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# DIVERSITY, SEASONAL CHANGES AND FLORAL CHOICES OF SPECIES OF THE APIDAE FAMILY (HYMENOPTERA: APOIDEA) IN TIZI-OUZOU REGION (ALGERIA)

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**ABSTRACT.** Bees have a great economic and environmental importance; they play an important role in terrestrial ecosystems as pollinators. This field survey was carried out on the bee fauna and its abundance in the region of Tizi-Ouzou (northern Algeria) from January to August over a period of three years, from 2012 to 2014. This study focused on the family *Apidae* (*Hymenoptera, Apoidea*) in four localities with different altitudes and with a great plant diversity, little is known about this family in the Tizi-Ouzou region. A total of 612 specimens of solitary harvesting bees (no cleptoparasites) including 34 species and subspecies belonging to six genera were collected in the study area using various sampling techniques. Represented by 13 species, *Eucera* was the dominant genus. It was followed by *Anthophora* and *Ceratina* with seven species each. The most abundant species were *Ceratina cucurbitina*, and *Eucera notata*. Moreover, we report two species and one subspecies as endemic for North Africa: *Eucera spatulata, Eucera decolorata, Xylocopa iris cupripennis*. The present study provides base data for studies of the insect biodiversity of Tizi-Ouzou area. These findings constitute a first step towards building regional networks to address issues regarding the understanding and management of our ecosystems.

**Keywords:** *Hymenoptera, apoidea, apidae, diversity, seasonal changes, floral choices, Algeria.*

## INTRODUCTION

Studies on solitary bees constitute one of the under-researched topics in Algeria, whereveryfewinvestigationshavebeendedicated to Apoidea. According to [1] the Maghreb probably presents a very high diversity close to or greater than that of California where 1200 species were counted in 1976 by Moldenke cited by [2]. The most famous studies on the bee fauna in Algeria are those of [3], [4], [1], [5] and [6]. The studies of [3], [1] and [4] concern Apoïdes fauna encompass several regions of Algeria and even the whole country, [5] explored northern Algeria from east to west. Concerning the Apidae family, a synthesis of the species number recorded by the work carried out in Algeria and North Africa has made it possible to note the absence of this family by several authors [5, 6, 7, 8, 4, 9]. However, [3] and [10] recorded two and three species of Apidae family respectively. Other authors focused their studies on specific taxa, such as *Halictus*

of the Hoggar (Algerian Sahara) [7, 9], *Ceratina* of the Maghreb [8] and *Xylocopa* of sub-group *Copoxyla*of the Mediterranean Region [11].

Recently, some local authors reported results on wild bee fauna in Constantine (north eastern Algeria) [12, 13, 14, 15, 16, 17, 18, 19, 20, 21]. These investigations revealed the presence of 382 species of Bees belonging to 55 genera. These species were distributed into six families: Colletidae (2 genera, 25 species), Melittidae (3 genera, 9 species), Halictidae (8 genera, 60 species), Andrenidae (5 genera, 77 species), Apidae (17 genera, 111 species) and Megachilidae (20 genera, 100 species). Long tongued bees were more represented with 211 species against 171 for those with a short tongue in Algeria. For the Kabylie area (Tizi-Ouzou), we only know studies by [22], [23] and [24]. Where they identified 103 bee taxa belonging to six taxonomic families (Colletidae, Andrenidae, Halictidae, Anthophoridae, Megachilidae, Apidae).

Since there was no known published data of wild bees in this region, the main objectives of this study were (*i*) to provide the first inventory of wild bee species belonging to the Apidae family in the region of Tizi-Ouzou (northern Algeria) and (*ii*) specify their phenology and floral choices, with a focus on their abundance.

## MATERIALS AND METHODS

### *Systematic frame*

The present study deals with one coherent ecological group, which is the solitary bees constituting the Apoidea, Apiformes (non cleptoparasites) from the Apidae family (*sensu* [25], ex-Anthophoridae). This family includes three subfamilies: the Apinae, also called social bees, the Xylocopinae, or carpenter bees, and the Nomadinae, which are cleptoparasites. The later subfamily was excluded from our investigation, which focuses on the tribes of Xylocopini, Ceratinini, Anthophorini and Eucerini.

The captured insects were preserved and their identification was based on the keys written by [8], Rasmont in [26] which concerns the Anthophorini and [11], [27], [28], [29] Concerning Xylopini, *Ceratina, Eucera*.

