APIS

Practice report

Erasmus+ Supported Citizen Science on Bee-Relevant Flora: A Hungarian Field Study Informing Estonian Beekeeping

Chris Rosenfeld[1*], Mirell Lattik, Daniil Brant, Kai Lasn, Aime Jakobson, Keity Raudmäe, Aivo Sildnik, Ülle Talimaa, Riina Kirber, Jorma Õigus, Maarika Puusepp, Jaan Pitsi, Tiit Uhek, Silva Tamsalu, Kadi Tamsalu, Rasmus Paesüld, Gerli Õige, Marianne Rosenfeld[1]

[1] NGO Alustame Algusest (brand name: Mesilaspere Training Center), Jyri Alevik, Harjumaa, Estonia

*Corresponding author: chrisrosenfeld@hotmail.com

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ABSTRACT

This study presents a citizen science–based field survey of bee-relevant plant species conducted during a professional visit to the National Botanical Garden and Institute of Ecology and Botany. The aim was to document plant taxa of apicultural importance and to support cross-border knowledge transfer in beekeeping education between Hungary and Estonia within the framework of the Erasmus+ programme.

Beekeeping educators were divided into four working groups responsible for recording scientific (Latin), English, and Estonian plant names, photographic documentation, and key ecological and apicultural characteristics. The collected data were later integrated into a unified dataset. The recorded species were documented in a structured format, including multilingual nomenclature, resource type (nectar and/or pollen), and flowering periods in Estonia and Hungary.

The results highlight differences in flowering phenology between the two regions and demonstrate the value of collaborative, multilingual data collection in documenting bee forage plants. The approach supports applied learning and enhances the transferability of ecological knowledge across regions.

However, the study is limited by the botanical garden context, where curated plant collections may not represent typical regional flora. As a result, the observed species composition, flowering periods, and apicultural relevance may differ from those found in natural habitats. Further studies in more representative environments are recommended.

Overall, the study demonstrates the potential of citizen science and international collaboration in strengthening beekeeping education and improving the understanding of pollinator-supporting plant resources.

Keywords: citizen science, beekeeping education, bee forage plants, apicultural relevance, botanical garden survey, collaborative data collection, Erasmus+ programme, cross-border knowledge transfer, Estonia, Hungary

INTRODUCTION

Pollinator-supporting plant resources play a key role in sustainable beekeeping and ecosystem functioning. Understanding the availability and phenology of bee forage plants across different regions is particularly important in the context of environmental variability and changing climatic conditions.

This study applies a citizen science approach within an Erasmus+ framework to document bee-relevant flora and to support knowledge transfer between Hungary and Estonia. By combining field observations with multilingual plant identification, the study aims to contribute to applied beekeeping education and cross-regional ecological understanding.

MATERIALS AND METHODS

A group of beekeeping educators from Estonia participated in a professional field visit to the National Botanical Garden and Institute of Ecology and Botany (Hungarian: Nemzeti Botanikus Kert, Ökológiai Kutatóközpont), located in Vácrátót. The visit took place at the end of April, a period characterized by the active flowering of several early-season, bee-relevant plant species.

The guided tour was led by Mr. Gergely Lunk, head gardener and curator of the National Botanical Garden, who introduced plant species of particular importance for apiculture. The presentation focused on plant taxa observable during the late April phenological stage.

Participants were divided into four working groups, each assigned a specific data collection task:

- Group 1 recorded the Latin (scientific) names of the presented plant species and matched them with their Estonian equivalents.
- Group 2 documented the corresponding English names of the same plant species.
- Group 3 was responsible for photographic documentation, capturing visual records of the plants and their phenological state.
- Group 4 compiled key ecological and apicultural information shared during the guided tour, recording these in Estonian and comparing them with existing Estonian reference data.

Following the fieldwork, the four datasets were integrated through collaborative synthesis among the groups, resulting in a consolidated multilingual and multidisciplinary dataset on bee-relevant flora observed during the visit.

