of extinction in the foreseeable future (Dostálová & Király 2011).

The typical habitat of *P. grandis* primarily consists of dry grassland pastures, occasionally grazed by domestic animals. These pastures are found on various types of bedrock, with soil pH values between 4.3 and 7.6 (Wells 1968). Within the Czech Republic, most of these habitats are located on neutral, or slightly acidic bedrock. Limestone areas host a smaller percentage (~7%) of these populations, and occurrences on serpentinite bedrock are rare (Rybka et al. 2005). Usually, *P. grandis* occurs in species-rich vegetation, averaging about 39.1 species per 25 m^2, according to the Czech National Phytosociological Database (Chytrý & Rafajová 2003).

Pulsatilla grandis is a perennial, hemicryptophytic (Kaplan et al. 2019), non-clonal (Klimešová et al. 2017) plant. One young individual usually has a simple rhizome, which can later produce groups of leaf rosettes from lateral buds. In the oldest plants, the roots and parts of the rhizome may eventually decay, and the new plants continue growing independently (Wells & Barling 1971). The species follows an early-spring flowering strategy, with its flowers typically appearing from March to May, depending on regional and local environmental conditions (Skalický 1990). A small part of the population may also occasionally flower in late summer after a period of drought. The species relies primarily on cross-pollination (entomogamy), which increases its dependence on pollinator activity for successful reproduction (Strzałkowska-Abramek et al. 2016). The maximum age of the individuals is unknown. However, studies indicate that large individuals of closely related *P. vulgaris* species can easily reach 20 years (Wells & Barling 1971), while individuals in populations on Gottland Island that survive the first 10 years may live between 27.1–49.6 years (Edelfeldt et al. 2019). Preliminary observations on Czech populations indicate similar longevities (L. Tichý & P. Slavík, unpublished data).

To ensure pollination in the variable weather in spring, *P. grandis* has several strategies. It produces a large amount of pollen (Strzałkowska-Abramek et al. 2016) and closes its flowers in response to wet or rainy weather (Sauberer & Panrok 2015). In addition, the anthers in its flowers open during the warmest parts of the day in sunny conditions. During this time, the inner space inside the flower can be up to 9 °C warmer than the surrounding air (Zimmermann 1963). A diverse range of non-specific insect pollinators is attracted to the flowers, drawn by both nectar and pollen, which provide the essential source of saccharides and proteins in spring (Mészáros & Józan 2018). The fertility has not been measured for this species, but closely related *P. vulgaris* produce, on average, 46 achenes per flower, with high germination rates, immediately after the maturation of the fruit (Wells & Barling 1971). Plants in low-populated and declining populations may exhibit reduced reproductive fitness (Hensen et al. 2005).

Pulsatilla grandis stands out for its conservation significance and aesthetic appeal as an ornamental species pivotal for protecting dry grassland habitats. This role highlights the habitat quality necessary for the survival of various endangered species in the Czech flora. Despite its widespread presence, there is a concerning declining trend in its abundance (Klinkovská et al. 2024). Recognized for its ecological importance, *P. grandis* has been under systematic surveillance by the Czech Nature Conservation Agency since 2005 as part of its commitment to the Natura 2000 network.

This paper aims to identify the main trends based on 19-years of field observations at 420 sites with at least the occasional presence of *P. grandis*. This extensive dataset offers novel insights into the current state, threats and possible prospects for this endangered species.

Methods

Study area and populations

In the Czech Republic, native populations of *P. grandis* occupy lowlands and hilly areas in the southern and eastern Moravian region up to elevations between 450–500 m. This species is notably concentrated in specific areas, particularly in hilly landscapes characterized by less intensive agriculture and remnants of former rural pastures, and also in areas with a high population density. Ten percent of the population occurs directly in the currently urbanized landscape area in the city of Brno and its surroundings that has a changing environment and flora (Lososová et al. 2024). Even the most populous site, hosting ~65,000 flowering individuals, is located directly within Brno on a 10-hectare area of former pastures in the Kamenný vrch nature reserve. Only three other populations recorded have at least 10,000 flowering plants, and the other 34 populations have more than 1,000 flowering plants. Artificial populations in the area of this species distribution were not considered.