### *Geographical frame and study area*

The region of Tizi-Ouzou belongs to one of the three great biogeographical subdivisions of the Mediterranean area in Algeria. This area is located 100 km east of Algiers. It is divided into three domains: the northern Mauritanian domain, the southern Mauritanian domain and the Atlas high mountains domain. Our study area is located in the northern Mauritanian domain, which stretches fromTenes in the west to Tunisia in the east. It is characterized by a Mediterranean climate with two contrasting seasons: wet and cold winter and hot and dry summer.

Our investigation was carried out at four stations (Fig.1), the characteristics (latitude, longitude, elevation (m) and land description) of which are recorded as following:

- Station1: Tadmaït 36° 43'N 4° 00'E, 180 m, fallow.
- Station 2: Azazga 36° 45'N 4° 18'E, 180 m, fallow.
- Station 3: Makouda36° 47'N 4° 03'E, 670 m, pasture.
- Station 4: Beni Douala36° 37'N 4° 05'E, 800 m, fallow.

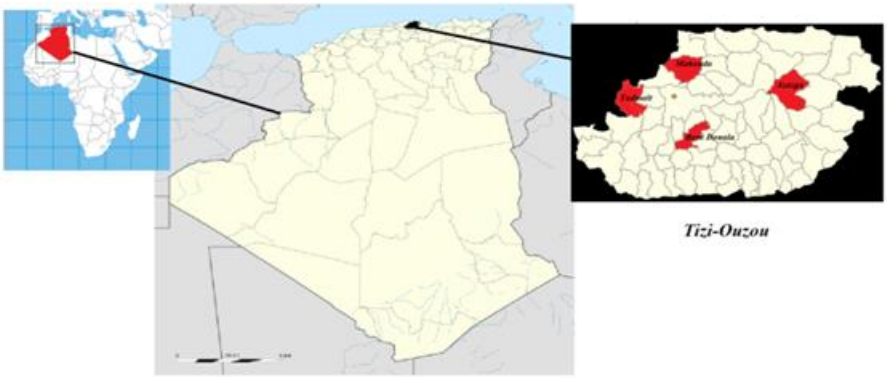


***Fig 1.*** *Location map of study stations*

### *Sampling and data analysis procedure*

Our study area encompassed four stations of about two hectares each (Fig.1). The presence of a wide range of vegetation types was the determining criterion for choosing the location and size of each station. Sampling consisted of regular fieldwork of three hours, once a week, from January to August over a period of three years, from 2012 to 2014. Data from several years were merged into the dynamic analysis because the data over a long period are more representative.

The sampling method was mainly based on sight hunting techniques, using small plastic boxes containing cotton soaked in ether. This direct capture approach facilitated the collection of bees, as the captured insects are killed quickly, as soon as they come into contact with the killing agent. Moreover, this approach allowed us also to know what the host plants were. The sampling procedure was completed by two other techniques, which are the entomological net for the bees characterized by quick flight, such as Xylocopes, and the insect aspirator for the small-sized species. Samples of the plants visited by the bees were also collected, conserved at the laboratory and identified by M. Laribi and T. Asla from the University of Tizi-Ouzou (Algeria).

A one-way analysis of variance by a mean comparison test (Newman-Keuls at a risk level of 5%) was performed to evaluate the effects of the stations on the distribution of the species of bees. We have also statistically tested the number of species and the number of specimens according to the months. These treatments are carried out by the STAT-BOX software version 6.40.

## RESULTS AND DISCUSSION

### *Apidae fauna*

A total of 598 specimens of solitary bees from the Apidae family belonging to 29 species, five subspecies and six genera were collected from the four study sites **(**Table 1**).** Among the listed species the most abundant solitary bee was *Ceratina cucurbitina* with an abundance of 40.68%. *Eucera notata* was the second most common species (14.70%) among wild bees identified in the region of Tizi-Ouzou. Represented by 264 specimens and 13 species, *Eucera* was the dominant genus. It was followed by *Ceratina* with 263 specimens and 7 species, *Anthophora* with four species, two subspecies and 31 specimens and *Xylocopa* with 30 specimens**.** The lowest diversity and abundance were recorded by the genera of *Amegilla* and *Tetralonia* (Fig. 1).

The number of captured bee species varied between 16 and 20 at each station. However, the stations 1 and 4 recorded slightly larger numbers than those collected at the stations 2 and 3. Moreover, the difference between these values was not significant at the 5% threshold. On the other hand, the number of specimens encountered varies significantly according to the study stations.