RESULTS

The recorded plant taxa are presented below in a structured format, using their scientific (Latin), English, and Estonian names. For each species, the main apicultural characteristics are provided, including the type of resource available for pollinators (nectar and/or pollen) and the flowering periods in Estonia (EE) and Hungary (HU).

This format reflects the collaborative data collection approach of the study, where multilingual terminology and ecological observations were integrated. The inclusion of Estonian and English plant names alongside the scientific nomenclature facilitates knowledge transfer between regions and supports the application of the findings in beekeeping education. The comparison of flowering periods highlights temporal differences between the two countries, which may be relevant for understanding the availability of bee forage resources under different climatic conditions.

In cases where a species is indicated as absent from Estonia, this refers specifically to the recorded taxon and does not exclude the presence of related taxa within the same genus or family.

Camassia sp.
English name: Camas lily
Estonian name: Preeriaküünal
Family: Asparagaceae
Natural distribution: Estonia and Hungary – rare
Use: ornamental plant
Bee resource: nectar, pollen
Flowering (EE / HU): May–June / April–May

Camassia sp.

Lavandula angustifolia
English name: Lavender
Estonian name: Tähklavendel
Family: Lamiaceae
Natural distribution: Estonia and Hungary – rare
Use: herb and ornamental plant
Bee resource: nectar, pollen
Flowering (EE / HU): July–August / June–July

Salvia rosmarinus
English name: Rosemary
Estonian name: Harilik rosmariin
Family: Lamiaceae
Natural distribution: Estonia – annual or in a pot ; Hungary – rare
Use: herb
Bee resource: nectar
Flowering (EE / HU): April–May / March–April

Symphytum officinale
English name: Common comfrey
Estonian name: Harilik varemerohi
Family: Boraginaceae
Natural distribution: Estonia – rare; Hungary – moderate
Use: medicinal plant
Bee resource: nectar, small amount of pollen
Flowering (EE / HU): May–July / April–June


Symphytum officinale

Symphytum tuberosum
English name: Tuberous comfrey
Estonian name: Mugul-varemerohi
Family: Boraginaceae
Natural distribution: Estonia – not present; Hungary – moderate
Use: medicinal plant
Bee resource: nectar, small amount of pollen
Flowering (EE / HU): May–June / April–May


Symphytum tuberosum

Euonymus alatus
English name: Winged spindle
Estonian name: Tiivuline kikkapuu
Family: Celastraceae
Natural distribution: Estonia – rare; Hungary – moderate
Use: ornamental plant
Bee resource: small amount of nectar and pollen
Flowering (EE / HU): May–June / April–May


Euonymus alatus

Cornus mas
English name: Cornelian cherry
Estonian name: Kirss-kontpuu
Family: Cornaceae
Natural distribution: Estonia – rare; Hungary – moderate
Use: ornamental plant
Bee resource: nectar
Flowering (EE / HU): March–April / February–March

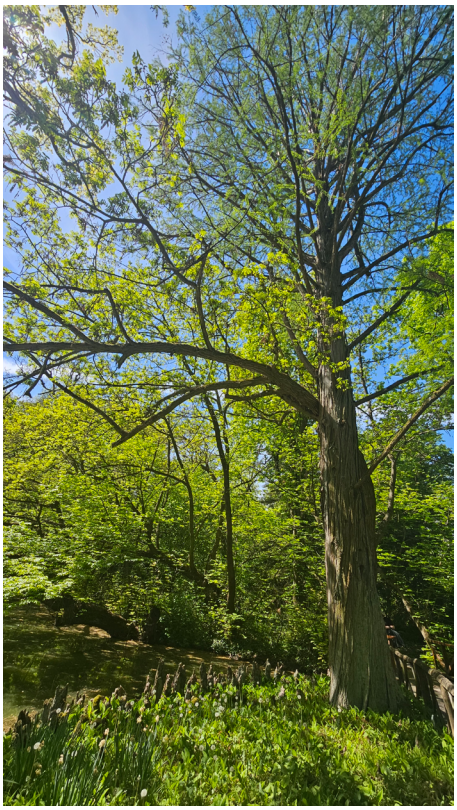

Cornus mas

Cornus florida
English name: Flowering dogwood
Estonian name: Õis-kontpuu
Family: Cornaceae
Natural distribution: Estonia – absent; Hungary – rare
Use: ornamental plant
Bee resource: pollen
Flowering (EE / HU): May / April

