

## To stuying of bees from subfamily *Xylocopinae* (*Apoidea*, *Apidae*) of Azerbaijan

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### Abstract

The article provides information about 15 species of bees of the subfamily *Xylocopinae* (*Apoidea*, *Apidae*) noted in Azerbaijan, their trophic relationships, distribution across natural areas, landscape and altitudinal zones and zoogeographical distribution. According to the research results, it was revealed that species of the genus *Ceratina* pollinate 46 species of plants belonging to 20 families, species of the genus *Xylocopa* pollinate 52 species of plants belonging to 18 families and the most preferred plant families are *Asteraceae*, *Leguminosae*, *Brassicaceae*, *Lamiaceae*, *Rosaceae*. Species of the subfamily are found in all landscape belts and altitudinal zones of Azerbaijan, starting from 27 meters below sea level to 2500 m above sea level. and are active pollinators of entomophilous crops. By zoogeographical origin, they mainly consist of the fauna of the Mediterranean subregion of the Palearctic department of the Holarctic region.

**Keywords:** Bees, xylocopinae, trophic connections, natural areas, landscape distribution, zonal distribution

### Introduction

The *Apidae* are divided into three subfamilies (see Roig-Alsina and Michener, 1993). Among these, the extensive and varied subfamily *Apinae* is closely related to either the *Xylocopinae* or the *Nomadinae* subfamilies. Despite the significant differences in appearance between the small, slender species of tribes such as *Ceratinini* and the large, robust species of the tribe *Xylocopini*, *Xylocopinae* is undeniably a holophyletic group. In some analyses conducted by Roig-Alsina and Michener in 1993, *Xylocopinae* is categorized among the tribes of *Apinae*, instead of being considered a foundational group. Therefore, the classification of *Xylocopinae* as a subfamily remains somewhat ambiguous. However, in various analyses, they are identified as the most primitive branch of the *Apidae* family, acting as a sister group to *Apinae* + *Nomadinae*. The *Xylocopinae* subfamily (*Apidae*), is found worldwide and encompasses several groups, including the large carpenter bees (tribe *Xylocopini*), the small carpenter bees (tribe *Ceratinini*), the allodapine bees (tribe *Allodapini*), and the relict genus *Manuelia* (tribe *Manueliini*)<sup>[1]</sup>.

**Material and Methods:** The material for this work was both our own collections (2021-2023) and collection materials of the Institute of Zoology (1925-2020). The collection of materials was carried out in all natural areas of Azerbaijan and various landscapes. The collection of material was carried out using generally accepted methods

in entomology. Trophic connections of bees were established by collecting female bees from already known plant species, and to identify plants unknown to us, herbarium material was made, which was then identified at the Institute of Botany. The identification of bee species was carried out using the Atlas of the European Bees – step project<sup>[2]</sup>, The bee of the world<sup>[1]</sup> guides.

**Discussion:** In Azerbaijan, 15 species from the subfamily *Xylocopinae* are common: these include 10 species from the genus *Ceratina*, belonging to the tribe *Ceratinini*, and 5 species from the genus *Xylocopa*, which are part of the tribe *Xylocopini*<sup>[3]</sup>.

Wild bees are crucial for the pollination of the majority of flowering plants across all continents, making the investigation of their dietary relationships particularly important. This relevance is tied to the need for conservation within natural habitats and the utilization of wild bees for the pollination of entomophilous crops, including alfalfa, clover, sainfoin, and numerous fruit and berry crops.

The identification of trophic connections of bees from the subfamily *Xylocopinae* was achieved through the documentation of plant species from which bees were collected. This process uncovered that species from the genus *Ceratina* are pollinators for 46 plant species across 20 different families, while species from the genus *Xylocopa* pollinate 52 plant species from 18 families, as detailed in Table 1.