Among the 34 collected species and subspecies, five species and two subspecies have been observed in three stations. Only three species and one subspecies were present in all the stations: *Anthophora plumipes pennata*; *E. notata*, *Eucera numida* and *C. cucurbitina* (Table 1). The other species were observed in only one or two stations. The station 4, in the locality of Beni Douala was the most diverse; it contains the highest number of species.

***Table 1.*** *List of collected bee taxa*

| Species | Number of specimens | | | | |
|---|---|---|---|---|---|
| | **Station 1** | **Station 2** | **Station 3** | **Station 4** | **Total** |
| *Anthophorasubterranea*Germar 1826. | 0 | 0 | 0 | 2 | 2 |
| *Anthophoraplumipesplumipes* Pallas, 1772 | 1 | 5 | 3 | 0 | 9 |
| *Anthophoraplumipespennata*Lepeletier 1841 | 1 | 4 | 3 | 1 | 9 |
| *Anthophoradispar*Lepeletier, 1841 | 0 | 0 | 1 | 3 | 4 |
| *Anthophoraquadricolor*Erichson 1840 | 0 | 0 | 0 | 4 | 4 |
| *Anthophoraatroalba*Lepeletier 1841 | 0 | 0 | 0 | 1 | 1 |
| *Anthophoraleucophaea*Pérez 1879 | 0 | 0 | 1 | 1 | 2 |
| *Amegillaalbigenatalaris*Pérez 1895 | 0 | 0 | 0 | 9 | 9 |
| *A. quadrifasciataquadrifasciata*de illers,1790 | 0 | 0 | 0 | 8 | 8 |
| *Euceraparvula*Friese, 1896 | 0 | 0 | 1 | 2 | 3 |
| *Euceralongicornis*Linnaeus, 1758 | 13 | 12 | 5 | 0 | 30 |
| *Eucerainterrupta*Bär, 1850 | 13 | 16 | 0 | 0 | 29 |
| *Eucera pannonica* Mocsary 1878 | 0 | 0 | 2 | 0 | 2 |
| *Euceraspatulata*Gribodo 1893 | 3 | 0 | 3 | 0 | 6 |
| *Eucerapulveracea*Dours 1873 | 9 | 0 | 5 | 0 | 14 |
| *Euceranotata*Lepeletier 1841 | 48 | 19 | 12 | 11 | 90 |
| *Euceraeucnemidea*Dours 1873 | 10 | 1 | 0 | 1 | 12 |
| *Euceranigrifacies*Lepeletier, 1841 | 2 | 15 | 0 | 3 | 20 |
| *Euceranumida*Lepeletier,1841 | 19 | 6 | 5 | 5 | 35 |
| *Euceradecolorata*, Gribodo 1893 | 0 | 8 | 0 | 1 | 9 |
| *Euceragraeca*Radoszkowski, 1876 | 2 | 6 | 3 | 0 | 11 |
| *Euceranigrilabris*Lepeletier 1841 | 1 | 2 | 0 | 0 | 3 |
| *Xylocopaviolacea*Linné 1758 | 12 | 0 | 6 | 2 | 20 |
| *Xylocopavalga*Gerstaecker 1872 | 4 | 0 | 0 | 0 | 4 |
| *Xylocopa iris cupripennis*Smith 1874 | 2 | 1 | 3 | 0 | 6 |
| *Ceratinacucurbitina*Rossi 1792 | 70 | 21 | 27 | 131 | 249 |
| *Ceratinaparvula* Smith 1854. | 3 | 0 | 0 | 0 | 3 |
| *Ceratinadentiventris*Gerstäcker, 1869 | 0 | 0 | 0 | 1 | 1 |
| *Ceratinacallosa*Fabricius 1794 | 0 | 1 | 0 | 0 | 1 |
| *Ceratinasaundersi*Daly 1983 | 0 | 0 | 2 | 1 | 3 |
| *Ceratinaalbosticta*Cockerell 1931 | 3 | 1 | 0 | 1 | 5 |
| *Ceratinadallatorreana*Friese 1896 | 0 | 0 | 0 | 1 | 1 |
| *Tetraloniamacroglossa* Illiger, 1806 | 0 | 0 | 3 | 0 | 3 |
| *Tetraloniadentata*Klug, 1835 | 0 | 4 | 0 | 0 | 4 |
| Total Specimens | 216 | 122 | 85 | 189 | 612 |
| Total Species and subspecies | 18 | 16 | 17 | 20 | 34 |