Telekia speciosum
English name: Yellow ox-eye
Estonian name: Kaunis teleekia
Family: Asteraceae
Natural distribution: Estonia – rare; Hungary – moderate
Use: ornamental plant
Bee resource: nectar, pollen
Flowering (EE / HU): July–August / June–September

Epimedium sp.
English name: Barrenwort
Estonian name: Haldjatiib
Family: Berberidaceae
Natural distribution: Estonia and Hungary – rare
Use: ornamental plant
Bee resource: nectar, small amount of pollen
Flowering (EE / HU): April–May / March–April

Taxodium distichum
English name: Bald cypress
Estonian name: Harilik sooküpress
Family: Cupressaceae
Natural distribution: Estonia – not present; Hungary – rare
Use: ornamental plant
Bee resource: insignificant for bees
Flowering (EE / HU): -


Taxodium distichum

Cercis griffithii
English name: Afghan redbud
Estonian name: Afgan juudapuu
Family: Fabaceae
Natural distribution: Estonia – absent; Hungary – rare
Use: ornamental plant
Bee resource: nectar, pollen
Flowering (EE / HU): April–May / March–April

Allium schoenoprasum
English name: Chives
Estonian name: Murulauk
Family: Liliaceae
Natural distribution: Estonia and Hungary – moderate
Use: herb
Bee resource: nectar
Flowering (EE / HU): June–July / May–June

Liriodendron tulipifera
English name: Tulip tree
Estonian name: Tulbipuu
Family: Magnoliaceae
Natural distribution: Estonia and Hungary – rare
Use: ornamental plant
Bee resource: nectar, pollen
Flowering (EE / HU): - / June

Salix babylonica
English name: Weeping willow
Estonian name: Babüloonia remmelgas
Family: Salicaceae
Natural distribution: Estonia – absent; Hungary – rare
Use: ornamental plant
Bee resource: pollen, small amount of nectar
Flowering (EE / HU): April–May / March–April

Euphorbia epithymoides
English name: Cushion spurge
Estonian name: Kuldne piimalill
Family: Euphorbiaceae
Natural distribution: Estonia – rare; Hungary – moderate
Use: ornamental plant
Bee resource: insignificant for bees
Flowering (EE / HU): April–May / March–April

Platanus × acerifolia
English name: London plane tree
Estonian name: Vahtralehine plaatan
Family: Platanaceae
Natural distribution: Estonia – moderate; Hungary – common
Use: ornamental plant
Bee resource: insignificant for bees
Flowering (EE / HU): May / March–April

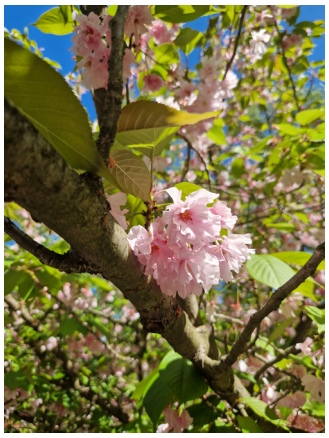
Tilia cordata
English name: Small-leaved linden
Estonian name: Harilik pärn
Family: Tiliaceae
Natural distribution: Estonia and Hungary – moderate
Use: honey plant
Bee resource: nectar, pollen
Flowering (EE / HU): July / June–July

Prunus padus
English name: Bird cherry
Estonian name: Harilik toomingas
Family: Rosaceae
Natural distribution: Estonia and Hungary – moderate
Use: ornamental plant
Bee resource: insignificant for bees
Flowering (EE / HU): May–June / April

