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A contribution to the knowledge of the genus *Andrena* Fabricius from Iran

(Hymenoptera, Apoidea, Andrenidae)

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During faunistic surveys of Short-Tongued (ST) bees in northeastern Iran, a total of 33 *Andrena* species were collected and identified. Within collected specimens, 12 species were new records for Iranian fauna. The subgenus *Tarsandrena* was also reported for the first time from the country. Taking into account the new records, the number of all bee species of the genus *Andrena* increased from 148 to 160. Brief ecological remarks on the recorded species are provided. The map of species richness of Iranian *Andrena* species is presented.

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Introduction

Pollination is one of the common mutualistic interactions between plants and animals (Shimizu et al. 2014). Majority of angiosperm plant species are pollinated by various types of pollinators (Thompson 2001) which among them, insects play a pivotal role as the chief vectors for pollen transfer in both domesticated and wild flowering plants (Gallai et al. 2009, Garibaldi et al. 2013, Zattara & Aizen 2021). One of the most diverse and lucrative insect pollinators are bees (Garibaldi et al. 2013, Kilpatrick et al. 2020, Prakash et al. 2020). There is an exclusively mutual bargain between the bees and flowering plants where the pollinator lead to help for reproduction of the plants in exchange for gaining pollen and nectar during its visitation of flowers (Theodorou et al. 2020) to conclude their larval development or for their own use as food (Westerkamp 1996, Vanderplanck et al. 2014).

Out of 20507 worldwide bee species, more than 50 % (10445 species) belong to five ST bee families, namely, Andrenidae, Colletidae, Halictidae, Melittidae and Stenotritidae (Ascher & Pickering 2022) which are frequently characterized by four similar segments of labial palpi (Michener 2007, Allahverdi et al. 2016). Out of approximately 10424 ST bee species currently described throughout the world, 487 species, i. e. nearly 5 % of the total described species, have been hitherto recorded from Iran (Ascher & Pickering 2022). However, with the scrutiny of all new and old published literature on Iranian ST bees and excluding the current research, the exact number of ST bee species of the country should be 572.

In Iran, the family Andrenidae has 11 genera, including *Andrena* Fabricius 1775; *Camptopoeum* Spinola, 1843; *Clavipanurgus* Warncke, 1972; *Flavomeliturgula* Patiny, 1999; *Gasparinahla* Patiny, 2001; *Khuzimelissa* Warncke, 1985; *Melitturga* Latreille, 1809; *Meliturgula* Friese, 1903; *Panurginus* Nylander, 1846; *Panurgus* Panzar, 1806 and *Plesiopanurgus* Cameron, 1907 as well as 46 subgenera and 179 species. Most studies on the Iranian andrenid bees have been focused on the largest genus of the family, i.e. *Andrena*. The genus *Andrena* is the second largest genus among all genera of apoid bees with approximately 1550 species throughout the world (Ascher & Pickering 2022). According to the latest classification of subgenera of *Andrena*, the genus comprises 38 subgenera and 148 species in Iran (Radchenko et al. 2021, Pisanty et al. 2021).

Despite the vastness of Iran and its high floral diversity, the number of taxonomic works focused on the genera of andrenid bees is relatively low (Warncke 1968, Ariana et al. 2009a, b, Allahverdi et al. 2015, 2016, Radchenko et al. 2021). Up-to-date entomological research programs of andrenid bees have not been spatially systematic, so certain areas of Iran have been studied more, while others less. Moreover, there is clear evidence of a decline in pollinators' diversity and abundance at global scale (Gallai et al. 2009, Fortel et al. 2014, Buchholz & Egerer 2020, Hooda & Jain 2020, Theodorou et al. 2020), so, protecting native bee biodiversity in natural areas is of great importance. Hence, there is a growing need to improve our understanding of faunal composition of bees in order to provide a basis for their conservation. The major purpose of this study is to broaden the knowledge of Iranian *Andrena* species which had previously been deficiently and sporadically studied and pave the way for future research of wild bee fauna of the country at local and regional levels.

