

# PODPORA PŘIROZENÝCH OPYLOVAČŮ V KULTURNÍ KRAJINĚ

## SUPPORT OF NATURAL POLLINATORS IN THE CULTURAL LANDSCAPE

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### Abstrakt

Na opylování zemědělských i planých rostlin se podílejí i samotářské včely. Cílem naší studie bylo zjistit potravní nabídku pro samotářské včely během vegetačního období na vybraných lokalitách. Soupis rostlinných druhů a pokryvnost kvetoucích bylin i sledování populace samotářských včel bylo provedeno v ovocných sadech a v okolní zemědělské krajině během vegetačního období v letech 2018–2022. Vyšší počet i pokryvnost kvetoucích druhů bylin byly zjištěny v květnatých pásích v sadech nebo na orné půdě. Všechny sledované aleje, meze, a květnaté pásy mohou být po odkvětu dřevin v sadech významným zdrojem potravy pro opylovače.

**Klíčová slova:** samotářské včely, rostliny, květnaté pásy, heterogenita krajiny

### Abstract

Pollination by natural pollinators is important for many agricultural and wild plants. Our study aimed to determine the food supply for solitary bees at selected localities during the vegetation period. The inventory of plant species and the cover of flowering herbs and solitary bee populations were carried out in orchards and agricultural landscapes during the growing season in 2018–2022. Higher cover of flowering herbs were found in the flower strips in orchards and arable land. All surveyed alleys, balks, and flowering strips appeared to be important food sources for pollinators.

**Keywords:** solitary bees, plants, flower strips, landscape heterogeneity

## INTRODUCTION

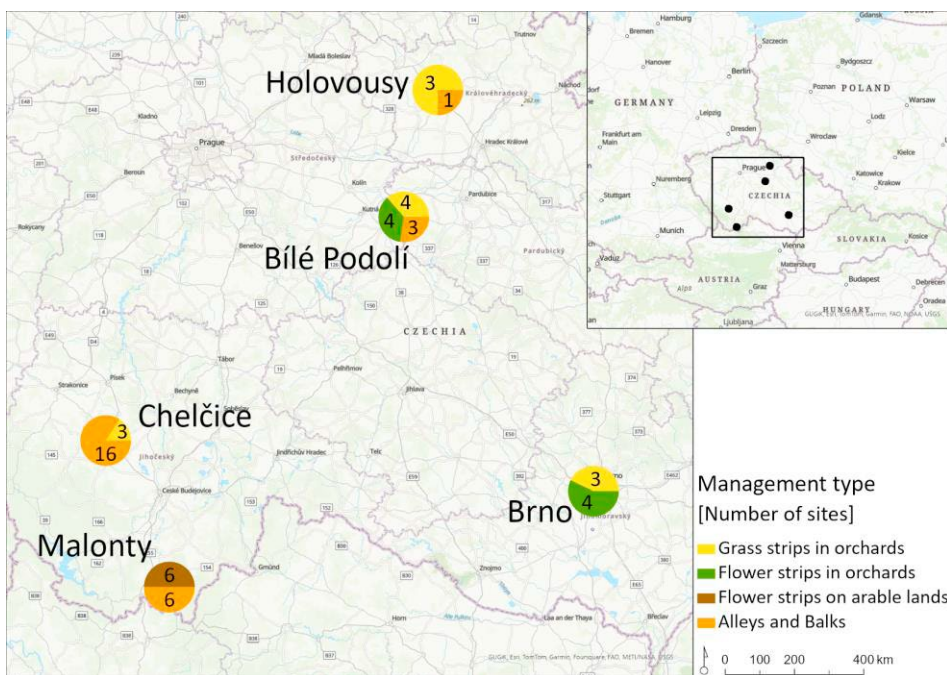
Landscape changes, especially agricultural intensification, lead to a loss of floral resources and thereby to a decline in natural pollinators and also bee species in the environment (Scheper *et al.*, 2015; Bukovinszky *et al.*, 2017). A benefit of some solitary bee species (e.g. *Osmia cornuta*) is the beginning of their activity at lower temperatures than honey bees (Eeraerts *et al.*, 2021). Food sources for pollinators have been monitored in sown flower

strips on arable land (Scheper *et al.*, 2015; Sydenham *et al.*, 2023; Holý *et al.*, 2015), in orchards (Eraerts *et al.*, 2021), and in field edges and alleys with semi-natural habitats (Bukovinszky *et al.*, 2017). A positive effect of a higher number of flowering plants on higher diversity and abundance of natural pollinators in landscapes with sufficient natural habitats (Burkle *et al.*, 2020; Eraerts *et al.*, 2021) or with the presence of sown flower strips (Sydenham *et al.*, 2023) has been observed.

