

# In search for wild bees and other Hymenoptera in the Primorsko-goranska and Karlovac provinces

U potrazi za divljim pčelama i drugim vrstama Hymenoptera u Primorsko-goranskoj i Karlovačkoj županiji

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## Abstract

In 2024, during the month of June, mainly aculeate wasps and bees were investigated in seven locations in the Primorsko-goranska county and one in the Karlovac county. A total of 150 aculeate species were found (119 bee species and 31 wasp species). However, there are still numerous wasps that have not been determined, as the author is missing the necessary expertise or up-to-date determination keys for the region could not be found. The bee species found represent 16% of the bee species found in Croatia (727 species). Among the species surveyed, one species was classified as Endangered (EN) by the European Red List of wild bees (*Halictus carinthiacus* Blüthgen, 1936).

**Keywords:** Hymenoptera, Aculeata, faunistic data, monitoring, Croatia

## Sažetak

U 2024. godini, tijekom mjeseca lipnja, istraživane su uglavnom akuleatne ose i pčele na sedam lokacija u Primorsko-goranskoj županiji i jednoj u Karlovačkoj županiji. Ukupno je pronađeno 151 akuleatnih vrsta (121 vrsta pčela i 31 vrsta osa). Međutim, još uvijek postoje brojne ose koje nisu određene, jer autoru nedostaje potrebna stručnost ili nisu mogli pronaći ažurirane ključeve za određivanje vrsta za to područje. Pronađene vrste pčela predstavljaju 16% svih pčela pronađenih u Hrvatskoj (727 vrsta prema popisu objavljenom na [discoverlife.com](https://discoverlife.com)). Među istraživanim vrstama, jedna vrsta je klasificirana kao ugrožena (EN) prema Europskoj crvenoj listi divljih pčela (*Halictus carinthiacus* Blüthgen 1936).

**Ključne riječi:** Hymenoptera, Aculeata, faunistički podaci, praćenje, Hrvatska

## Introduction - Uvod

Addressing and reversing biodiversity loss in the Anthropocene requires comprehensive data on species identity, distribution, ecology, and population trends. However, data gaps continue to hinder biodiversity assessments and conservation efforts. Despite significant progress in recent decades, our understanding of bee diversity, decline, and distribution in Europe remains limited due to these shortfalls.

A clear example of the data gap concerning the status and trends of bees (*Anthophila*) in Europe is highlighted in the European Red List of Bees which classifies more than half (56.7%) of the 1,942 assessed species as Data Deficient (Nieto et al. 2014).

To address these data gaps, the Beefall project was launched with an interactive online Shiny app designed to visualize missing data and highlight knowledge shortfalls (Marshall et al. 2024). By leveraging a unique digital dataset on wild bee occurrence and ecology, the project identifies seven critical areas where information is lacking: geographic distribution, (functional) trait variation, population dynamics, evolutionary relationships, biotic interactions, species identity, and tolerance to abiotic conditions.

An analysis of these shortfalls indicates that Croatia, along with many other European countries, ranks poorly, suggesting a significant lack of data. In response, the author conducted monitoring of wild bees and other Hymenoptera in the Primorsko-goranska and Karlovac counties in Croatia during a holiday visit. The publication of these findings represents a small but valuable step toward closing the knowledge gap on bee diversity, decline, and distribution in Croatia.

## Materials and Methods – *Materijali i metode*

The selection of the monitoring sites was predominantly opportunistic, often determined through visual assessment during travel. A notable example is the peninsula on Krk Island, which was initially identified while traversing the Krk bridge. Subsequently, a decision was made to monitor this location at a later stage, as it appeared to contain diverse habitats suitable for wild bees. In contrast, the expedition to Risnjak National Park was deliberately planned. A formal permit was obtained in advance, authorizing the observation of wild bees and other Hymenoptera within this protected area, subject to specific stipulations.

Investigated locations:

<u>Location</u>	<u>Date</u>	<u>GPS location</u>	<u>Monitoring duration</u>
<u>Primorsko-goranska</u>			
Šetnica uz Sušicu (Dražice)	1/6/2024	45.3888, 14.4586	2 hours and 30 minutes
Vrbnik (Otok Krk)	11/6/2024	45.0721, 14.6838	1 hour and 20 minutes
Omišalj (Otok Krk)	2/6/2024 & 5/6/2024	45.2341, 14.5780	7 hours and 40 minutes
Platak ski center (Soboli)	9/6/2024	45.4256, 14.5693	1 hour and 45 minutes
Stanić (Otok Cres)	6/6/2024	44.8337, 14.4121	25 minutes
National Park Risnjak	8/6/2024	45.4171, 14.6848	5 hours and 30 minutes
Podkilavac	4/6/2024	45.4028, 14.4699	1 hour and 30 minutes
<u>Karlovačka</u>			
Begovac	7/6/2024	45.0192, 15.4145	45 minutes

The majority of the specimens were collected using a sweeping net and were subsequently identified either in situ or through examination of macro photographs or collected specimens. Certain specimens of species with distinctive characteristics, such as *Bombus pascuorum* (Scopoli, 1793), were not captured but were recorded based on visual observation. All observations were uploaded to the citizen science portal Observation.org utilizing the ObsMapp application. The observations, with additional details, can be viewed on the website (<https://hr.observation.org/users/163444/observations/?advanced=on>).