Materials and methods

This survey was carried out on the landscapes of northeastern Iran during a period of two years from March 2017 to August 2018. Specimens were collected using sweeping net and put in containers containing ethyl acetate and then were brought to the laboratory for further morpho-taxonomic examinations. Identification of all collected Andrenidae specimens was conducted using available keys and resources (Warncke 1968, Osytshnjuk 1977, Gusenleitner & Schwarz 2002, Osytshnjuk et al. 2005, 2008, Michener 2007). In this paper, the classification by Tadauchi & Xu (1999) and Michener (2007) is followed. The nomenclature and terminology follows Ascher & Pickering (2022). Based on the review of the relevant literature data and the samples collected in the current study, the map of species richness of ST bees was prepared by ArcMap version 10.6.1. All of the specimens collected during this study are deposited in the Collection of Entomology of Ferdowsi University of Mashhad, Iran.

Results

Numerous sampling efforts in 21 studied areas of Razavi and North Khorasan provinces resulted in identification of 33 species belonging to 16 subgenera of the genus *Andrena* which among them, 12 species are new records for the Iranian fauna. The species *Andrena* (*Tarsandrena*) *tarsata* Nylander, 1848 (Fig. 1), is a new subgenus for the country. The collected species in this study are arranged alphabetically by the subgenus and finally by the species name. First records for Iran are denoted by an asterisk (*).

Genus *Andrena* Fabricius, 1775

Subgenus *Aciandrena* Warncke, 1968

Andrena chersona Warncke, 1972*

Material examined: Iran, Razavi Khorasan, Gonabad (34°20'54'' N, 58°44'42'' E), 28.IV.2018, 1♂; Roshtkhar (34°29'45'' N, 59°39'29'' E), 29.IV.2018, 1♂.

Associated plants. This study: *Tamarix* sp. (Tamaricaceae) and *Astragalus* sp. (Fabaceae). Literature data: Oligolege on Brassicaceae (Osytshnjuk 1977, Osytshnjuk et al. 2005).

Distribution. Ukraine, Azerbaijan, Turkmenistan and Hungary (Warncke 1972, Gusenleitner & Schwarz 2002, Osytshnjuk et al. 2005, Ascher & Pickering 2022).

Andrena tenuis Morawitz, 1877

Material examined: Iran, Razavi Khorasan, Neishabur, Soleimani (34°29'45'' N, 59°39'29'' E), 16.IV.2017, 1♂.

Associated plants. This study: *Medicago sativa* (Fabaceae). Literature data: Oligolectic of Brassicaceae (Osytshnjuk et al. 2005).

Distribution. Iran: Qazvin, Tehran and Khorasan (Popov 1967); Turkmenistan, Azerbaijan, Georgia, Russia, Turkey and Hungary (Warncke 1974a, Gusenleitner & Schwarz 2002, Ascher & Pickering 2022).

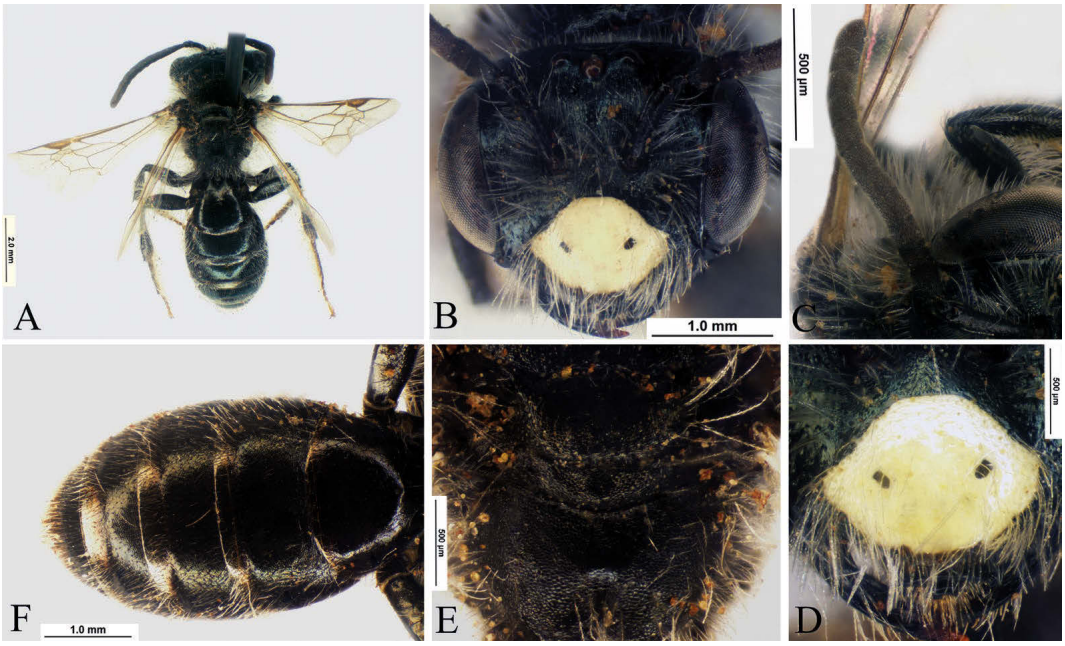

Fig. 1. *Andrena* (*Tarsandrena*) *tarsata* Nylander. **A.** General habitus; **B.** Head in frontal view; **C.** Antenna; **D.** Clypeus; **E.** Propodeum; **F.** Metasoma.