Field sampling

In this study, a team of 86 professional field botanists, organized by the Nature Conservation Agency of the Czech Republic, searched for populations. The known populations were regularly monitored from 2005 within the national monitoring program of European priority plant species. Due to the team's limitations in terms of covering all sites annually, some populations were monitored every 2–5 years. During the survey, ~20% of the populations were recorded at previously unknown sites. In total, we compiled a unique dataset of 2,397 observations and counted in total 855,279 flowering individuals. Visits were timed to occur during the flowering or fruiting seasons (April–May) when all adult plants are easily visible. Generally, only flowering plants were counted at all the sites visited. Data on the number of sterile rosettes were not considered because they were not systematically recorded. In areas with a high density of individuals, distinguishing between young plants with a single flower and older plants with a divided rhizome supporting multiple flowers was challenging. In such cases, a consistent artificial method was used to estimate a "flowering individual", defined as a set of flowering stems in an area of ~100 cm^2. In populations with mainly less than 1,000 individuals, the percentage of small (1–2 flowers) and large plants (more than 2 flowers) was recorded. The percentage of large plants was used as a measure of reproductive potential. Field experts estimated several key parameters of the populations studied. Population fertility was estimated in three ways for flowering and fruiting populations and subjectively included the ratio between flowering and sterile adult plants, as well as the level of disturbance to the flowers caused by people, animals, or unfavourable conditions at the site. Management was recorded based on whether any active conservation or maintenance practices were evident or known. The quantitative percentage of alien invasive (Pyšek et al. 2022) and native expansive (Hejda et al. 2021, Axmanová et al. 2024) species was estimated by visually determining the percentage of area covered by these species within the sites studied. The approximate litter accumulation was measured by estimating the percentage of the ground surface covered by plant litter.

Analyses

In total, 70.0% of the entries in the data set were missing, posing a significant challenge for subsequent analyses. Field experts recorded only 2,397 of 7,980 expected flowering plant entries. Other population characteristics were also sparsely recorded: population fertility was noted 2,056 times, management 2,446 times, invasive and expanding species 2,206 times and litter accumulation 2,240 times. Two approaches were used to complete the matrix with expected values in order to maintain the integrity of the dataset:

(i) Nearest-Neighbour Inference ("optimistic scenario"). Here, missing values were replaced by the nearest value recorded for the same site. This method assumes that, due to the perennial nature of the species, temporally close observations at the same site are likely to be correlated. For example, if a flowering count is missing for a particular year, it was substituted by the nearest available count from adjacent years at the same site. If the missing value occurred halfway between two known values, the inferred value was calculated as the average of these two records. This method is referred to as the 'optimistic scenario', because it assumes that conditions remain relatively stable over time. However, this method may be less accurate at the start and end of the time series, because it tends to assume few changes if a trend or ecological shift is present in the data (Eskelson et al. 2009).

(ii) Inference with generalized additive models ("pessimistic scenario"). For the second approach, generalized additive models (GAMs) were used to estimate missing values by modelling trends in the data. GAMs allow non-linear relationships between the predictor variables (e.g. time) and the response (e.g. counts of flowering individuals), by providing a more flexible model of ecological dynamics. The GAMs were fitted independently for each site, with a focus on sites that had sufficient data (329 populations). For these populations, a GAM was used to model the flowering trends and missing values were predicted based on these trends. The smoothing of the trend in GAMs allows for a flexible, non-parametric estimation, which can incorporate more complex temporal changes in flowering dynamics. For the remaining 91 populations, where data were too

