

Data from Beekeepers and Maps for Beekeepers: A Decade of Monitoring Honey bee Colony Losses in the Czech Republic

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Abstract:

For over a decade, systematic monitoring of honey bee colony overwintering has been conducted in the Czech Republic as part of the international initiative of the COLOSS (Prevention of honey bee COLony LOSSes) association (Brodschneider et al., 2019). COLOSS unites more than 1,800 scientists, beekeepers, and experts from over 100 countries, aiming to improve honey bee health through research, sharing best practices, and long-term monitoring of colony losses (van der Zee et al., 2013). In the Czech Republic, this monitoring has been carried out since the winter of 2013/2014 using the standardized COLOSS questionnaire, collecting data on winter colony losses, disease occurrence and other factors.

In Czechia, all honey bee colonies and beekeepers are mandatorily registered. This situation is providing a unique foundation for data collection (Charrière and Neumann, 2010). The response rate to the survey has increased from 1% to 12% over the project's duration, demonstrating growing engagement within the beekeeping community. However, this increase also revealed significant challenges—variations in response rates between regions can affect loss rate calculations and introduce bias in multi-year comparisons. To address this issue, we have introduced a new parameter of representativity in our data analysis. This approach enables better evaluation of colony losses across different regions and improves the accuracy and reliability of results, particularly in areas with uneven response coverage.

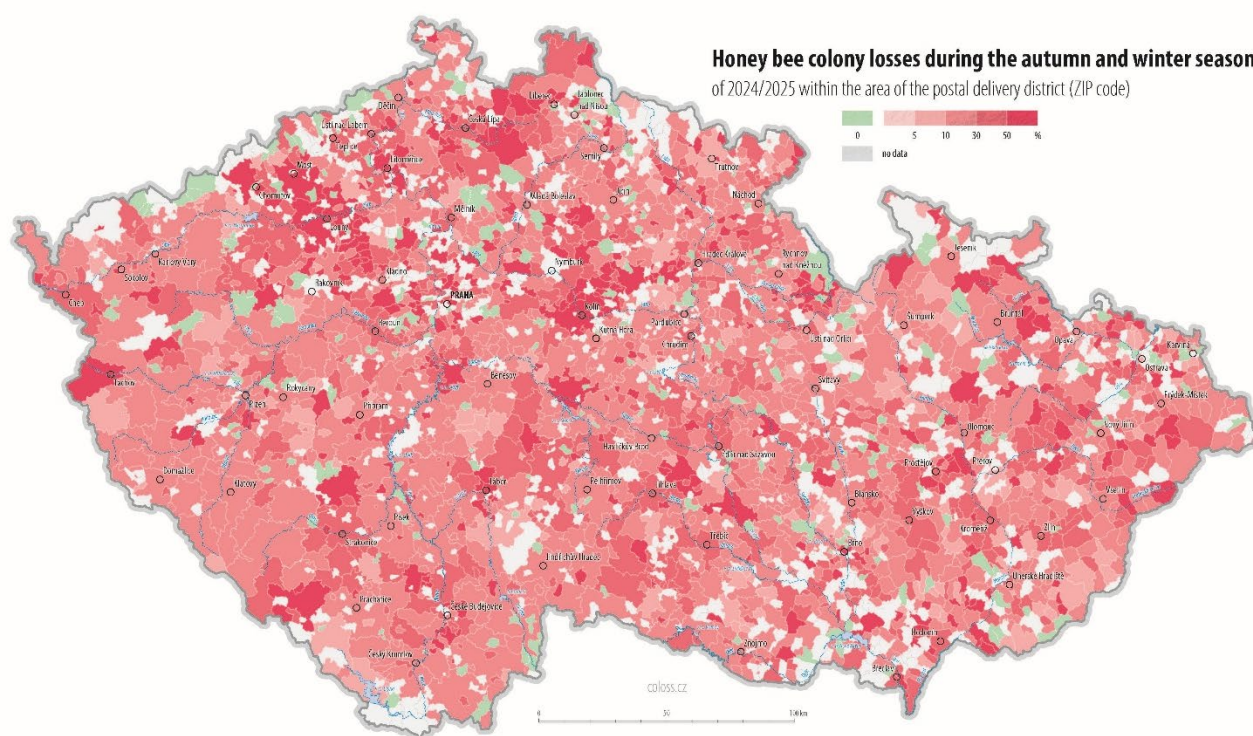
Monitoring has shown that years with relatively low losses alternate with years of higher losses, highlighting the variability in colony survival. The results indicate that beekeeping practices and weather conditions significantly influence colony losses in a given year. Specifically, an earlier onset of spring with warmer temperatures and milder winters have been identified as key factors impacting colony losses. Furthermore, spatial variations in *Varroa destructor* control strategies and their implementation have been shown to play a significant role in colony health across Europe (Brodschneider et al., 2023).

Monitoring results are presented through thematic maps that visualize not only the spatial distribution of colony losses but also key influencing factors such as climate impacts and disease occurrence. Although initially challenging for beekeepers to adopt, maps quickly became the preferred means of presenting results. They have allowed us to track trends in colony losses over the years, even in regions with varying data quality.

In terms of cartographic methodology, the spatial processing of survey responses is based on linking individual beekeeper data with their reported ZIP codes. These codes serve as spatial identifiers for aggregating responses and calculating metrics such as loss rates, treatment types, and response density. Using GIS tools (primarily ArcGIS Pro and QGIS), we create annual choropleth maps that visualize the spatial patterns of colony losses and their influencing factors, including climate change and density of colonies. The representativity parameter is included in the maps as an additional layer or metric, helping to assess the robustness of each region's data. In printed and static maps, this parameter is used for filtering biased data. We filter the data and display only those regions that meet a desired level of representativity, thus improving the comparability of loss rates across space and time. Moreover, interactive web maps and a web-based application were also developed. These tools allow users to explore colony loss data by region, view representativity values in pop-ups, and dynamically filter the displayed data based on chosen representativity thresholds.

This contribution aims to present the data collection methodology and analysis, highlight the importance of parameters such as representativity, and showcase key trends in Czech beekeeping over the past decade. Additionally, the role of citizen science is emphasized, as feedback and respondent motivation have ensured increasing beekeeper participation.

This initiative contributes to better-informed strategies for honey bee conservation and sustainable beekeeping management in the Czech Republic.



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