Subgenus *Aenandrena* Warncke, 1968

Andrena hedikae Jaeger, 1934

Material examined: Iran, Razavi Khorasan, Gonabad (34°20'54" N, 58°44'42" E), 28.IV.2018, 1♂.

Associated plants. This study: *Tamarix* sp. (Tamaricaceae). Literature data: Females visit flowers of Brassicaceae (*Isatis tinctoria*, *Cardaria draba*) and Apiaceae, sometimes they were found on *Gallium*, *Medicago sativa* (Osytshnjuk et al. 2005).

Distribution. Iran: North of Iran (Gusenleitner & Schwarz 2002), Kazakhstan, Azerbaijan, Turkey, Russia (Volgograd region), Ukraine, Moldova, Hungary, Slovakia, Serbia, Slovenia, France, Italy, Spain and Morocco (Gusenleitner & Schwarz 2002, Shebl & Tadauchi 2009, Lhomme et al. 2020, Ascher & Pickering 2022).

Andrena hystrix Schmiedeknecht, 1883*

Material examined: Iran, Razavi Khorasan, Qare su (36°58'21" N, 59°40'50" E), 10.VII.2018, 1♀.

Associated plants. This study: *Cardaria draba* (Brassicaceae). Literature data: Females visit the flowers of Brassicaceae and Asteraceae (Osytshnjuk et al. 2005).

Distribution. Turkmenistan, Armenia, Georgia, Turkey, Ukraine, Hungary, Moravia, Bohemia, Croatia, Switzerland, France, Portugal, Spain, Morocco and Tunisia (Gusenleitner & Schwarz 2002, Lhomme et al. 2020, Ascher & Pickering 2022).

Subgenus *Chlorandrena* Pérez, 1890

Andrena humilis Imhoff, 1832

Material examined: Iran, Razavi Khorasan, Neishabur, Soumea (36°16'59" N, 58°50'12" E), 10.V.2017, 1♂.

Associated plants. This study: *Cardaria draba* (Brassicaceae). Literature data: Oligolectic, females collect pollen from the flowers of Asteraceae (Osytshnjuk et al. 2005).

Distribution. Iran: Alborz (Ascher & Pickering 2022); Russia, Kyrgyzstan, Kazakhstan, Uzbekistan, Azerbaijan, Georgia, Turkey, Jordan, Tunisia, Algeria, Morocco, Portugal, Spain, Ireland, United Kingdom, France, Belgium, Germany, Czech Republic, Austria, Italy, Denmark, Hungary, Romania, Greece, Bulgaria, Lithuania, Belarus, Ukraine, Latvia, Finland, Sweden and Norway (Gusenleitner & Schwarz 2002, Lhomme et al. 2020, Wood 2021, Ascher & Pickering 2022).

Subgenus *Cnemidandrena* Hedicke 1933

***Andrena simillima* Smith, 1851**

Material examined: Iran, Razavi Khorasan, Neishabur, Baqrud (36°14'02'' N, 58°51'52'' E), 10.IV.2018, 1♂.

Associated plants. This study: unknown. Literature data: Females collect pollen from the flowers of Asteraceae, Rosaceae, Lamiaceae, Campanulaceae, and Ericaceae (Osytshnjuk et al. 2005).

Distribution. Iran: Alborz (Ascher & Pickering 2022); Mongolia, Russia, Azerbaijan, Ukraine, Finland, Lithuania, Slovakia, Greece, Italy, Switzerland, Austria and United Kingdom (Sidorov et al. 2020, Ascher & Pickering 2022).

Andrena tridentata* (Kirby, 1802)

Material examined: Iran, Razavi Khorasan, Neishabur, Soleimani (34°29'45'' N, 59°39'29'' E), 16.IV.2017, 1♂.

Associated plants. This study: *Medicago sativa* (Fabaceae). Literature data: Females collect pollen from the flowers of Asteraceae (Osytshnjuk et al. 2005).