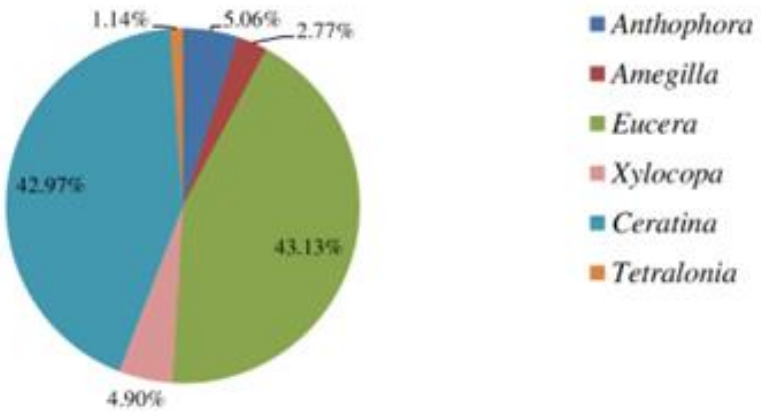


***Fig 2.*** *Distribution of specimens of bees in respective genera.*

Our results show that no species were observed at any of the four stations in January. In February, only four species were captured in stations 1 and 4. From March to July, the number of species collected varied between 10 and 16. The maximum number of species was recorded in March, April and May. Number of specimens captured in June and July was most important (Fig. 2) it may be due to the flowers abundance in this period. Only one species, *E. numida* was observed in August. The statistical test showed that there was a significant difference (at the 5% threshold) of the number of species as well as the number of specimens according to the months.

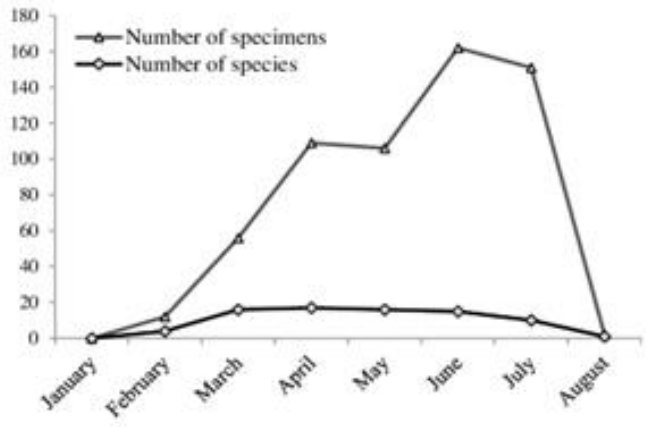


***Fig 3.*** *Apidae seasonal changes from January to August for the period 2012-2014.*

The number of individuals increased significantly in June and July, which was mainly due to a proliferation of *E. notata* and *C. cucurbitina* during that period of the year (Fig. 3). Other species, such as *A. albigenatalaris, A. quadrifasciata quadrifasciata* and *A. quadricolor*, appeared in July just after the flowering of *A. azurea.* In May, we observed

a great abundance of *E. notata* on *S. hispanicus*. However, this was accompanied by a concomitant slight decrease of this species during this month.

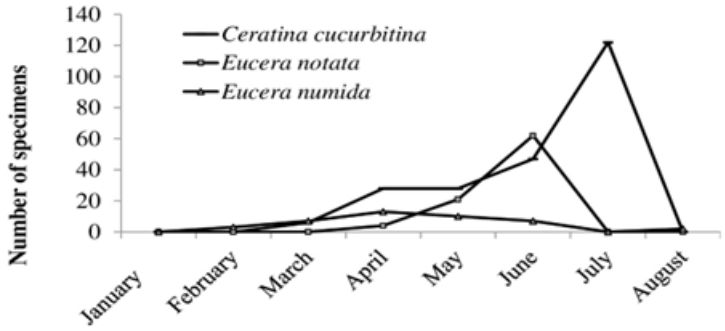


***Fig 4.*** *Seasonal changes of the most abundant Apidae species during the study period.*

### *Floristic inventory*

The common and most prevalent plant species in the different stations were: *Centaurea pullata*L., *Scolymus hispanicus* L. *Andryala integrifolia* L., *Galactites tomentosa* Moench *Pallenis spinosa* L., *Pulicaria odora* Reich (Asteraceae); *Cerinthe major* L., *Echium australe* Lamark (Poiret), *Borago officinalis* L. (Boraginaceae); *Daucus carota* L. (Umbelliferae); *Lotus edulis* L. (Fabricius) (Fabaceae); *Oxalis pes-caprae* L. (Thumb) (Oxalidaceae) and *Sinapis arvensis* L. (Brassicaceae).