The collected wild bee specimens were determined using the following determination keys:

- Alain Pauly 2009 (Les espèces de Seladonia Robertson en France et en Europe)
- Amiet et al. 2001. (Halictus, Lasioglossum)
- Amiet et al. 2004 (Anthidiurn, Chelostoma, Coelioxys, Dioxys, Heriades, Lithurgus, Megachile, Osrnia, Stelis)
- Amiet et al. 2007 (Ammobates, Ammobatoides, Anthophora, Biastes, Ceratina, Dasypoda, Epeoloides, Epeolus, Eucera, Macropis, Melecta, Melitta, Nomada, Pasites, Tetralonia, Thyreus, Xylocopa)
- Amiet et al. 2014 (Colletes, Dufourea, Hylaeus, Nomia, Nomioides, Rhophitoides, Rophites, Sphecodes, Systropha)
- Bogush et al. 2012 (Review and identification of the cuckoo bees of Central Europe)
- H.H. Dathe 1980 (Les espèces du genre Hylaeus en Europe)
- Jan Smit 2018 (Identification key to the European species of the bee genus Nomada including 23 new species)
- Kuhlmann et al. 2014 (The bees of the genus Colletes Latreille 1802 of the European part of Russia, with keys to species)
- Max Kasperek 2014 (The Cuckoo Bees of the Genus Stelis in Europe, North Africa and the Middle East)
- Max Kasperek 2022 (The resin and wool carder bees (Anthidiini) of Europe and Western Turkey)
- Müller, A. 2025: Identification keys to the osmiine bees of Europe (Megachilidae, Osmiini).
- Rasmont et al. 2021 (Bumblebees of Europe and neighbouring regions)
- Schmid-Egger and Scheuchl 1997 (Illustrierte BestimmungsTablelen der Wildbienen Deutschlands und Österreichs, Band III: Andrenidae)

The collected wasp specimens were determined using the following determination keys:

- Dvořák et al. 2006 (Key to the paper and social wasps of Central Europe)
- Hans-Joachim Jacobs 2007 (Die grabwespen Deutschlands)
- van Achterberg et al. 2023 (Review of the European Eumenes Latreille using morphology and DNA barcodes, with an illustrated key to species)

While many of the species found during this trip can also be found in northwestern Europe, the author is not familiar with many of the Hymenoptera species present in Croatia. His goal is to have most specimens verified by another specialist to improve data quality and to create a checked personal reference collection of wild bees from Croatia. So far, the collected Andrena specimens have been verified by Thomas Wood, a researcher based at the Naturalis Biodiversity Center with a strong focus on Andrena (Andrenidae) in the Palaearctic.

Currently, all collected specimens are in the personal collection of the author. In the future, excess specimens will be deposited in the Royal Belgian Institute of Natural Sciences (RBINS).

## Results - Rezultati

Investigated locations in the Primorsko-goranska province

### Dražice

**Table 1.** List of species found in Dražice.

scientific name	No.	sex	related species
<b>Apidae</b>			
<i>Bombus humilis tristis</i> (Illiger, 1806)	1	F	<i>Vicia sativa</i>
<i>Bombus pascuorum</i> (Scopoli, 1763)	4	F	<i>Lamium maculatum</i> , <i>Vicia spec.</i>
<i>Bombus pratorum</i> (Linnaeus, 1758)	1	M	<i>Lamium maculatum</i>
<i>Bombus sylvarum</i> (Linnaeus, 1761)	1	F	<i>Vicia sativa</i>
<i>Eucera longicornis</i> (Linnaeus, 1758)	1	M	
<i>Xylocopa violacea</i> (Linnaeus, 1758)	1	F	
<b>Colletidae</b>			
<i>Hylaeus chypearis</i> (Schenck, 1853)	1	M	<i>Melilotus officinalis</i>
<i>Hylaeus signatus</i> (Panzer, 1798)	3	M	<i>Reseda lutea</i>
<i>Hylaeus spec.</i>	1	M	
<b>Halictidae</b>			
<i>Halictus scabiosae</i> (Rossi, 1790)	1	F	<i>Erigeron annuus</i>
<i>Lasioglossum pauxillum</i> (Schenck, 1853)	1	F	<i>Leucanthemum vulgare</i>
<i>Rophites canus</i> (Eversmann, 1852)	1	M	
<b>Megachilidae</b>			
<i>Anthidium manicatum</i> (Linnaeus, 1758)	2	F	<i>Stachys byzantina</i>
<i>Anthidium oblongatum</i> (Illiger, 1806)	1	F	
<i>Anthidium oblongatum</i> (Illiger, 1806)	2	F	<i>Reseda lutea</i>
<i>Hoplitis acuticornis</i> (Dufour & Perris, 1840)	1	M	<i>Lotus corniculatus</i>
<i>Hoplitis adunca</i> (Panzer, 1798)	1	M	
<i>Hoplitis adunca</i> (Panzer, 1798)	2	F	<i>Echium vulgare</i>
<i>Megachile argentata</i> (Fabricius, 1793)	1	M	
<i>Osmia rufohirta</i> (Latreille, 1811)	1	F	
<i>Stelis signata</i> (Latreille, 1809)	1	M	
<b>Crabronidae</b>			
<i>Oxybelus trispinosus</i> (Fabricius, 1787)	1	M	
<i>Tachysphex brullii</i> (F. Smith, 1856)	1	F	
<i>Tachysphex tarsinus</i> (Lepeletier, 1845)	1	M	
<b>Ichneumonidae</b>			
<i>Ichneumonidae indet.</i>	2		
<b>Symphyta</b>			
<i>Symphyta indet.</i>	1		
<b>Vespidae</b>			
<i>Ancistrocerus spec.</i>	1	F	
<i>Polistes dominula</i> (Christ, 1791)	1	F	
<i>Polistes nimpha</i> (Christ, 1791)	2	F	

The monitoring for wild bees in Dražice mainly took place in the Šetnica uz Sušicu, a promenade next to the canal, but also in some fields in the direct neighbourhood. The promenade is flanked by a wood edge, making it a sheltered location. The vegetation was varied, ranging from plants who prefer dry conditions, like *Reseda lutea* and *Echium vulgare* as roadside vegetation, to plants like *Lamium maculatum* preferring a more moist soil near the canal banks.