Distribution. Kazakhstan, Russia (Bashkortostan, Krasnodar Region), Belarus, Latvia, Ukraine, Poland, France and United Kingdom (Gusenleitner & Schwarz 2002, Osytshnjuk et al. 2005, Shebl & Tadauchi 2009, Scheuchl & Willner 2016, Ascher & Pickering 2022).

Subgenus *Euandrena* Hedicke, 1933

Andrena ruficrus* Nylander, 1848

Material examined: Iran, North Khorasan, Shirvan, Gelian (37°13'59'' N, 57°34'59'' E), 18.V.2017, 1♂.

Associated plants. This study: *Astragalus* sp. (Fabaceae). Literature data: In Finland it was recorded on the flowers of 29 plant species (Elfving 1968). Females collect pollen from the flowers of various early spring plants *Pulsatilla*, *Anemone*, *Tussilago*, etc., but prefer flowers of *Salix* sp. (Osytshnjuk et al. 2008). Based on Scheuchl & Willner (2016), it is strikingly oligolectic on *Salix* sp.

Distribution. Russia, Japan, South Korea, Turkey, Caucasus, Kazakhstan, Kyrgyzstan, Ukraine, Finland, Lithuania, Hungary, Malta, Germany, France, Belgium, Netherlands, Denmark, United Kingdom and United States (Gusenleitner & Schwarz 2002, Osytshnjuk et al. 2008, Ascher & Pickering 2022).

Subgenus *Melandrena* Pérez, 1890

***Andrena albopunctata* (Rossi, 1792)**

Material examined: Iran, Razavi Khorasan, Neishabur, Eshq abad (35°58'46'' N, 59°40'50'' E), 4.V.2017, 1♀.

Associated plants. This study: *Cardaria draba* (Brassicaceae). Literature data: Females collect pollen from the flowers of Brassicaceae, Caprifoliaceae, Lamiaceae, Asteraceae, Apiaceae, Fabaceae, Rosaceae, Ranunculaceae, Geraniaceae, Valerianaceae (Popov 1967, Osytshnjuk 1977, Osytshnjuk et al. 2008), but mainly on Brassicaceae.

Distribution. Iran: Golestan, Isfahan, Damavand, Balouchistan (Popov 1967, Allahverdi et al. 2016, Khodarahmi Ghahnavieh & Monfared 2019, Ascher & Pickering 2022); Morocco, Spain, Tunisia, France, Corsica, Italy, Slovenia, Czech Republic, Poland, Bulgaria, Romania, Ukraine, Turkey, Russia, Georgia, Kazakhstan, Azerbaijan, Pakistan, Afghanistan, Turkmenistan and Uzbekistan (Popov 1967, Gusenleitner & Schwarz 2002, Osytshnjuk et al. 2008, Tadauchi 2008, Grace 2010, Hazir et al. 2014, Lhomme et al. 2020, Ascher & Pickering 2022).

***Andrena cussariensis* Morawitz, 1886**

Material examined: Iran, North Khorasan, Bojnurd (37°31'46'' N, 57°20'45'' E), 15.V.2018, 1♂.

Associated plants. This study: *Cirsium* sp. (Asteraceae). Literature data: Females collect pollen from the flowers of Rosaceae, Ranunculaceae, Asteraceae, Cistaceae (Osytshnjuk et al. 2008).

Distribution. Iran: Alborz and Mazandaran (Ascher & Pickering 2022); India, Pakistan, Kyrgyzstan, Tajikistan, Kazakhstan, Uzbekistan, Mongolia, Turkey, Azerbaijan, Russia, Georgia and Ukraine (Gusenleitner & Schwarz 2002, Osytshnjuk et al. 2008, Ascher & Pickering 2022).

***Andrena nigroaenea* (Kirby, 1802)**

Material examined: Iran, Razavi Khorasan, Gonabad (34°20'54'' N, 58°44'42'' E), 28.IV.2018, 1♀.

Associated plants. This study: *Tamarix* sp. (Tamaricaceae). Literature data: *Onosma tanaiticum* (Boraginaceae) (Radchenko 1989), *Vaccinium vitis-idea* (Ericaceae), *Berteroa incana* (Brassicaceae), *Taraxacum officinale*, *Pyretrum* sp., *Leucanthemum raciborskii* (Asteraceae), *Potentilla* sp. (Rosaceae), *Geranium sanguineum* (Geraniaceae), *Salvia nemorosa* (Lamiaceae) (Osytshnjuk 1977). In England, females collect pollen from 15 species of 9 families (Chambers 1968) and

in Poland, females visited 91 plant species from 25 families (Ruszkowski et al. 2000).