Plant species on which bees were observed during our sampling campaigns are reported in Table 2. The distribution of the visits between the Apidae showed that the highest number of plant families and plant species was visited by Genus *Eucera* (Fig. 4). Moreover, each species of bee visited a selection of forage plants and the number of plant families and plant species visited varies by species as it's illustrated for the most representative species (Figs. 5, 6). Our findings showed that *E. australe* (Boraginaceae), *Stachys arvensis* and *Teucrium cylindraceum.* (Lamiaceae) are highly appreciated by *Ceratina* species and particularly, by the most frequent species, *C. cucurbitina*. Some species, such as *E. notata* and *C. cucurbitina,* are polylectic. The flight period of these bees is long; it lasts more than three months. Other species seem to be more or less restricted to specific plants, such as *A. quadricolor, A. quadrifasciata* and *A. albigena talaris* that are attracted exclusively by *A. azurea.*

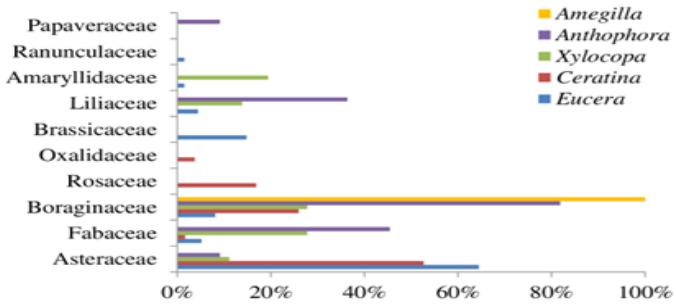


***Fig 5.*** *Frequency (%) of the different genera of Apidae on plant families.*

***Table 2.*** *The distribution of the frequent bee species collected from the available forageplants*

| **Beesspecies** / **Plant species** | ***Anthophoraplumipes*** | ***Anthophoradispar*** | ***Anthophoraquadrico*** | ***Amegillaalbigena*** | ***Amegillaquadrifasci*** | ***Xylocopaviolacea*** | ***Xylocopa valga*** | ***Xylocopa iris*** | ***Ceratinacucurbitina*** | ***Ceratinasendersi*** | ***Ceratinaalbosticta*** | ***Eucerapulveracea*** | ***Eucera notata*** | ***Eucera numida*** | **Total Specimens** | **Total Species** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Chrysanthemum fontanesii* Quezel& Santa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | 0 | **1** | **1** |
| *Galactites tomentosa* Moench | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** | 0 | 0 | 0 | **7** | **2** | **11** | **3** |
| *Scolymus hispanicus* L. | 0 | 0 | 0 | 0 | 0 | **2** | **1** | **1** | **103** | 0 | 0 | 0 | **30** | 0 | **137** | **5** |
| *Anthemis arvensis* L. | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | **1** |
| *Andryala integrifolia* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **6** | 0 | **1** | 0 | **9** | 0 | 16 | **3** |
| *Pulicaria odora* (L.) RC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** | 0 | 0 | 0 | **5** | 0 | **9** | **2** |
| *Centaurea pullata* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** | **1** | **1** | **9** | **19** | **1** | **33** | **6** |
| *Hieracium prenanthoides* Vill. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **6** | 0 | 0 | 0 | **1** | 0 | **7** | **2** |
| *Reichardia picroides* (L.) Roth | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** | **1** | **3** | **2** |
| *Trifolium campestre* Schrb. | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | **1** |
| *Lotus corniculatus* L. | 0 | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | **3** | **5** | **3** |
| *Lotus edulis* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **3** | **3** | **1** |
| *Lupinus angustifolius* L. | 0 | 0 | 0 | 0 | 0 | **7** | 0 | **3** | **4** | 0 | 0 | 0 | 0 | 0 | **14** | **3** |
| *Cerinthe major* L. | **1** | **2** | 0 | 0 | 0 | 0 | 0 | **2** | 0 | 0 | 0 | 0 | 0 | **16** | **21** | **4** |
| *Echium australe* Lamarck | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **31** | **1** | **1** | 0 | 0 | 0 | **33** | **4** |
| *Anchusa azurea* Miller | **2** | 0 | **4** | **9** | **8** | **2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **25** | **5** |
| *Borago officinalis* L. | 0 | 0 | 0 | 0 | 0 | **6** | 0 | 0 | 0 | 0 | 0 | 0 | **3** | **2** | **11** | **3** |
| *Stachys arvensis* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **14** | 0 | **1** | 0 | 0 | 0 | **15** | **2** |
| *Teucrium cylindraceum* Greuter&Burdet | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **15** | 0 | 0 | 0 | 0 | 0 | **15** | **1** |
| *Oxalis pes-caprae*L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **7** | **1** | **1** | 0 | 0 | 0 | **9** | **3** |
| *Papaver rhoeas*L. | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | **1** |
| *Asphodelus microcarpus* Salzm. &Viv. | **4** | 0 | 0 | 0 | 0 | **4** | **1** | 0 | 0 | 0 | 0 | 0 | 0 | **6** | **15** | **4** |
| *Narcissus tazetta* L. | 0 | 0 | 0 | 0 | 0 | **5** | **2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **7** | **2** |
| *Rubus ulmifolius* Schott. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **41** | 0 | 0 | 0 | 0 | 0 | **41** | **1** |
| *Ranunculus bulbosus* L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** | 0 | **2** | **1** |
| *Sinapis arvensis*L. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **14** | 0 | 0 | 0 | 1**0** | **1** | **25** | **3** |