Several species of bumblebees were seen, mostly foraging on *Lamium maculatum* (Lamiaceae) and *Vicia sativa* (Fabaceae). Both plants have a rather deep calyx and nectar can only be accessed by insects with a long tongue, like bumblebees. In general, plants from the Lamiaceae and Fabaceae families are essential for bumblebees. Bees from the Megachilidae family in general also have a longer tongue than most other solitary bees. They can also be found foraging on plants with deeper calyxes. *Lotus corniculatus*, also a plant from the Fabaceae family, attracts many Megachilidae species. In Dražice only one species, *Hoplitis acuticornis*, was found foraging on this plant, but in other locations the plant attracted more species.

Bees from the Colletidae and Halictidae families have shorter tongues, thus mainly foraging on plants with a less deep calyx. During my monitoring here I found species of these families on *Erigeron annuus* and *Leucanthemum vulgare* (both Asteraceae) which are superficially flowering plants, with nectar easily accessible, but also on *Reseda lutea* (Resedaceae) and *Melilotus officinalis* (Fabaceae). Both plants have a small calyx, making the nectar also accessible for bees with shorter tongues.

#### Vrbnik, Otok Krk

Table 2. Species found in Vrbnik near the Plaža Kozica

Scientific name	No.	Sex	Related species
<b>Apidae</b>			
<i>Ceratina cyanea</i> (Kirby, 1802)	2	F	<i>Echium plantagineum</i>
<b>Colletidae</b>			
<i>Hylaeus clypearis</i> (Schenck, 1853)	1	M	<i>Orlaya grandiflora</i>
<b>Halictidae</b>			
<i>Halictus scabiosae</i> (Rossi, 1790)	1	F	<i>Centaurea jacea</i>
<i>Lasioglossum laticeps</i> (Schenck, 1870)	2	F	<i>Echium plantagineum</i>
<i>Lasioglossum nitidulum</i> (Fabricius, 1804)	1	F	
<i>Lasioglossum politum</i> (Schenck, 1853)	1	F	<i>Echium plantagineum</i>
<b>Megachilidae</b>			
<i>Hoplitis adunca</i> (Panzer, 1798)	6	F	<i>Echium plantagineum</i>
<i>Megachile argentata</i> (Fabricius, 1793)	1	M	
<i>Megachile melanopyga</i> (Costa, 1863)	1	F	<i>Echium plantagineum</i>
<i>Megachile melanopyga</i> (Costa, 1863)	1	M	
<b>Scoliidae</b>			
<i>Megascolia maculata maculata</i> (Drury, 1773)	1	M	
<b>Vespidae</b>			
<i>Delta unguiculatum</i> (Villers, 1789)	1	M	
<i>Leptochilus regulus</i> (de Saussure, 1855)	1	M	
<i>Polistes foederatus</i> (Kohl, 1898)	1	F	

In Vrbnik, on the island of Krk, a patch of flowers next to the Plaža Kozica was monitored. The patch, where *Echium plantagineum* was abundantly present, attracted a large variety of bee species. *Echium plantagineum* is related to *Echium vulgare*, so the pollen is also collected by the specialist bee *Hoplitis adunca*. This bee was found here, together with several other *Megachilidae* species.

The calyx of *Echium plantagineum* is less deep than from the related *Echium vulgare*, making the nectar also accessible for the shorter tongued bees from the *Lasioglossum* family. Several males from various wasp species but also some *Megachilidae* bee species were found patrolling the flower patch or rocky surface in search for females they could mate with.

#### Omišalj, Otok Krk

Table 3. Species found in Omišalj near the Uvala Voz beach.