Distribution. Iran: Khoram Abad and Mazandaran (Alfken 1935, Ascher & Pickering 2022); Azerbaijan, Georgia, Israel, Afghanistan, Egypt, Tunisia, Finland, Ireland, Turkey, Morocco, Portugal, Spain, Ireland, United Kingdom, France, Belgium, Germany, Czech Republic, Austria, Italy, Denmark, Hungary, Romania, Greece, Bulgaria, Lithuania, Belarus, Ukraine, Latvia, Finland, Sweden, Norway, Poland, Latvia and Hungary (Warncke 1969, 1973, Osytshnjuk 1977, Gusenleitner & Schwarz 2002, Scheuchl & Willner 2016, Lhomme et al. 2020, Ascher & Pickering 2022).

Subgenus *Micrandrena* Ashmead, 1899

Andrena alfkenella Perkins, 1914*

Material examined: Iran, Razavi Khorasan, Neishabur, Baqrud (36°14'02''N, 58°51'52''E), 10.IV.2018, 1♂; Fariman, Baqsalar (35°58'46''N, 59°45'12''E), 1.VI.2018, 1♂.

Associated plants. This study: *Peganum harmala* (Nitrariaceae) and unknown for the first location. Literature data: Females collect pollen from the flowers of Brassicaceae, Asteraceae, Apiaceae, Rosaceae (Osytshnjuk 1977).

Distribution. Azerbaijan, Russia, Ukraine, Turkey, Greece, Bulgaria, Latvia, Slovakia, Austria, Germany, Switzerland, Denmark, United Kingdom, Morocco and Portugal (Warncke 1974a, 1974b, Osytshnjuk 1977, Gusenleitner & Schwarz 2002, Scheuchl & Willner 2016, Lhomme et al. 2020, Ascher & Pickering 2022).

Andrena falsifica Perkins, 1915

Material examined: Iran, Razavi Khorasan, Roshtkhar (34°29'45''N, 59°39'29''E), 29.IV.2018, 1♀.

Associated plants. This study: *Astragalus* sp. (Fabaceae). Literature data: Females collect pollen from the flowers of Rosaceae, Brassicaceae, Ranunculaceae, Liliaceae, Asteraceae, Cistaceae (Osytshnjuk 1977).

Distribution. Iran: Golestan (Allahverdi et al. 2016); Russia, Ukraine, Azerbaijan, Georgia, Bulgaria, Italy, Germany, Austria, Switzerland, Portugal, United Kingdom, Czech Republic, Hungary, Latvia and Sweden (Osytshnjuk 1977, Gusenleitner & Schwarz 2002, Scheuchl & Willner 2016, Sidorov et al. 2020, Ascher & Pickering 2022).

Andrena floricola Eversmann, 1852

Material examined: Iran, Razavi Khorasan, Neishabur, Mirabad (36°16'59''N, 58°47'59''E), 18.IV.2017, 1♂.

Associated plants. This study: *Medicago sativa* (Fabacaeae). Literature data: Females collect pollen from the flowers of Brassicaceae and Apiaceae (Osytshnjuk 1977).

Distribution. Iran: Isfahan (Khodarahmi Ghahnavieh & Monfared 2019); Armenia, Russia, Georgia, Turkey, Bulgaria, Moldova, Ukraine, Lithuania, Sweden, Poland, Germany, Austria and France (Osytshnjuk 1977, Gusenleitner & Schwarz 2002, Ascher & Pickering 2022).

Andrena magunta Warncke, 1965

Material examined: Iran, Razavi Khorasan, Neishabur, Baqrud (36°14'02''N, 58°51'52''E), 10.IV.2018, 1♂.

Associated plants. This study: unknown. Literature data: Females collect pollen from the flowers of Brassicaceae and Asteraceae (Osytshnjuk 1977).

Distribution. Russia, Ukraine, Bulgaria, Georgia, Azerbaijan, Turkey, Romania and Greece (Osytshnjuk 1977, Hazir et al. 2014, Allahverdi et al. 2016, Wood 2021, Ascher & Pickering 2022).

Andrena minutula (Kirby, 1802)*

Material examined: This study: Iran, North Khorasan, Shirvan, Tansavan (37°21'51''N, 57°56'20''E), 18.V.2017, 1♀.