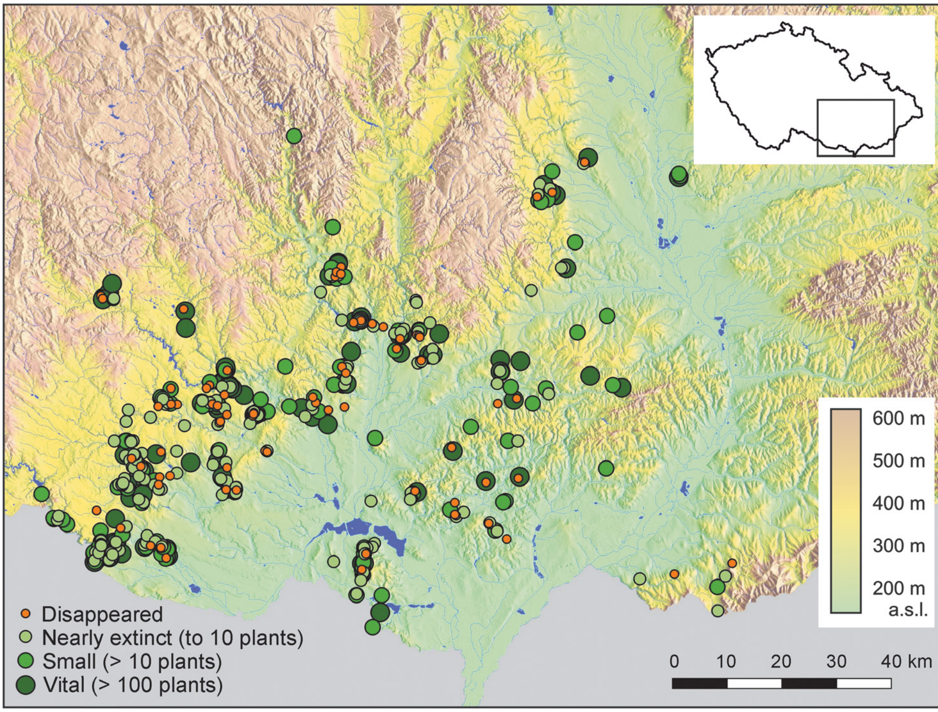

Fig. 1. Map showing the spatial distribution of the 420 populations *Pulsatilla grandis* within its native distribution that were monitored in the Czech Republic and their last known number of flowering individuals within the native distribution area.

sparse to fit a reliable GAM model, a simple linear model or constant value in the case of one observation was used. Only predicted positive values were considered, ensuring that unrealistic negative predictions were replaced by zeros. This method is referred to as the pessimistic scenario, as it accounts for potential shifts or trends based on a small number of records, which could cause significant changes in the pattern in the data, especially at the start or end of the monitoring interval. To quantify uncertainty in these inferred values, the standard errors associated with the predictions were calculated for individual models for each site (GAM or linear). These standard errors were pooled for all sites in order to estimate the total number of flowering individuals per year, along with 95% confidence intervals for these estimates.

All analyses were done using the R programming environment (R Core Team 2024). Taxonomy and nomenclature of plants follow Kaplan et al. (2019).

Results

Throughout this 19-year study, spanning from 2005 to 2023, a total of 420 populations of *Pulsatilla grandis* were monitored in the southern-, eastern- and central-Moravian regions in the Czech Republic (Fig. 1A). Prior to 2023, flowering plants were not recorded in 73 (17.3%) populations, and a decline in flowering plants was recorded at