Scientific name	No.	Sex	Related species
<b>Andrenidae</b>			
<i>Andrena afzeliella</i> (Kirby, 1802)	2	F	<i>Lotus corniculatus</i>
<i>Andrena labialis</i> (Kirby, 1802)	2	M	
<i>Andrena minutula</i> (Kirby, 1802)	2	F	<i>Oenanthe pimpinelloides</i>
<i>Andrena spec.</i>	1	F	parasitized by stylops, <i>Lotus corniculatus</i>
<b>Apidae</b>			
<i>Bombus argillaceus</i> (Scopoli, 1763)	11	F	<i>Galega officinalis</i> , <i>Vicia villosa</i> , <i>Trifolium pratense</i> , <i>Lamium maculatum</i> , <i>Linaria vulgaris</i> , <i>Prunella laciniata</i>
<i>Bombus hortorum</i> (Linnaeus, 1761)	1	M	<i>Prunella laciniata</i>
<i>Bombus terrestris-gr</i>	6	F	<i>Vicia villosa</i>
<i>Ceratina callosa</i> (Fabricius, 1794)	1	M	
<i>Ceratina chalcites</i> (Germar, 1839)	1	M	<i>Stachys germanica</i>
<i>Ceratina cucurbitina</i> (Rossi, 1792)	1	M	<i>Silybum marianum</i>
<i>Eucera nigrescens</i> (Pérez, 1879)	12	F	<i>Vicia villosa</i>
<i>Xylocopa iris</i> (Christ, 1791)	1	F	
<b>Colletidae</b>			
<i>Colletes albomaculatus</i> (Lucas, 1849)	2	F	<i>Dorycnium pentaphyllum</i>
<i>Colletes brevigena</i> (Noskiewicz, 1936)	1	F	<i>Dorycnium pentaphyllum</i>
<i>Hylaeus annularis</i> (Kirby, 1802)	2	F	<i>Oenanthe pimpinelloides</i> , <i>Dorycnium pentaphyllum</i>
<i>Hylaeus brevicornis</i> (Nylander, 1852)	1	F	<i>Oenanthe pimpinelloides</i>
<i>Hylaeus chypearis</i> (Schenck, 1853)	1	F	<i>Oenanthe pimpinelloides</i>
<i>Hylaeus chypearis</i> (Schenck, 1853)	3	M	<i>Oenanthe pimpinelloides</i>
<i>Hylaeus imparilis</i> (Förster, 1871)	2	M	<i>Dorycnium pentaphyllum</i>
<i>Hylaeus imparilis</i> (Förster, 1871)	1	F	<i>Oenanthe pimpinelloides</i>
<i>Hylaeus lineolatus</i> (Schenck, 1861)	3	F	<i>Dorycnium pentaphyllum</i>
<i>Hylaeus gracilicornis</i> (Morawitz, 1867)	2	M	<i>Oenanthe pimpinelloides</i>
<i>Hylaeus punctatus</i> (Brullé, 1832)	1	F	<i>Echium vulgare</i>
<i>Hylaeus punctulatus</i> (Smith, 1842)	2	M	



Scientific name	No.	Sex	Related species
<i>Hylaeus spec.</i>	1	F	<i>Oenanthe pimpinelloides</i>
<i>Hylaeus soror</i> (Pérez, 1903)	1	M	
<i>Hylaeus styriacus</i> (Förster, 1871)	1	M	<i>Dorycnium pentaphyllum</i>
<i>Hylaeus variegatus</i> (Fabricius, 1798)	1	M	
<i>Hylaeus variegatus</i> (Fabricius, 1798)	3	F	
<b>Halictidae</b>			
<i>Halictus langobardicus</i> (Blüthgen, 1944)	3	F	<i>Trifolium campestre</i>
<i>Halictus smaragdulus-gr</i>	1	F	<i>Trifolium campestre</i>
<i>Lasioglossum angusticeps</i> (Perkins, 1895)	1	F	<i>Silybum marianum</i>
<i>Lasioglossum glabriusculum</i> (Morawitz, 1872)	2	F	<i>Silybum marianum</i>
<i>Lasioglossum interruptum</i> (Panzer, 1798)	1	F	<i>Orlaya grandiflora</i>
<i>Lasioglossum laticeps</i> (Schenck, 1870)	1	F	<i>Ziziphus spina-christi</i>
<i>Lasioglossum morio</i> (Fabricius, 1793)	1	M	
<i>Lasioglossum nigripes</i> (Lepeletier, 1841)	1	F	
<i>Lasioglossum pauxillum</i> (Schenck, 1853)	1	F	<i>Silybum marianum</i>
<i>Lasioglossum politum</i> (Schenck, 1853)	1	F	<i>Oenanthe pimpinelloides</i>
<i>Lasioglossum punctatissimum</i> (Schenck, 1853)	4	F	<i>Teucrium chamaedrys</i> , <i>Dorycnium pentaphyllum</i>
<i>Nomiapis diversipes</i> (Latreille, 1806)	4	F	
<b>Megachilidae</b>			
<i>Anthidiellum strigatum</i> (Panzer, 1805)	1	U	
<i>Anthidium oblongatum</i> (Illiger, 1806)	1	U	<i>Lotus corniculatus</i>
<i>Anthidium taeniatum</i> (Latreille, 1809)	2	F	<i>Trifolium campestre</i>
<i>Anthidium undulatum</i> (Dours, 1873)	1	M	
<i>Coelioxys conoideus</i> (Illiger, 1806)	1	F	<i>Knautia arvensis</i>
<i>Heriades crenulatus</i> (Nylander, 1856)	1	F	<i>Trifolium campestre</i>
<i>Heriades truncorum</i> (Linnaeus, 1758)	1	M	
<i>Hoplitis adunca</i> (Panzer, 1798)	3	M	<i>Echium vulgare</i>
<i>Hoplitis adunca</i> (Panzer, 1798)	2	F	<i>Echium vulgare</i>
<i>Hoplitis laevifrons</i> (Morawitz, 1872)	3	M	<i>Dorycnium pentaphyllum</i>
<i>Hoplitis pallicornis</i> (Friese, 1895)	1	M	
<i>Hoplitis tridentata</i> (Dufour & Perris, 1840)	2	U	<i>Lotus corniculatus</i>
<i>Megachile argentata</i> (Fabricius, 1793)	2	M	<i>Lotus corniculatus</i> , <i>Dorycnium pentaphyllum</i>
<i>Megachile argentata</i> (Fabricius, 1793)	1	F	
<i>Megachile ericetorum</i> (Lepeletier, 1841)	2	M	<i>Thymus pulegioides</i>
<i>Megachile flabellipes</i> (Pérez, 1895)	1	F	<i>Lotus corniculatus</i>
<i>Megachile parietina</i> (Geoffroy, 1785)	7	F	<i>Stachys germanica</i>
<i>Megachile pyrenaica</i> (Lepeletier, 1841)	2	M	<i>Teucrium chamaedrys</i>
<i>Osmia aurulenta</i> (Panzer, 1799)	1	F	<i>Prunella laciniata</i>
<i>Stelis nasuta</i> (Latreille, 1809)	1	M	
<b>Braconidae</b>			
<i>Cheloninae</i> indet.	3	U	
<b>Chrysididae</b>			
<i>Chrysis analis</i> (Spinola, 1808)	1	M	
<i>Chrysis germari</i> (Wesmael, 1839)	1	M	
<i>Chrysura cuprea</i> (Rossi, 1790)	1	M	