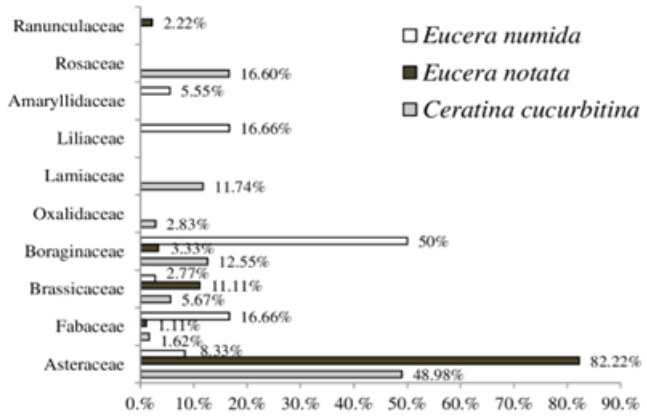


***Fig 6.*** *Frequency (%) of the most abundant species on plant families.*

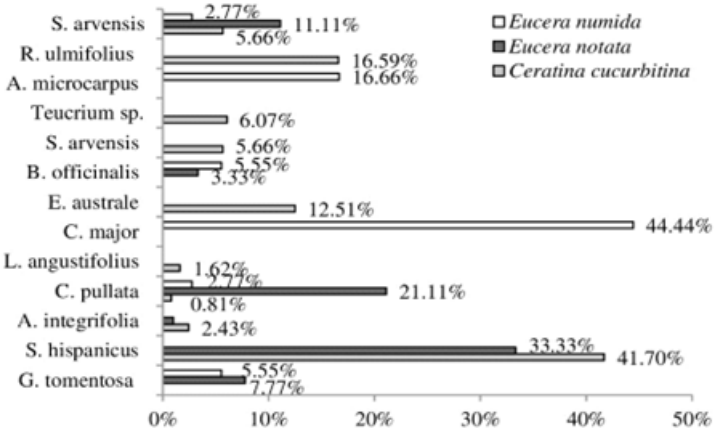


***Fig 7.*** *Frequency (%) of the most abundant species on plant species.*

To quantify the degree of specialization of the most abundant species of bees, we calculated the indices of floral visits by applying the Simpson diversity index (it indicates the concentration of individuals on the foraged plants, it varies between zero and one. The concentration is high when the SIMPSON index approaches to one); Is*f* for families and Is*p* for species. The values of these indices are reported in Table 3. Bees whose Is*f* is less than 0.5 are species which visited many families of plants, they therefore appear as polylectic, this is the case of *C. cucurbitina* (0, 298) and *E. numida* (0, 296). *Eucera notata* has the lowest index of visits Is*p* (0.180), which means that it is the least selective in its choices of plants to forage. It is clear that the species of bees for which the Is*f*/Is*p* ratio is the highest, in this case *E. notata* (3,811) concentrated its visits on various plants of its preferred family. The number of plant species for *E. notata* in Astaraceae is indeed very important (eight plant species), which explains why the Isf / Isp ratio is the highest for this bee.