**Table 1:** The trophic connections of bees within the subfamily *Xylocopinae*

| Genus           | Plant families and species  |
|-----------------|---|
| <i>Ceratina</i> | Fam. <i>Boraginacea</i> ( <i>Echium altissimum</i> , <i>Echium</i> sp., <i>Myoposis alpestris</i> ); fam. <i>Leguminosae</i> ( <i>Melilotus albu</i> , <i>Medicago sativa</i> , <i>Glycirrhiria echinata</i> ); fam. <i>Asteraceae</i> ( <i>Carduus thoermeri</i> , <i>Jurinea subacaulis</i> , <i>Leontodon asper</i> , <i>Senecio arenaris</i> , <i>S.orientalis</i> , <i>Anthemis oltissima</i> , <i>Scabiosa bipinuata</i> , <i>Senecio coronopifolius</i> , <i>Taraxacum</i> sp.); fam. <i>Rosaceae</i> ( <i>Rubus</i> sp., <i>Alchimilla sericea</i> , <i>Poterium polyganum</i> ); fam. <i>Grossulariaceae</i> ( <i>Ribes biebersteinii</i> ); fam. <i>Brassicaceae</i> ( <i>Erysimum collinum</i> , <i>Erysium repandum</i> , <i>Bunias orientalis</i> , <i>Isatis anceps</i> , <i>Echium rubrum</i> ); fam. <i>Plantaginaceae</i> ( <i>Veronica nudicaulis</i> , <i>V.gentianoides</i> ); fam. <i>Amaryllidaceae</i> ( <i>Allium rubellum</i> , <i>A.cepa</i> ); fam. <i>Convolvulaceae</i> ( <i>Convolvus fischerianus</i> ); fam. <i>Campanulaceae</i> ( <i>Campanulis grossheimi</i> ); fam. <i>Zygophyllaceae</i> ( <i>Zygophyllum</i> sp., <i>Zygophyllum fabago</i> , <i>Pegenum harmale</i> ); fam. <i>Umbellifera</i> ( <i>Eryngium nigromontanum</i> ); fam. <i>Euphorbiaceae</i> ( <i>Euphorbia turkomenica</i> ); fam. <i>Geraniaceae</i> ( <i>Erodium turmenum</i> ); fam. <i>Convolvulaceae</i> ( <i>Calystegia sepium</i> , <i>Convolvulus</i> sp.); fam. <i>Cucurbitaceae</i> ( <i>Citrus edulis</i> , <i>Cucurbita pepo</i> ); |

|                 |  |
|-----------------|--|
|                 | fam. <i>Ranunculaceae</i> ( <i>Clematis orientalis</i> , <i>Delphinium sp.</i> ); fam. <i>Malvaceae</i> ( <i>Alcea rugosa</i> ); fam. <i>Campanulaceae</i> ( <i>Campanula grossheimii</i> , <i>C.erinus</i> ); fam. <i>Caryophyllaceae</i> ( <i>Vaccaria segetalis</i> )   |
| <i>Xylocopa</i> | Fam. <i>Malvaceae</i> ( <i>Malva silvestris</i> , <i>M.neglecta</i> , <i>Lavatera punctata</i> , <i>Lavatera thuringiaca</i> ); fam. <i>Leguminosae</i> ( <i>Medicago sativa</i> , <i>Trifolium campestre</i> , <i>T.spadiceum</i> , <i>Anthyllis variegata</i> , <i>Acacia sp.</i> , <i>Onobryches sp.</i> , <i>Lotus sp.</i> , <i>Gleditsia triacanthos</i> , <i>Robinia pseudoacacia</i> , <i>Colutea sp.</i> , <i>Caragana grandiflora</i> ); fam. <i>Lamiaceae</i> ( <i>Lamium album</i> , <i>Salvia verticellata</i> , <i>Calamintha caucasica</i> , <i>Betonica grandiflora</i> ); fam. <i>Urticaceae</i> ( <i>Urtica urens</i> , <i>U.dioica</i> ); fam. <i>Rosaceae</i> ( <i>Sorbus boissieri</i> , <i>Crataegus sp.</i> , <i>Padus racemosa</i> , <i>Cotoneaster integerrima</i> , <i>Pyrus sp.</i> , <i>Malus domestica</i> , <i>Cerasus avium</i> , <i>Armeniaca vulgaris</i> ); fam. <i>Tiliaceae</i> ( <i>Tilia caucasica</i> , <i>Tilia cordata</i> ); fam. <i>Caprifoliaceae</i> ( <i>Cephalaria sp.</i> , <i>Cephalaria syriaca</i> , <i>Solidago armena</i> , <i>Scabiosae bipinnata</i> ); fam. <i>Brassicaceae</i> ( <i>Bunias orientalis</i> ); fam. <i>Asteraceae</i> ( <i>Anthemis rudophiana</i> , <i>Senecio caucasicus</i> , <i>Carduus sp.</i> , <i>Tanacetum sp.</i> ); fam. <i>Amaryllaceae</i> ( <i>Allium rubellium</i> , <i>Allium cepa.</i> ); fam. <i>Oleaceae</i> ( <i>Syringa sp.</i> ); fam. <i>Tamaricaceae</i> ( <i>Tamarix sp.</i> ); fam. <i>Saxifragaceae</i> ( <i>Saxifraga tridactylites</i> ); fam. <i>Euphorbiaceae</i> ( <i>Euphorbia sequieriana</i> ); fam. <i>Eleagnaceae</i> ( <i>Hippophae rhamnoides</i> , <i>Elaeagnus orientalis</i> ); fam. <i>Rhamnaceae</i> ( <i>Paliurus spina-christi</i> , <i>Rhamnus cathartica</i> ); fam. <i>Celastraceae</i> ( <i>Evonymus nanus</i> ); fam. <i>Zygophyllaceae</i> ( <i>Zygophyllum sp.</i> ) |