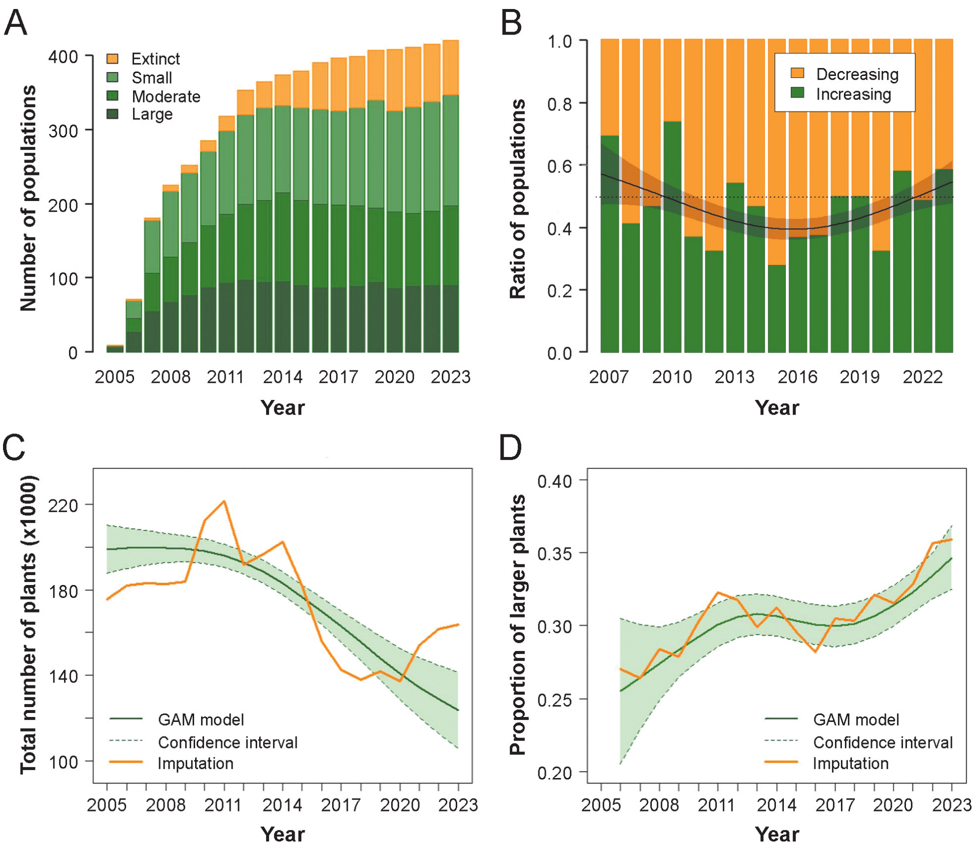

Fig. 2. Dynamics and characteristics of populations of *Pulsatilla grandis*, derived from field counts of flowering individuals. (A) In total, 420 distinct populations were categorized by the number of flowering plants present: large = populations with over 100 flowering plants, moderate = 11 to 100 plants; small = 1 to 10 plants; and extinct = sites where flowering plants were not recorded at the last observation (see Fig. 1). During the period monitored, no flowering plants were recorded at 73 (17.3%) sites. (B) Relative ratio between recorded populations with increasing and decreasing numbers of flowering individuals at the last record. Data from the first two years of the monitoring period were merged. The generalized additive model evaluates the trend with confidence intervals applied to binomial data, including absolute frequencies of increasing and decreasing populations. Two techniques, Nearest-Neighbour prediction (optimistic scenario) and prediction based on generalized additive models (pessimistic scenario), were used to model the total number of flowering plants in the Czech Republic between 2005 and 2023 (C) and plant reproductive potential (D). Reproductive potential is defined here as the average percentage of large plants (those with more than two flowers per plant) in all the populations. The reproductive potential was recorded for populations with ~1,000 flowering individuals.

further 83 sites (19.7%). The data also revealed that in 2023, 150 (35.7%) populations consisted of fewer than 10 flowering individuals (Fig. 2A). An analysis of the population trends between 2006 and 2023 revealed that the number of populations experiencing a decrease in the number of flowering plants significantly exceeded those that increased (Fig. 2B).