Prunus padus

Rosa foetida
English name: Austrian briar
Estonian name: Kollane kibuvits
Family: Rosaceae
Natural distribution: Estonia – rare; Hungary – moderate
Use: ornamental plant
Bee resource: pollen
Flowering (EE / HU): June / April–May

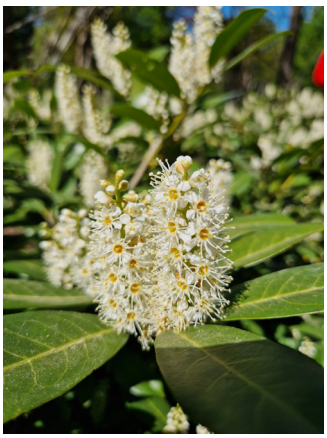
Rosa foetida



Prunus serrulata

Prunus serrulata
English name: Japanese cherry
Estonian name: Peensaagjas kirsipuu
Family: Rosaceae
Natural distribution: Estonia and Hungary – rare
Use: ornamental plant
Bee resource: small amount of nectar
Flowering (EE / HU): May / April

Prunus laurocerasus
English name: Cherry laurel
Estonian name: Loorberkirsipuu
Family: Rosaceae
Natural distribution: Estonia and Hungary – rare
Use: ornamental plant
Bee resource: nectar, pollen
Flowering (EE / HU): May–June / April–May



Prunus maackii
English name: Manchurian cherry
Estonian name: Amuuri toomingas
Family: Rosaceae
Natural distribution: Estonia and Hungary – rare
Use: ornamental plant
Bee resource: nectar, pollen
Flowering (EE / HU): May–June / April–May

Prunus laurocerasus

Malus sp.
English name: European apple tree
Estonian name: Õunapuu
Family: Rosaceae
Natural distribution: Estonia and Hungary – moderate
Use: fruit tree
Bee resource: nectar, pollen
Flowering (EE / HU): May–June / April–May

Foeniculum vulgare
English name: Fennel
Estonian name: Harilik apteegitill
Family: Apiaceae
Natural distribution: Estonia and Hungary – rare
Use: medicinal plant
Bee resource: nectar
Flowering (EE / HU): August–September / July–August

Fallopia sachalinensis
English name: Giant knotweed
Estonian name: Sahhalini pargitatar
Family: Polygonaceae
Natural distribution: Estonia and Hungary – invasive species
Use: biogas production
Bee resource: nectar
Flowering (EE / HU): August–September / July–October

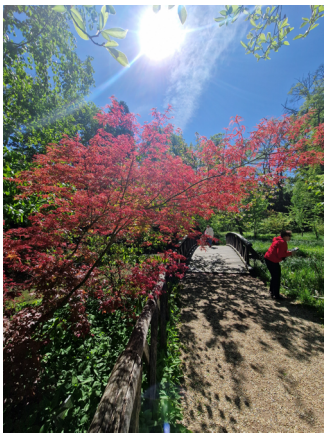

Fallopia sachalinensis

Eranthis hyemalis
English name: Winter aconite
Estonian name: Talvine lumekupp
Family: Ranunculaceae
Natural distribution: Estonia and Hungary – rare
Use: ornamental plant
Bee resource: nectar
Flowering (EE / HU): March–April / February–March

Acer pseudoplatanus
English name: Sycamore maple
Estonian name: Mägivaher
Family: Aceraceae
Natural distribution: Estonia – rare; Hungary – moderate
Use: ornamental plant
Bee resource: nectar, pollen
Flowering (EE / HU): May / April–May


Acer pseudoplatanus

Acer palmatum
English name: Japanese maple
Estonian name: Kämmalvaher
Family: Aceraceae
Natural distribution: Estonia and Hungary – rare
Use: ornamental plant
Bee resource: nectar, pollen
Flowering (EE / HU): May–June / April–May


Acer palmatum

LIMITATIONS

This study has several limitations that should be considered when interpreting the results. First, data collection was restricted to a single field visit, which limited both temporal representativeness and the ability to capture variability in plant phenology. Second, due to time constraints, it was not possible to survey the entire area of the National Botanical Garden and Institute of Ecology and Botany; observations were therefore confined to selected sections of the garden.