Scientific name	No.	Sex	Related species
<i>Chrysura dichroa</i> (Dahlbom, 1854)	1	U	
<i>Spintharina versicolor</i> (Spinola, 1808)	1	M	
<b>Crabronidae</b>			
<i>Cerceris arenaria</i> (Linnaeus, 1758)	1	F	
<i>Cerceris bupresticida</i> (Dufour, 1841)	1	F	
<i>Cerceris bupresticida</i> (Dufour, 1841)	1	M	
<i>Cerceris sabulosa</i> (Panzer, 1799)	1	M	
<i>Cerceris spec.</i>	2	U	
<i>Crabronidae</i> indet.	2	U	
<i>Tachysphex unicolor</i> (Panzer, 1807)	1	F	
<b>Gasteruptiidae</b>			
<i>Gasteruption spec.</i>	1	U	
<b>Pompilidae</b>			
<i>Aporinellus sexmaculatus</i> (Spinola, 1806)	1	M	
<i>Cryptocheilus octomaculatus</i> (Rossi, 1790)	3	M	
<b>Sphecidae</b>			
<i>Ammophila heydeni</i> (Dahlbom, 1845)	1	M	
<b>Vespidae</b>			
<i>Celonites abbreviatus</i> (Villers, 1789)	1	M	
<i>Eumenes coarctatus</i> (Linnaeus, 1758)	1	F	
<i>Euodynerus dantici</i> (Rossi, 1790)	1	M	<i>Dorycnium pentaphyllum</i>
<i>Gymnomerus laevipes</i> (Shuckard, 1837)	1	M	
<i>Polistes dominula</i> (Christ, 1791)	1	F	
<i>Polistes foederatus</i> (Kohl, 1898)	1	F	parasitized by stylops

The peninsula near the Krk bridge was monitored more intense than other locations because the area had a great variety of suitable wild bee habitats.

Near the Uvala Voz beach, sheltered by surrounding hills, a field where *Oenanthe pimpinelloides* and *Dorycnium pentaphyllum* flowered in large quantities can be found. Many bee species, mostly short tongued *Colletidae*, were attracted to these flowers.

An earthy ridge with exposed soil provided a suitable nesting location for ground nesting bees and wasps. This ridge was monitored, hoping to find parasitic bees and wasps. However, few of them were found during the monitoring. From the species found in this location, mainly those from the *Andrenidae* and *Halictidae* families, but also from the genus *Colletes*, would use dry, sunny exposed earthy soil like these as nesting locations. However, the large amount of *Hylaeus* and *Megachilidae* bees that were present at this location nest above ground, in dried stems or in tunnels in death wood.

The vegetation in other parts of this peninsula was different, attracting different kinds of bee species. On the slope of the hill various Fabaceae, like *Lotus corniculatus*, *Vicia villosa* and *Trifolium pratense* were present attracting various bumblebee species but also numerous *Eucera nigrescens*, a bee specialized on plants from this family.



On top of the hill, on the West side of the plateau, the vegetation was dominated by *Silybum marianum* with *Trifolium campestre* as undergrowth. Several *Halictidae* were found foraging on these plants. The other side was rockier with sparser vegetation. Many bees and wasps were flying round a solitary *Paliurus spina-christi* shrub, probably using it as a focal point for finding a suitable mate. On the road in between both parts, several *Megachile parietina* were found collecting earth as nesting material.

On the East side there was also a small landfill area, with several mounds of earth, providing a richer soil with denser vegetation from flowers from the *Fabaceae* family, attracting various bee species like *Andrena labialis*, *Eucera nigrescens* and *Megachile ericetorum* whom are specialized on collecting pollen from this plant family.

On this peninsula, many wasps species were found, mainly *Crabronidae*, *Pompilidae*, *Sphecidae* and *Vespidae* species. And while I didn't find that many parasitic bees, several *Chrysididae* cuckoo wasps were found. These colourful wasps are mainly parasitic on other wasp species, but not only.