The study of the trophic preferences of *Xylocopinae* bees has identified that the most favored plant families for these pollinators include the *Asteraceae*, *Leguminosae*, *Brassicaceae*, *Lamiaceae*, and *Rosaceae*.

Further exploration into the habitat distribution and ecological niches of the *Xylocopinae* bees in Azerbaijan has revealed their presence across different natural areas, landscapes, and altitudinal zones within the country. Specifically: 10 species have been found residing in the regions of the Lesser and Greater Caucasus within Azerbaijan, highlighting the diverse habitats ranging from lowlands to mountainous areas. Eight species are located in the Kura-Araz lowland, an area characterized by its unique ecological conditions and vegetation types. Twelve species have been recorded in the Lenkoran region, indicating a high diversity of bees in this area, which is known for its humid subtropical climate and rich biodiversity. Nine species exist in the Middle Araz region, demonstrating the adaptability of these bees to different environmental conditions and their role in the pollination of various plant species across Azerbaijan.

The subfamily's species inhabit various landscape regions and altitude ranges throughout Azerbaijan, ranging from 27 meters below sea level to 2500 meters above sea level.

When examining the distribution of bees within the *Xylocopinae* subfamily across various landscapes, it was observed that in high-mountain terrains such as subalpine and alpine meadows, six species were identified: *Ceratina chalcites*, *C.cyanea*, *C. callosa*, *Xylocopa valga*, and *X.iris*, in mid-mountain landscapes (deciduous forests and post-forest meadow-shrub, steppe and dry-steppe landscapes) - 3 species: *Ceratina callosa*, *C.cyanea*, *Xylocopa valga*, in low mountains - *Ceratina callosa*, *C.cyanea*, *C.nigrolabiata*, *Ceratina cucurbitina*, *C.loewi*, *C. chalcites*, *C. dallatorreana*, *Xylocopa valga*, *X.violaceae*, *X.iris*, *X.rufa*, *X.olivieri*, in the foothills and low mountains (foothill and low mountain, partly flat, arid forest-shrub (arid woodland) landscape with upland xerophytes on rocky slopes) - *Ceratina callosa*, *C.dallatorreana*, *C.loewi*, *C.cyanea*, *C.chrysomalla*, *Xylocopa valga*, *X.iris*, *X.violaceae*, in lowlands (meadow-forest landscape of moderately dissected intermountain plains and lowlands, semi-desert lowland landscape, salt marsh lowland landscape, aeolian-sandy landscape of the lowlands) - *Ceratina dallatorreana*, *C.cyanea*, *C.chrysomalla*, *C.nigroaenea*, *Xylocopa valga*, *X.violaceae* *X.iris*, *X.rufa*.