The main objective of our study was to determine the food supply for solitary bees at selected localities during vegetation seasons 2018–2022.

## METHODS

Plant species diversity and in addition solitary bee populations were monitored at 27 sites with seeded grasses and flowering herbs and 26 sites included alleys and balks in the agricultural landscape during growing seasons in 2018–2022. Four localities as Brno, Malonty, Chelčice, Holovousy were observed in 2018–2020 and the locality Bílé Podolí in the year 2020 and 2022. All sites were followed throughout the whole monitoring period (Fig. 1). Our study sites contained apple, plum, apricot, and cherry orchards; sown flowering strips were created mainly by a mixture of annual, biennial, and perennial plants (e.g. Holý *et al.*, 2015), and alleys and balks wild plants, bushes, and trees. The plant species inventory was surveyed in spring (May, June) and summer (July, August) by a detailed survey of a 10 m wide strip connecting the first and the last trap for solitary bees in the series (Šlachta *et al.*, 2021). The cover of each herb species was recorded using the Braun-Blanquet scale in percentages. The nomenclature of plant names was modified according to Pladias.cz.



1: Four different types of management sites in the Czech Republic

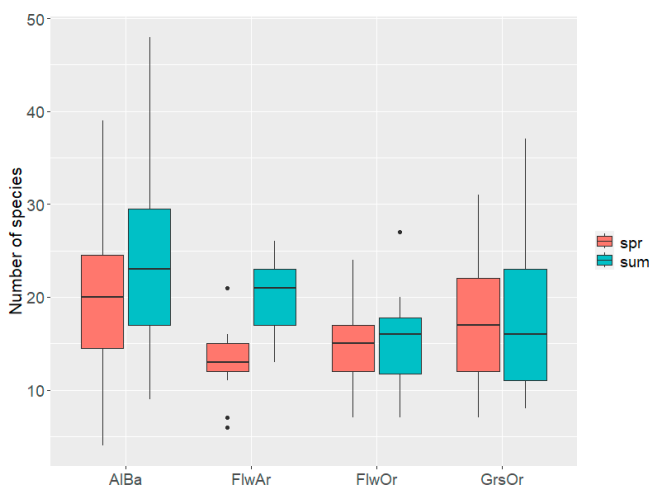
Differences in the number of plant species and number of flowering herbs, and their cover among the four management types, observed in spring and summer, were tested together by ANOVA and by a Tukey post-hoc test in the R program (R Core Team, 2022).

## RESULTS

Significant differences between sites and between sampling times were found for the total species number, the number of flowering species, and the cover of flowering herb species in all types of management. The significantly highest number of plant species was found in alleys and balks compared with other three different intensively managed sites ( $F = 8.415$ ,  $p < 0.001$ ; Fig. 2, Tab. I). However, the number of flowering herbs was the highest in flower strips in arable land and orchards, and lowest in alleys and balks ( $F = 3.678$ ,  $p = 0.013$ ), and a significant difference by post-hoc test was found only between flower strips in arable land and alleys and balks ( $t = 2.801$ ,  $p = 0.028$ ) (Fig. 3). The orchard flower strips had the highest coverage of flowering herb species ( $F = 34.184$ ,  $p < 0.001$ ; Fig. 4, Tab. I), followed by the flower strips in arable land. These sites had a significantly higher coverage calculated by post-hoc test of flowering herb species compared to the alleys and balks, which had the lowest flowering species cover ( $t = 2.773$ ,  $p = 0.03$ ).

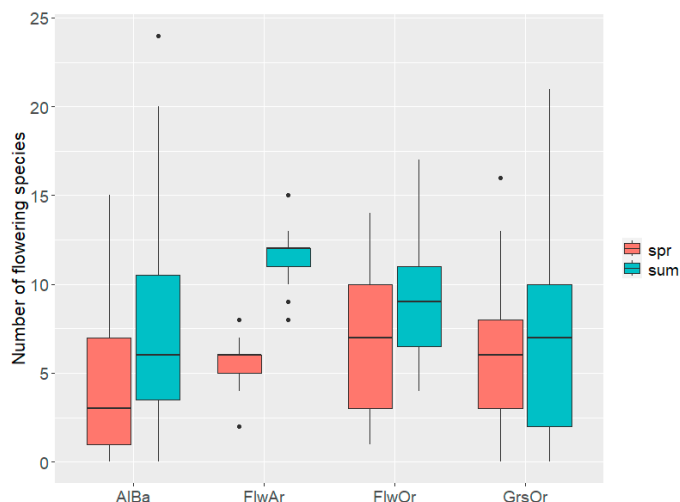
The main flowering herb species that served as a food source for solitary bees, were: *Achillea millefolium*, *Anthriscus sylvestris*, *Taraxacum* sect. *Taraxacum*, *Trifolium pratense*, *Trifolium hybridum*, *Vicia cracca*. Flowering herbs in the strips in orchards and arable land were *Daucus carota*, *Sinapsis alba*, *Lotus corniculatus*, *Malva sylvestris*, *Melilotus albus*, *Onobrychis viciifolia*, *Phacelia tanacetifolia*, *Securigera varia*, *Trifolium pratense*, *Trifolium repens*.