#### Soboli

**Table 4.** Species found at the Platak ski center.

Scientific name	No.	Sex	Related species
<b>Andrenidae</b>			
<i>Andrena combinata</i> (Christ, 1791)	1	M	
<i>Andrena combinata</i> (Christ, 1791)	1	F	<i>Veronica officinalis</i>
<b>Apidae</b>			
<i>Bombus hortorum</i> (Linnaeus, 1761)	2	F	<i>Anthyllis vulneraria</i>
<i>Bombus lapidarius</i> (Linnaeus, 1758)	1	F	<i>Rubus spec.</i>
<i>Bombus pascuorum</i> (Scopoli, 1763)	4	F	<i>Lotus corniculatus</i> , <i>Rubus spec.</i>
<i>Ceratina cucurbitina</i> (Rossi, 1792)	2	M	<i>Lotus corniculatus</i>
<b>Colletidae</b>			
<i>Hylaeus angustatus</i> (Schenck, 1861)	1	F	<i>Veronica officinalis</i>
<i>Hylaeus lineolatus</i> (Schenck, 1861)	1	F	<i>Veronica officinalis</i>
<b>Halictidae</b>			
<i>Halictus carinthiacus</i> (Blüthgen, 1936)	1	F	<i>Buphthalmum salicifolium</i>
<i>Halictus maculatus</i> (Smith, 1848)	1	F	<i>Trifolium campestre</i>
<i>Halictus tumulorum</i> (Linnaeus, 1758)	2	F	<i>Veronica officinalis</i>
<i>Lasioglossum calceatum</i> (Scopoli, 1763)	2	F	<i>Reseda lutea</i> , <i>Geranium robertianum</i>
<i>Lasioglossum fulvicorne</i> (Kirby, 1802)	1	F	<i>Veronica officinalis</i>
<b>Megachilidae</b>			
<i>Heriades truncorum</i> (Linnaeus, 1758)	1	F	<i>Buphthalmum salicifolium</i>
<i>Hoplitis acuticornis</i> (Dufour & Perris, 1840)	2	M	<i>Lotus corniculatus</i>
<i>Osmia gallarum</i> (Spinola, 1808)	1	F	
<i>Osmia viridana</i> (Morawitz, 1874)	2	F	<i>Lotus corniculatus</i>
<b>Crabronidae</b>			
<i>Passaloecus spec.</i>	1	M	
<b>Symphyta</b>			
<i>Symphyta indet.</i>	1		
<b>Vespidae</b>			
<i>Gynomerus laevipes</i> (Shuckard, 1837)	1	M	

While many different plant species were present, most bees were found foraging on either *Lotus corniculatus* or *Veronica officinalis*. *Lotus corniculatus* was mainly found on one of the slopes. *Veronica officinalis*, together with *Anthyllis vulneraria* and *Bupthalmum salicifolium* was found on a rougher patch near a water basin.

On the side of the monitored slope a pile of branches was found. Both the rocky slope and the branches are possible nesting locations, and several bees have been found here.

#### Stanić, Otok Cres

**Table 5.** Species found on a small clearing near lake Varna in Stanić

Scientific name	No.	Sex	Related species
<b>Andrenidae</b>			
<i>Andrena minutula</i> (Kirby, 1802)	2	F	<i>Sedum acre</i>
<b>Apidae</b>			
<i>Ceratina cucurbitina</i> (Rossi, 1792)	1	M	<i>Scabiosa columbaria</i>
<i>Xylocopa violacea</i> (Linnaeus, 1758)	2	F	<i>Genista tinctoria</i>
<b>Megachilidae</b>			
<i>Heriades crenulatus</i> (Nylander, 1856)	1	M	<i>Scabiosa columbaria</i>
<i>Heriades crenulatus</i> (Nylander, 1856)	1	F	<i>Scabiosa columbaria</i>
<i>Hoplitis pallicornis</i> (Friese, 1895)	1	M	<i>Lotus corniculatus</i>
<i>Osmia cyanoxantha</i> (Pérez, 1879)	3	F	
<b>Sphecidae</b>			
<i>Prionyx spec.</i>	1	M	
<b>Vespidae</b>			
<i>Microdynerus spec.</i>	1	M	
<b>Crabronidae</b>			
<i>Crabronidae indet.</i>	1		
<i>Tachysphex obscuripennis</i> (Schenck, 1857)	1	M	

A small clearing next to the road to Cres, near lake Varna, was monitored. Several honeybee hives were present in the clearing. *Sedum acre* was growing on the rocky soil and *Scabiosa columbaria* and *Genista tinctoria* on the roadside. Several, mostly still to be determined, male solitary wasp species were found flying low above the ground in search for females.

#### National Park Risnjak

**Table 6.** Species found at the Risnjak National Park near Crni Lug

Scientific name	No.	Sex	Related species
<b>Andrenidae</b>			
<i>Andrena barbilabris</i> (Kirby, 1802)	1	F	
<i>Andrena bicolor</i> (Fabricius, 1775)	1	M	<i>Ranunculus acris</i>
<i>Andrena fulvata</i> (Müller, 1776)	1	F	<i>Anthriscus sylvestris</i>
<i>Andrena fulvicornis</i> (Schenck 1853)	1	F	<i>Anthriscus sylvestris</i>
<i>Andrena haemorrhoa</i> (Fabricius, 1781)	1	F	<i>Anthriscus sylvestris</i>
<i>Andrena hattorfiana</i> (Fabricius, 1775)	1	M	<i>Knautia arvensis</i>
<i>Andrena intermedia</i> (Thomson, 1870)	1	M	