The optimistic scenario model indicated that the total number of flowering plants reached a maximum of 212,291 in 2010 and a minimum of 137,095 in 2020 (64.6% of the

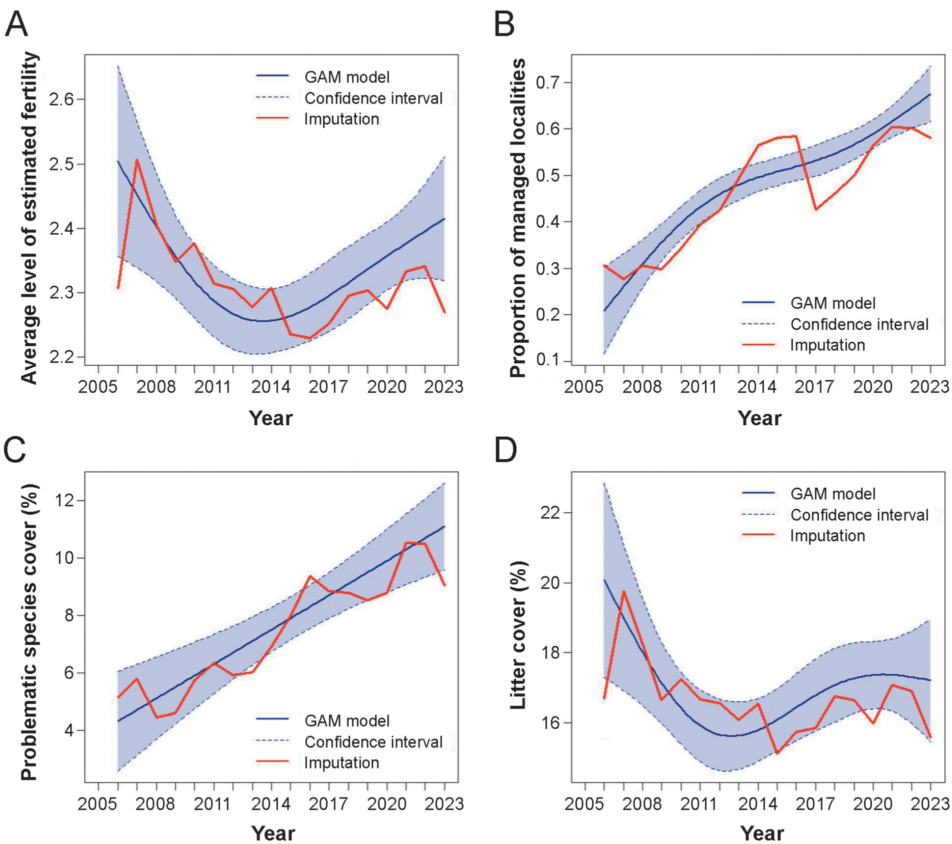

Fig. 3. Additional population and environment characteristics recorded at the sites with populations of *Pulsatilla grandis*. Population fertility (A) was categorized as: poor, insufficient, and good. Management (B) was recorded as present/absent. The cover of invasive and expanding species (C), as well as litter accumulation (D), were estimated using four categories (0%, 0–10%, 10–50%, and 50–100%). The midpoint of each interval was used for modelling purposes. The same two predictions of the models as in Fig. 2C and 2D were used to estimate missing data and trends for these characteristics.

maximum value). However, in 2023, the model predicted the occurrence of 163,864 flowering plants (77.2% of the maximum). The pessimistic scenario model forecasted a maximum of 193,179 flowering plants in 2010 and a minimum of 105,543 plants in 2023 (54.4%; Fig. 2C). Both models indicated a slowing in the decline in the total population and an increase in reproductive potential in recent years (Fig. 2D).

Empirical data collected by field experts indicated a temporal decrease in population fertility (Fig. 3A), in spite of increases in management, which was highest in 2010 and 2015 (Fig. 3B). In addition, a continuous upward trend in the percentage of invasive or expanding plant species was recorded (Fig. 3C). In contrast, litter accumulation declined (Fig. 3D). Field experts also identified litter accumulation as the most frequent problem for population survival (Table 1). Despite these concerns, traditional management, such as mowing and grazing, was frequently cited as not being the solution.