## DISCUSSION

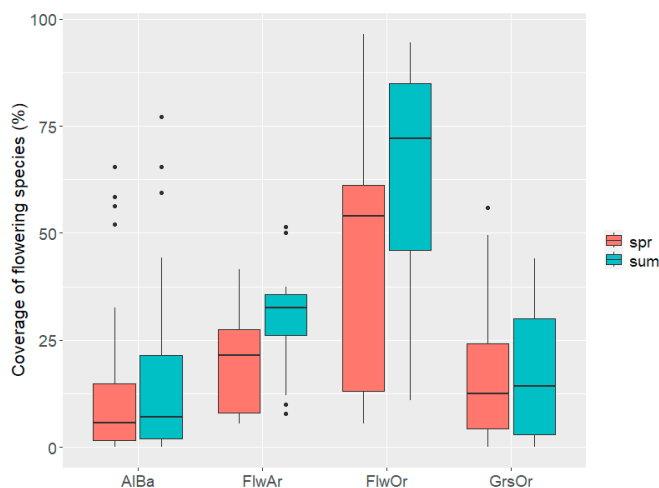


2: The total number of plant species found at the monitored sites in 2018–2022 in spring (spr) and summer (sum). Median, first and third quartile, minimum and maximum, and outliers are displayed in the boxplot.

Legend: AlBa – alleys and balks, FlwAr – flower strips on arable lands, FlwOr – flower strips in orchards, GrsOr – grass strips in orchards.



3: The total number of flowering herb species found at the monitored sites in 2018–2022 in spring (spr) and summer (sum). Legend: see Fig. 2.



4: The percentage of flowering herb species coverage found at monitored sites in 2018–2022 in spring (spr) and summer (sum). Legend: see Fig. 2.

We observed the highest diversity of plant species and relatively high coverage of flowering herbs in alleys and bulks in the landscape. Also, Eeraerts *et al.* (2021) recommended preserving floral resources for solitary bees after mass-flowering in orchards and Burkle *et al.* (2020) maintaining a higher proportion of semi-natural habitats in the landscapes. Sutter *et al.* (2017) identified *Achillea millefolium*, *Origanum vulgare*, and *Trifolium sp.* as important bee species. These species were presented in flower strips with high coverage at our sites, too. Additionally, according to Scheper *et al.* (2015), the sown flower strips effectively enhance the abundance of solitary bees in the landscape. On the other hand, for a sufficient increase in the wild bee population, agri-environment measures over the whole landscape were important (Bukovinszky *et al.*, 2017). A similar number of solitary

I: The average number of plant species, number and coverage of flowering herbs (%) in observed localities from 2018 to 2022. Legend: N.d. – no data.

Type of management	Locality	Spring			Summer		
		Plant species number	Flowering herbs number	Flowering herbs coverage	Plant species number	Flowering herbs number	Flowering herbs coverage
Grass strips in orchards	Chelčice	22	9	31.4	19	10	22.3
	Brno	13	5	10	11	2	1.83
	Holovousy	18	7	14.3	18	6	16.5
	Bílé Podolí	12	4	8.2	N.d.	N.d.	N.d.
Flower strips in orchards	Brno	18	10	59.9	27	5	11
	Bílé Podolí	12	4	34.5	17	9	63.1
Flower strips on arable lands	Malonty	14	6	19.9	20	12	30.2
Alleys and balks	Chelčice	19	5	11.3	22	6	7.3
	Holovousy	27	8	4.9	24	9	25.6
	Bílé Podolí	5	3	4.5	N.d.	N.d.	N.d.
	Malonty	22	5	19.2	28	14	36.5

bee species was found in our orchard sites as well as in the surrounding landscape, and the numbers of bee species varied more between individual localities (Šlachta *et al.*, 2021).

CONCLUSION

All surveyed alleys, balks, and flower strips in the agricultural landscape appeared to be an important food source for pollinators after the flowering of trees in orchards. Flowering strips with a suitable mix of plants on arable land or in orchards have been shown to be an effective measure to support and increase plant diversity in the agricultural landscape, thereby increasing the population of pollinators such as solitary bees.

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