***Table 3.*** *Indices of floral visits (Is) of the most abundant bees by plant families and plant species visited*

| Espèces | Ni | Is*p* | Is*f* | Is*f*/Is*p* | Number of plant families visited | Number of plant species visited |
|---|---|---|---|---|---|---|
| ***Ceratinacucurbitina*** | 249 | 0.226 | 0.298 | 1.318 | 7 | **12** |
| ***Euceranotata*** | 90 | 0.180 | 0.686 | 3.811 | 5 | **12** |
| ***Euceranumida*** | **35** | **0.230** | **0.296** | **1.286** | **6** | **9** |

Among the 24 plant species recorded, some are very rarely visited by the bees. In contrast, others are greatly appreciated and constitute excellent bee-forage plants. The most visited plants by bees belong to Asteraceae as *Centaurea, Scolymus, Galactites* (47.82%), Boraginaceae as *Echium, Anchusa* (19.65%) and Fabaceae as *Lupinus* (5.02%). The most visited plant species are *S. Hispanicus* with 29.3% and *Rubus ulmifolius* (Rosaceae) with 10% of all visits of bees. *A. Azurea* and *E. Australe* are also relatively well foraged on. *Rubus ulmifolius* seems to be appreciated by *C. cucurbitina*.

Of the solitary species of Apidae that were caught between January and August within the study area, three species are specifically Mediterranean: *Eucera spatulata, Ceratina saundersi* and *Ceratina albosticta*. The other species are wide spread. *Eucerini* species are distributed throughout the Mediterranean area and even in northern Europe. They are, in fact, known for their polylectic character [2, 30]; our results confirm this.

Our inventory (34 species and subspecies) lists less than half of the species that were quoted by [3] and [8]. [1] reported more than 70 species, mainly among the two genera of *Anthophora* and *Eucera* in eastern and southern Algeria. [5] recorded 31 species of *Eucera in* the center of Algeria. In addition, many other species have been quoted by authors such as [31], [6], [7], [15], [21],[22], [24], [23], [12] and [13].

This lower number of collected species could be the result of the sampling period length, which did not include the autumn season, as well as the result of different biogeographical contexts between this study and the above mentioned ones: our region is located outside the thermomediterranean climate zone shelter a specific flora.

The significant number of the genera *Ceratina* and *Anthophora* is approximately the same in Tizi-Ouzou and in Constantine: seven species for *Ceratina* and eight species for *Anthophora* in Tizi-Ouzou; seven species for *Ceratina* and five species for *Anthophora* in Constantine [21]. The genus *Ceratina* consists of thermophile species. Therefore, the largest number of species should be observed in Tizi-Ouzou because Constantine is situated in a semi arid region and it is three times more distant from the Mediterranean Sea than Tizi-Ouzou. However, these similar findings could be explained by the fact that the sampling period was extended until November in Constantine, while in our study it ended in August.

For the genus *Ceratina,* [8] quoted nine species in Algeria. In our investigation, we identified only six, among which we cite *Ceratina parvula*. This species has been only identified in two Algerian sea side localities (Annaba: 36°54’N 7°45’E and El Kala: 36°42’N 8°26’E) [8]. This affinity of the species for the thermomediterranean climate was reported by [32] and by [29]. The presence of *C. Parvula* in Tizi-Ouzou is remarkable. The tiny size of this species (less than 3mm) makes it very discrete, which

may be explains the fact that its distribution was reported as limited, since its observation in the field is not very easy.

Among the four species of the genus *Xylocopa* listed in Algeria, only *Xylocopa amedaei* was not observed. So far, this species has been identified only in the region of Constantine and its nests have been observed only in woods of Atlas cedar trees [3]; [15]. Hence, the absence of this tree species within 20 km around our study area probably accounts for the absence of *X. amedaei*. A reference was made by [33] concerning the presence of *Xylocopa cantabrita* in Constantine. However, this species is only known in the Middle Atlas in Morocco, the Iberian Peninsula and the south of France [27]. Probably, the specimen observed by [33] was *X. amedaei*, as the two species could be easily confused. *Eucera spatulata, Eucera decolorata* and *Xylocopa iris cupripennis* are endemic species and sub-species of North Africa [11]. *X. iris cupripennis* is known from the Atlantic coast to Tunisia. A population also exists in Cyrenaica. It seems to avoid arid zones and, consequently, is concentrated along coastal areas. Our findings corroborate those reported by [1], who had already observed this species in Tizi-Ouzou.