Table 1. The most frequent environmental problems affecting *Pulsatilla grandis* populations recorded by field experts. Activities recorded less than 20 times were omitted.

Activity	Frequency
Accumulation of organic material (litter)	643
Mowing	420
Damage by wildlife grazing	288
Competition among plants	209
Abandonment of grazing	136
Trampling, overuse	112
Grazing	74
Eutrophication	34
Invasion of neophytes	26

Discussion

This joint investigation by several tens of professional botanists organized by the Nature Conservation Agency of the Czech Republic assembled one of the broadest datasets of the population dynamics of a single vascular species of plant, both in terms of the number of populations monitored (420) and the duration of the study (19 years). However, a notable challenge for the data analysis was the incompleteness of the dataset. Around 70% of the data points (site vs year) were missing and approximation methods were used to fill these gaps. Although such methods are used with even much higher levels of missing data (Joswig et al. 2023), the high percentage of missing information introduces uncertainties in the analysis, potentially affecting the precision of the estimations of the trends. To address this, two independent methods were used: the Nearest-Neighbour prediction and generalized additive models, the results of which were compared in order to validate the conclusions. To ensure the robustness of the findings in the initial years 2005 and 2006, with the limited number of observations, a sensitivity analysis was done in which these two years were not included and the data extrapolated in order to obtain a worst-case scenario. The results of this analysis fell within the confidence intervals of the original model, indicating that the inclusion of predicted values does not significantly affect the conclusions.

This analysis has identified important trends, including the alarming fact that at 17–20% of the sites monitored no flowering individuals were recorded during the rather short period of 19 years (Fig. 3A). Furthermore, the findings indicate that this species decline is highly significant. The value of the peak in the decline of flowering plants across all sites reached an estimated 23–46% (Fig. 3C). These observations partly contrast with the categorization of *Pulsatilla grandis* in the 3rd edition of the Red List of Vascular Plants of the Czech Republic (Grulich 2012), where it is classified as C2b – endangered. This category includes rare species with occurrences at 6–20 localities and declining. However, this categorization may not fully reflect the status and distribution patterns recorded in this study, which indicates both historically high population density and more pronounced decline. It is estimated that at least 50–90% of all historically recorded populations are now extinct. It corresponds more closely to the category C2t (sensu Grulich 2012), which is for species at risk, with prevailing small, rapidly declining populations. Formerly, many populations of this species were much more populated or even disappeared before the year 2000, as indicated by the distribution data in the Pladias database

(Chytrý et al. 2021) and early records of Czech Agency of Nature Conservation. Currently, there are only six populations with more than 5,000 flowering individuals.

Pulsatilla grandis is considered Vulnerable (VU) by the national IUCN categorization (Grulich 2012, 2017), which is optimistic. As this species is long-lived, with the lifespan of at least some individuals of 20–30 years, the total loss needs to be estimated over at least 60–90 years, i.e. the length of three generations, which is what is recommended by the IUCN. Considering the recorded rate of decline, this species must be categorized as Endangered (EN), because there has been between 43 and 57% reduction in the number of populations and a much larger percentage reduction in number of flowering plants. This species occurs at sites where the reduction in the population is not easily reversible because of their physical destruction, abandonment, or continuous degradation of the vegetation (Klinkovská et al. 2024), and restoration of these habitats often leads only to the dominance of generalist species (Prach et al. 2014). A simple extrapolation of population loss over the next 60–90 years indicates that only 5% of the currently flowering individuals will survive. These criteria would formally categorize this species as Critically Endangered (CR). However, the results of the studies over the last few years are slightly more optimistic. The ratio of the declining and growing populations tends to be more equal (Fig. 2B), the reproduction potential and fertility of plants has increased slightly (Figs 2D and 3A), and the number of native populations is still rather high (347).