Scientific name	No.	Sex	Related species
<i>Andrena limata</i> (Smith, 1853)	1	F	<i>Ranunculus acris</i>
<i>Andrena minutula</i> (Kirby, 1802)	1	F	<i>Leucanthemum vulgare</i>
<i>Andrena ovata</i> (Kirby, 1802)	3	F	<i>Genista sagittalis</i>
<i>Andrena subopaca</i> (Nylander, 1848)	16	F	<i>Anthriscus sylvestris</i> , <i>Heracleum sphondylium</i> , <i>Ranunculus acris</i> , <i>Veronica officinalis</i> , <i>Potentilla erecta</i> , <i>Aegopodium podagraria</i>
<b>Apidae</b>			
<i>Bombus hortorum</i> (Linnaeus, 1761)	6	F	<i>Lamium maculatum</i> , <i>Trifolium pratense</i> , <i>Salvia pratensis</i>
<i>Bombus humilis tristis</i> (Illiger, 1806)	1	F	<i>Salvia pratensis</i>
<i>Bombus pascuorum</i> (Scopoli, 1763)	19	F	<i>Trifolium repens</i> , <i>Genista sagittalis</i> , <i>Lotus corniculatus</i> , <i>Salvia pratense</i> , <i>Trifolium pratense</i> , <i>Knautia spec.</i>
<i>Bombus pratorum</i> (Linnaeus, 1758)	1	F	<i>Phyteuma spicatum</i>
<i>Bombus terrestris</i> (Linnaeus, 1758)	6	F	<i>Rubus spec.</i> , <i>Lamium maculatum</i> , <i>Genista sagittalis</i>
<i>Eucera longicornis</i> (Linnaeus, 1758)	1	F	<i>Trifolium pratense</i>
<i>Nomada flavoguttata</i> (Kirby, 1802)	1	M	
<i>Nomada incisa</i> (Schmiedeknecht, 1882)	1	F	
<i>Nomada ruficornis</i> (Linnaeus, 1758)	1	F	<i>Heracleum sphondylium</i>
<i>Nomada sexfasciata</i> (Panzer, 1799)	1	F	
<i>Xylocopa violacea</i> (Linnaeus, 1758)	2	F	<i>Echium vulgare</i>
<b>Colletidae</b>			
<i>Hylaeus communis</i> (Nylander, 1852)	1	F	<i>Anthriscus sylvestris</i>
<i>Hylaeus confusus</i> (Nylander, 1852)	1	F	<i>Potentilla erecta</i>
<i>Hylaeus duckei</i> (Alfken, 1904)	2	M	<i>Heracleum sphondylium</i>
<i>Hylaeus incongruous/gibbus</i>	1	M	<i>Anthriscus sylvestris</i>
<b>Halictidae</b>			
<i>Halictus langobardicus</i> (Blüthgen, 1944)	1	F	<i>Potentilla reptans</i>
<i>Halictus maculatus</i> (Smith, 1848)	4	F	<i>Potentilla reptans</i>
<i>Halictus subauratus</i> (Rossi, 1792)	1	F	
<i>Halictus tumulorum</i> (Linnaeus, 1758)	2	F	
<i>Lasioglossum calceatum</i> (Scopoli, 1763)	2	F	<i>Knautia dipsacifolia</i> , <i>Ranunculus acris</i>
<i>Lasioglossum laevigatum</i> (Kirby, 1802)	2	F	
<i>Lasioglossum leucopus</i> (Kirby, 1802)	1	F	<i>Veronica officinalis</i>
<i>Lasioglossum majus</i> (Nylander, 1852)	1	F	<i>Anthriscus sylvestris</i>
<i>Lasioglossum morio</i> (Fabricius, 1793)	1	F	
<i>Lasioglossum pauxillum</i> (Schenck, 1853)	4	F	<i>Campanula patula</i>
<i>Lasioglossum politum</i> (Schenck, 1853)	3	F	<i>Anthriscus sylvestris</i> ; <i>Potentilla reptans</i>
<i>Lasioglossum rufitarse</i> (Zetterstedt, 1838)	1	F	
<i>Lasioglossum sexnotatum</i> (Kirby, 1802)	1	F	
<i>Lasioglossum villosulum</i> (Kirby, 1802)	1	F	<i>Crepis biennis</i>
<i>Sphecodes longulus</i> (Hagens, 1882)	1	F	
<i>Sphecodes miniatus</i> (Hagens, 1882)	2	F	

Scientific name	No.	Sex	Related species
<i>Sphecodes pseudofasciatus</i> (Blüthgen, 1925)	1	F	
<i>Sphecodes puncticeps</i> (Thomson, 1870)	2	F	
<i>Sphecodes reticulatus</i> (Thomson, 1870)	1	F	
<b>Megachilidae</b>			
<i>Chelostoma distinctum</i> (Stoeckert, 1929)	1	M	<i>Campanula patula</i>
<i>Chelostoma florissomne</i> (Linnaeus, 1758)	4	F	<i>Ranunculus acris</i>
<i>Osmia caerulea</i> (Linnaeus, 1758)	1	F	<i>Lotus corniculatus</i>
<i>Osmia leaiana</i> (Kirby, 1802)	4	M	
<b>Symphyta</b>			
Symphyta indet.	2		
<b>Vespidae</b>			
<i>Dolichovespula saxonica</i> (Fabricius, 1793)	1	F	
<i>Symmorphus crassicornis</i> (Panzer, 1798)	5	M	
<b>Crabronidae</b>			
Crabronidae indet.	2		
<i>Lestica clypeata</i> (Schreber, 1759)	2	M	
<i>Oxybelus trispinosus</i> (Fabricius, 1787)	2	M	
<i>Trypoxylon beaumonti</i> (Antropov, 1991)	1	M	
<b>Ichneumonidae</b>			
Ichneumonidae indet.	3		

The visit to this national park was planned ahead and a special license to catch bees and wasps was requested in advance with the ministry of Economy and Sustainable Development.

Several large flower rich meadows near the main entrance were monitored and numerous bees and wasps were found. There was a great variety of flower species present, each meadow seemed to have a different flower composition, resulting in a great variety of wild bees.