The distribution of bee subfamilies corresponds to altitudinal zones in the following manner: within the alpine zone, two species were discovered (*Ceratina chalcites*, *C. callosa*). These species are also present in subalpine and various other zones, making it challenging to identify

exclusively alpine species. Within the subalpine zone, the species *Ceratina chalcites*, *C. callosa*, *C. cyanea*, *Xylocopa valga*, and *X. iris* were recorded.

In the mountainous forest area, species such as *Ceratina chalcites*, *C. callosa*, *C. acuta*, *C. cyanea*, *C. nigrolabiata*, *Xylocopa valga*, *X. violaceae*, and *X. iris* were observed. It is evident from this that the bee subfamilies are relatively diverse in this region. This diversity is primarily influenced by the variety of habitats and vegetation types present, including meadows, meadow-steppes, steppes, forests, shrubs, and post-forest vegetation. In the mountain-steppe zone, species like *Ceratina chalcites*, *C. callosa*, *C. dallatorreana*, *C. acuta*, *C. cyanea*, *C. chrysomalla*, *C. nigrysomalla*, *C. nigroaenea* and *Xylocopa iris* were found.

The abundance of species in this zone is attributed to the diverse range of habitats, soil compositions, lush vegetation, and climate variations. This area supports both forest-dwelling and subalpine species, and it even hosts semi-desert species. Common species found in the semi-desert zone include *Ceratina cucurbitina*, *C. chalcites*, *C. callosa*, *C. dallatorreana*, *C. loewi*, *C. acuta*, *C. nigroaenea*, *Xylocopa valga*, *X. iris*, *X. violaceae* and *X. rufa*.

In terms of zoogeographical distribution, the species within the *Xylocopinae* subfamily are categorized into 8 complexes. Among these, there are 5 species of Mediterranean origin, which encompass all territories surrounding the Mediterranean Sea, including islands, and some of these species are also found in more distant areas. These species are *Ceratina chalcites*, *C. callosa*, *C. acuta*, *Xylocopa iris* and *X. violaceae*. Additionally, there are 2 Transcaucasian-Turanian species, whose ranges extend across the deserts and foothills of Transcaucasia, Iran, Afghanistan, and the Turanian lowland: *Xylocopa rufa*, *X.olivieri*; 1 East Mediterranean-Caucasian species (range covers the Balkan Peninsula, Asia Minor and the Caucasus, sometimes also the Crimean Peninsula) - *Ceratina loewi*; 1 species with a trans-Palaeartic distribution, primarily occupying the nemoral or subtropical zone of the Palaeartic, except for its southeastern part (southern China, the Himalayas), with occasional settlements in the Ancient Mediterranean area, mainly in mountainous regions and river valleys - *Xylocopa valga*; 1 species from the Western Palaeartic region, covering Europe, the Mediterranean, and western Asia, but typically avoiding Eastern Siberia and Central Asia - *Ceratina cyanea*; 1 species of European-Caucasian origin, found throughout Europe except for its northern regions, northern Asia Minor, and the Caucasus, including Transcaucasia - *Ceratina nigroaenea*; 1 species from the East European-Caucasian region, occupying the steppes and foothills of Eastern Europe, excluding the north, as well as the Caucasus with Transcaucasia, often extending

into Asia Minor, northern Iran, and the mountains of Turkmenistan - *Ceratina dallatorreana*; and 3 species of Eastern European-Transcaucasian origin, covering the southern regions of Eastern Europe, the northern areas of Asia Minor, Transcaucasia, and occasionally the northern parts of Iran - *Ceratina cucurbitina*, *C. nigrolabiata* and *C. chrysomalla*.

### Conclusion

Based on the information provided, it can be inferred that the species within the subfamily are present across all landscape types and altitude ranges in Azerbaijan, spanning from 27 meters below sea level to 2500 meters above sea level. These species play an important role as pollinators for entomophilous crops and, in terms of their zoogeographical origin, they predominantly belong to the fauna of the Mediterranean subregion within the Palearctic division of the Holarctic region.

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