[1] and [5] also listed some of our species, such as *A. quadricolor, A. Albigenatalaris* and *A. quadrifasciata quadrifasciata*, which are very attracted to plants belonging to the Boraginaceae family. Our results show that these same bee species for age exclusively on *A. azurea*. Furthermore, these bees seem to be more adapted to high elevations, as we did not notice the presence of any of these species in the low-lying part of our study area, like in Tadmaït (station 1), where *A. azurea* is largely available. The station 4, in the locality of Beni Douala was the most diverse; it contains the highest number of species. This could be explained by the presence of *Anchusa azurea* (Lamiaceae), as *Anthophora quadricolor*; *Amegilla albigenatalaris* and *Amegilla quadrifasciata quadrifasciata* appreciate this plant species. More over, these bee species were observed only in this station and exclusively on this plant.

The abundance of bees reached its peak in March, while the plants were in full flower. This peak has been mentioned in April for the region of Constantine [15]. This is mainly due to the climate differences between the two regions. Indeed, the mean monthly temperature in March and April is higher in the region of Tizi-Ouzou (13.6 °C) than in the Constantine area (10.5 °C). The abundance of *E. notata* on *S. hispanicus* in May which was accompanied by a concomitants light decrease of this species during this month could be explained by the disappearance and scarcity of some othe rplant species appreciated by these bees at that period of the year.

We note that our most abundant species, *C. Cucurbitina* (frequency of 38.6%), is relatively rare in the region of Constantine (frequency of 0.1%) [9]. Furthermore, *Rubus ulmifolius* Schott in which *Ceratina* nest frequently, has not been reported in the list of the plant species by [15] for his study area.

The species most visited by the bees is *S. hispanicus*. It is visited by 29.3% of the bee species, followed by *R. ulmifolius* with10% and two species *C. pullata* and *Echium australe*, which each one was foraged by 7.2% of the bee species. We also noticed that the flowers of *A. integrifolia* and *O. pes-caprae* were rarely visited by the bees collected, despite their wide distribution in our study area. The Asteraceae and the Oxalidaceae are in fact, known to be attractive to long-tongued bees, which belong the Apidae. The morphology of the Apidae mouthparts explains why these bees with a long and slender glossa mostly visit flowers with deep corolla tubes, such as those of the families Boraginaceae, Fabaceae and Lamiaceae, which account for about 26% of plants in the stations we studied.

We observed that the bees that visited the highest number of plants were *E. Notata* and *C. cucurbitina*. Similar results were reported by [5] in Algeria. In the region of Constantine, [15] noted that *E. Notata* was the bees pecies that visited the highest number of plants (15).

## CONCLUSION

In conclusion, our results showed that *Eucera* was the dominant genus, it was followed by *Ceratina.* Among the listed species the most abundant solitary bee was *Ceratina cucurbitina, Eucera notata* and *Eucera numida.* Regarding the floral choices, we noted that the bee species collected did not visit homogeneously the available plant species in our study area. *E. notata* which was the most polylectic species has foraged various species of plants. On the contrary, some of our species, such as *A. quadricolor, A. albigena talaris and A. quadrifasciata quadrifasciata* foraged exclusively on *A. azurea*, they are thereby monolectic. Moreover, *Centaurea pullata, Scolymus hispanicus, Anchusa azurea* were the plant species most foraging by bees.

In Algeria, research on bees remains a little-studied topic. Our study provides baseline data on bee biodiversity in the region of Tizi-Ouzou. While new species were identified, further studies are needed on a larger scale and for a longue period, involving more bee families in order to build a larger data scale network.

These Apoïdes may play a non-negligible pollination role in blooming spontaneous plants and culture. Consequently, it is important to maintain wild bee populations at sufficiently high levels. It is therefore necessary to preserve these populations of bees and promote their development by protecting their habitats. It is suggested to conserve the nesting sites of this important group of insects and to ovoid unjustified use of pesticides during the flowering period.

Our study being limited to a single family that of the Apidae, it would be interesting to approach future studies treating the other families of Apoids in the same region and the same conditions.

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