Several of these suitable nesting locations were observed, and it seems some were intentionally made. Near a weather station, a large patch of bare soil was present, and this particular location was a real hot spot with bees, including many cuckoo bees from the *Nomad* and *Sphecodes* genus.

Also, a small square patch of bare soil was present nearby. Presumably this patch is man-made. Also, here on and around this patch many bee species, including cuckoo bees, were found. Suitable nesting locations are essential for wild bee, but are not always abundantly present. Certainly, in Belgium, where we suffer from the negative impact from nitrogen deposition, created by intense farming, bare soil is a rare thing. Plant growth, especially from grasses, is boosted by the extra nitrogen and bare soil is rapidly overgrown. Creating patches of bare soil, like here in the national park, really helps wild bees. Keeping these patches of soil open throughout the year is crucial.

**Podkilavac**

Scientific name	No.	Sex	Related species
<b>Apidae</b>			
<i>Bombus hortorum</i> (Linnaeus, 1761)	4	F	<i>Anthyllis vulneraria</i> , <i>Rhinanthus minor</i> , <i>Lamium maculatum</i>
<i>Bombus humilis tristis</i> (Illiger, 1806)	1	F	<i>Rhinanthus minor</i>
<i>Bombus pascuorum</i> (Scopoli, 1763)	8	F	<i>Rubus idaeus</i> , <i>Lotus corniculatus</i> , <i>Salvia</i> <i>pratensis</i> , <i>Trifolium pratense</i> , <i>Rubus spec.</i>
<i>Bombus pascuorum</i> (Scopoli, 1763)	1	M	<i>Salvia pratensis</i>
<i>Eucera longicornis</i> (Linnaeus, 1758)	2	F	<i>Trifolium pratense</i>
<b>Colletidae</b>			
<i>Hylaeus gredleri</i> (Förster, 1871)	1	M	<i>Rubus spec.</i>
<i>Colletes mlokoszewiczi</i> (Radoszkowski, 1891)	1	M	<i>Leucanthemum vulgare</i>
<b>Halictidae</b>			
<i>Lasioglossum pauxillum</i> (Schenck, 1853)	2	F	<i>Leucanthemum vulgare</i>
<b>Megachilidae</b>			
<i>Megachile centuncularis</i> (Linnaeus, 1758)	1	M	<i>Rubus spec.</i>
<b>Crabronidae</b>			
<i>Cerceris quinquefasciata</i> (Rossi, 1792)	1	M	
<b>Ichneumonidae</b>			
<i>Ichneumonidae</i> indet.	3		
<b>Megalodontesidae</b>			
<i>Megalodontes spec.</i>	1		

In Podkilavac a meadow and a hillside were monitored. Most bees, mainly bumblebees, were found in the meadow, which was flanked by blackberries.

Investigated location in Karlovac province.

**Begovac**

**Table 7.** Species found near the village of Begovac.

Scientific name	No.	Sex	Related species
<b>Apidae</b>			
<i>Bombus terrestris</i>	3	F	<i>Rhinanthus angustifolius</i>
<b>Megachilidae</b>			
<i>Ceratina cucurbitina</i> (Rossi, 1792)	3	M	<i>Echium vulgare</i>
<i>Chelostoma distinctum</i> (Stoeckhert, 1929)	6	F	<i>Campanula rapunculus</i>
<i>Chelostoma rapunculi</i> (Lepeletier, 1841)	1	M	
<i>Megachile willughbiella</i> (Kirby, 1802)	1	F	<i>Rhinanthus angustifolius</i>
<i>Pseudoanthidium nanum</i> (Mocsáry, 1880)	1	M	
<b>Vespidae</b>			
<i>Gymnomerus laevipes</i> (Shuckard, 1837)	1	M	

In Begovac a hillside and a flower meadow were monitored. *Rhinanthus angustifolius* was abundantly present in the meadow, but only a few bumblebees and a single leafcutter bee were found foraging on this plant. Most bees were found on a small patch with some *Echium vulgare* and *Campanula rapunculus* plants on the roadside. This location was only monitored for a short while since few wild bees were present, despite its suitable appearance.

## Discussion - Rasprava

Although the monitoring was conducted for only ten days in June 2024 with relatively low intensity, a significant number of bee species were recorded. The survey covered locations at the seaside, characterized by a Mediterranean climate, as well as mountainous regions with a more continental climate. This allowed for the observation of diverse habitats, resulting in a high number of bee species identified.

Several of the observed bee species may be new to the Croatian fauna. However, confirming this is challenging due to the absence of a recent and comprehensive checklist of Croatian wild bees.

A publication summarizing faunistic data on Croatian Aculeata collected between 2001 and 2009 (Józan 2009) reported a total of 527 Aculeata species, 319 of which were wild bees. Additionally, to enhance knowledge of pollinator distribution at national and continental levels, records of 3,000 European bee and hoverfly species were published (Reverté Saiz et al. 2023), including a checklist of 665 wild bee species for Croatia. The Discover Life website (Ascher J. S. and J. Pickering 2020) provides another checklist, listing 727 wild bee species in Croatia.

Despite the availability of multiple checklists, none of them appears to be fully comprehensive. Even the Discover Life checklist, which records the highest number of species, does not include all species reported in other publications. This highlights the knowledge gap regarding species distribution in Europe, particularly in Croatia.

The author is eager to undertake further field excursions across different regions of Croatia to close this knowledge gap on wild bee diversity. The extra information gained during these excursions will hopefully lead to a more comprehensive checklist for wild bees in Croatia.

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