The small size of the remaining populations is another factor limiting the future survival of this species as 74% of the populations have less than 100 flowering individuals (Fig. 2A). While *P. grandis* is presumed to be primarily fertilized by insects (Wells & Barling 1971, Strzałkowska-Abramek et al. 2016), small populations may be at risk of inbreeding depression. Fragmentation and habitat destruction result in declines in genetic diversity in small populations of *Pulsatilla* species, even when some level of genetic exchange exists (Hensen et al. 2005). Fitness-related characteristics, such as seed production and seed quality, are also associated with population size and genetic diversity, with small populations being less resilient to environmental changes. This could pose a significant challenge for the regeneration of these populations, even if environmental conditions improve. Nevertheless, intensive field sampling of *P. grandis* populations has had a positive effect, indirectly but significantly enhancing their habitat management. At the start of the monitoring, managed sites constituted only a third of the monitored sites. Currently, this proportion is nearly two-thirds (Fig. 4B). Regular management is also the reason for lower availability of nutrients (Merunková & Chytrý 2012), which probably accounts for the decrease in fertility of the populations (Fig. 3A). However, from a long-term perspective, this negative effect can be often mitigated, or even reversed, by the recorded decrease in litter accumulation (Fig. 3D). Litter acts as a protective layer that enhances soil moisture and nutrient availability (Mariotte et al. 2020). It plays an important role in supporting flowering and generative reproduction (Fujita et al. 2014), which may temporarily benefit from high available phosphorus levels in the soil. However, the continuous presence of litter can significantly restrict generative reproduction by creating a physical barrier (Galvánek & Lepš 2012).

Although the reason is unknown, phosphorus availability may have different roles on different types of bedrock, where this species frequently occurs. It is well-known that the soils on limestone limit phosphate solubilization by many dry-grassland plants (Tyler 1992). In accordance with these findings, a difference in the phosphorus content in leaves collected from 20 plants from acidic (2.3 $g \cdot kg^{-1}$; pH = 5.5) and basic (2.0 $g \cdot kg^{-1}$; pH = 7.8) soils was recorded. This could account for the recorded steep decline in the flowering population and vitality of plants recorded at several limestone localities after the use of intensive regular mowing. In addition, it is in accordance with subjective field observations, where field botanists indicated not only the absence of management (litter accumulation and competition) but also that mowing and grazing had a visible negative effect on the population (Table 1).

However, using different management strategies, including grazing, mowing, and possibly, in the future also, controlled burning, is essential for species protection, which directly affects habitat quality and plant reproductive success. Grazing was reported at the sites of more than 60 populations (P. Slavík, pers. observ.). Other managed areas are mostly subject to at least partial regular mowing. Also, controlled burning is accepted as a promising management practice for dry grasslands (Valkó et al. 2014) and recently, it has been officially authorized for use in nature-protected areas. Despite its potential, it remains an under-utilized strategy in conservation. However, its significance as a management tool will probably increase.

Approximately 35% of the populations currently known, or ~12% of all individuals estimated using the optimistic scenario model for the year 2023 are unmanaged. These can be characterized as (i) size-limited grasslands on rocky outcrops, typically hosting a few adult plants rooted in rock crevices; (ii) neglected dry grasslands outside protected areas; and (iii) populations in open oak forests. Collectively, these habitats contain only a small percentage of the flowering plants in the Czech population.