An important limitation of this study arises from the nature of the botanical garden setting. The plant taxa presented do not necessarily represent the most typical or widely occurring species in Hungary, as botanical gardens often include rare, ornamental, or non-native taxa. Consequently, the observed species may not fully reflect the composition of natural or agricultural bee forage resources.

This may also influence the reported flowering periods and apicultural relevance, which can differ from those of the same or related species under natural conditions. The relatively frequent occurrence of taxa categorized as “rare” in this study is therefore partly a result of the curated selection within the garden.

For this reason, the findings should be interpreted with caution, and further citizen science–based studies conducted in more representative, natural habitats would be necessary to validate and extend the results. Additionally, only plant species that had reached a suitable phenological stage for presentation at the time of the visit (late April) were included, potentially excluding other bee-relevant taxa that emerge earlier or later in the season. The photographic

documentation was carried out using mobile phones rather than professional imaging equipment, which may have affected image quality and consistency.

Finally, the data integration and synthesis process was conducted within a limited timeframe, with approximately two evening sessions available for collaborative analysis. This constrained period may have reduced the depth of cross-validation and harmonization among the datasets produced by the different working groups.

DISCUSSION

The results demonstrate that even a short-term, structured field survey can provide valuable insights into bee-relevant plant diversity and flowering phenology. The observed differences in flowering periods between Hungary and Estonia reflect regional climatic conditions and highlight the importance of temporal planning in beekeeping practices. In several cases, earlier flowering in Hungary compared to Estonia was evident, particularly among early-season species.

The relatively high proportion of rare or ornamental species in the dataset is consistent with the botanical garden setting and should be interpreted accordingly. Nevertheless, the findings illustrate the diversity of potential nectar and pollen sources and underline the importance of species selection in managed and semi-natural environments. Despite this, the dataset provides a useful reference framework for comparative observations and educational applications.

Importantly, the study confirms the effectiveness of this collaborative approach in applied ecological data collection. The integration of multilingual documentation enhances both the educational value and the practical applicability of the results, while data reliability was supported by cross-group validation and expert guidance during the field observations.

An additional important outcome of the study is the practical application of a structured data collection methodology by the participating educators. Through coordinated group work within a limited timeframe, participants experienced a complete workflow of field data collection, processing, and synthesis. This hands-on approach may support the independent application of similar methods in their future teaching and professional practice.

From a broader perspective, the comparative observations may also be relevant in the context of potential future environmental changes. If conditions in Estonia were to shift towards those currently observed in more southern regions, plant species typical of Central European bee forage systems could become increasingly relevant. In this context, the present observations may serve as a preliminary reference for understanding how such species might contribute to future forage availability.

Strengths

This study demonstrates several strengths. The collaborative, practice-based approach, involving beekeeping educators as active data collectors, enabled efficient and multidisciplinary documentation of bee-relevant plant species. The division of tasks among working groups (taxonomy, language mapping, photographic documentation, and ecological interpretation) increased both the depth and reliability of the collected data, while also providing participants with a transferable methodological framework for future use.

Furthermore, the multilingual data integration (Estonian, English, and Latin nomenclature) enhances the usability of the dataset across different professional and educational contexts. The study also benefits from its international and applied perspective, as the field observations conducted in Hungary directly contribute to the knowledge base supporting Estonian beekeeping education.

Finally, the framework of the Erasmus+ programme provided a structured environment for knowledge exchange, strengthening the link between field-based ecological observations and practical apicultural training.

CONCLUSION

This study demonstrates that structured field observations can effectively document bee-relevant plant species and support knowledge transfer in beekeeping education. The integration of multilingual plant data and phenological information provides a practical basis for understanding regional differences in forage availability.

In addition, the study highlights the value of structured group-based learning, where participants not only contribute to data collection but also gain practical experience in applying a reproducible methodology.

Despite its limitations, the study highlights the value of international collaboration within the Erasmus+ framework in supporting applied ecological learning and pollinator-friendly practices.

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