The active management of biotopes does not only improve the survival of *P. grandis*. This plant, widely recognized and valued by the public, acts as an umbrella species, signalling the presence of various other important species that occur in dry grassland ecosystems. Examination of vegetation-plot data in the Czech National Vegetation Database (Chytrý & Rafajová 2003) has revealed a specific association of *P. grandis* with many other species typical of dry grasslands. Notably, species with a fidelity coefficient (Phi; Chytrý et al. 2002) above 0.2 indicating frequent co-occurrence in the same habitats with 26% of other Red-Listed species (Grulich 2012): *Achillea pannonica*, *Anthericum ramosum*, *Aster amellus*, *Carex humilis*, *Chamaecytisus ratisbonensis*, *Cytisus procumbens*, *Galatella linosyris*, *Galium glaucum*, *Inula ensifolia*, *Peucedanum cervaria*, *Potentilla incana*, *Scabiosa canescens*, *Seseli osseum*, *Thymus pannonicus*, *Thymus praecox*, and *Veronica spicata.* This association underscores the vital role of *Pulsatilla grandis* in indicating the high biodiversity in dry grassland ecosystems.

Among the most concerning outcomes of this research is the reported continuous, non-interrupted increase in the number and possible effect of invasive (Pyšek et al. 2022) and expanding species (Hejda et al. 2021, Axmanová et al. 2024). Even in managed areas, monitored sites are becoming progressively dominated by these generalist species, which pose a significant threat to existing populations.

Although *P. grandis* is not one of the most endangered species in the Czech flora, its protection is not only about conserving a single species but also about safeguarding the whole biodiversity of Pannonian dry grassland habitats. These grasslands support a variety of rare plants, insects and other organisms, many of which are adapted to the specific ecological conditions of these habitats. The conservation of *P. grandis* contributes to maintaining the overall ecological integrity of these ecosystems, which are increasingly threatened. The recorded decline in populations, coupled with the increasing effect of invasive and expanding species, emphasizes the importance of proper management of all the localities where this species occurs.

Conclusions

Nineteen-year monitoring of 420 populations of *Pulsatilla grandis* in the Czech Republic reveals a concerning decline, with plants not flowering at up to 20% of the sites and significant decreases in numbers of flowering plants in most of the monitored populations. The discrepancy between the IUCN status of this species and the results presented highlights the need for a re-evaluation and enhanced conservation efforts at national and regional levels. This study reveals the crucial role of habitat management in supporting this species survival and reproductive success. Despite the reported increase in managed sites, the persistent threat from invasive and expanding species and habitat degradation calls for diversified and effective management strategies. As an umbrella species, the decline of *P. grandis* signals broader ecological threats to the biodiversity in its typical habitats. Therefore, its conservation is integral to preserving the overall biodiversity mainly of dry grasslands. In summary, the findings support the necessity of continuous conservation, including habitat restoration, regular monitoring, and adaptive management practices. This approach is essential for the long-term survival of *P. grandis* in the majority of its current habitats.

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Hodnocení budoucího vývoje *Pulsatilla grandis* v České republice – dlouhodobé trendy populací, stav lokalit a jejich management

Naše rozsáhlá studie zahrnuje sledování 420 moravských populací *Pulsatilla grandis* po dobu devatenácti let. Do studie byly zahrnuty všechny současné populace nacházející se v rámci přirozeného areálu druhu v České republice. Dlouhodobý monitoring odhalil znepokojivý pokles počtu kvetoucích jedinců, jelikož až 20 % populací postupně za dobu pozorování přišlo o veškeré kvetoucí rostliny. Modely celkového úbytku počtu kvetoucích rostlin v České republice ukazují na ještě větší, tedy asi 23–46% pokles. Studie poukazuje na významnou roli managementu pro přežití a úspešnou reprodukci druhu. Přes zvýšení počtu udržovaných lokalit z původní asi jedné třetiny na dvojnásobek jsou stávající populace stále ohroženy šířením expanzivních a invazních druhů, degradací stanovišť a akumulací biomasy. Jako deštníkový druh signalizuje *Pulsatilla grandis* širší ekologické hrozby pro biodiverzitu suchých trávníků. Jeho ochrana je proto klíčová nejen pro záchranu samotného druhu, ale i z důvodu podpory a zachování celkové biodiverzity především suchých trávníků střední Evropy.

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