Associated plants This study: *Astragalus* sp. (Fabaceae). Literature data: Wide polylectic, females collect pollen from the flowers of Salicaceae, Rosaceae, Asteraceae, Ranunculaceae, Companulaceae, Ericaceae, Brassicaceae, Geraniaceae, Scrophulariaceae and Dipsacaceae (Osytshnjuk 1977).

Distribution. Japan, China, Georgia, Azerbaijan, Russia, Ukraine, Moldova, Romania, Turkey, Israel, Libya, Algeria, Morocco, Syria, Spain, France, Belgium, Germany, Czech Republic, Greece, Italy, Serbia, England, Ireland, Sweden, Slovakia, Austria, Switzerland, Poland, Estonia, Finland, Denmark and Norway (Osytshnjuk 1977, Gusenleitner & Schwarz 2002, Xu & Tadauchi 2011, Scheuchl & Willner 2016, Lhomme et al. 2020, Wood 2021, Ascher & Pickering 2022).

Andrena nanula **Nylander, 1848***

Material examined: Iran, Razavi Khorasan, 20 km to Faruj (37°03'43''N, 58°18'12''E), 18.V.2017, 1♀; Qare su (36°58'21''N, 59°40'50''E), 10.vii.2018, 1♀; Mashhad, Kang (36°17'36''N, 59°11'22''E), 08.V.2017, 1♀.

Associated plants. This study: *Consolida* sp. (Ranunculaceae), Asteraceae or Fabaceae and unknown for the third location.

Distribution. Russia, Belarus, Spain, Italy, France, Belgium, Austria, Switzerland, Slovenia, Germany, Bohemia, Moravia, Hungary, Slovakia, Denmark, Estonia, Lithuania, United Kingdom, Sweden, Poland, Finland, Norway and Ukraine (Sidorov et al. 2020, Ascher & Pickering 2022).

Andrena rugulosa **Stoeckhert, 1935**

Material examined: Iran, North Khorasan, Bojnurd (37°31'46''N, 57°20'45''E), 15.V.2018, 1♂.

Associated plants. This study: *Cirsium* sp. (Asteraceae). Literature data: *Taraxacum officinale* (Asteraceae), *Alyssum desertorum*, *Alyssum trichostachyum*, *Calepina irregularis* (Brassicaceae), *Helianrhemum obscurum* (Cistaceae) (Osytshnjuk 1977).

Distribution. Iran: Fars, Golestan (Khodaparast & Monfared 2012, Allahverdi et al. 2016); Georgia, Far eastern Turkey, Greece, Macedonia, Romania, Ukraine, Italy, Slovenia, Hungary, France, Switzerland, Germany, Czech Republic, Moravia, Bulgaria, Poland and Lithuania (Gusenleitner & Schwarz 2002, Grace 2010, Khodaparast & Monfared 2012, Wood 2021, Ascher & Pickering 2022).

Andrena stoeckhertella **Pittioni, 1948**

Material examined: Iran, Razavi Khorasan, Neishabur, Soleimani (34°29'45''N, 59°39'29''E), 16.IV.2017, 2♂♂.

Associated plants. *Medicago sativa* (Fabaceae). Literature data: Females predominantly collect pollen on the flowers of Brassicaceae such as *Lepidium draba*, *Barbarea arcuata*, *Sisymbrium altissimum*, *S. orientale*, *Pyrethrum* sp. and other, but were also found on the flowers of *Taraxacum officinale*, *Senecio* sp. (Asteraceae), *Euphorbia* sp. (Euphorbiaceae), and one male was collected from the flowers of Lamiaceae (Osytshnjuk 1977).

Distribution. Iran, Azerbaijan, Georgia, Russia, Ukraine, Moldova and Turkey (Osytshnjuk 1977, Proshchalykin et al. 2017, Ascher & Pickering 2022).

Andrena tringa **Warncke, 1973***

Material examined: Iran, Razavi Khorasan, Qare su (36°58'21''N, 59°40'50''E), 10.VII.2018, 1♀.

Associated plants. This study: Asteraceae or Fabaceae. Literature data: Females predominantly collect pollen on the flowers of Brassicaceae such as *Lepidium draba*, *Isatis tinctoria*, *Erucastrum armoracioides*, *Crambe tataria*, *Sinapis arvensis*, *Barbarea arcuata*, *B. vulgaris*, *Alyssum tortuosum*, *Sisymbrium altissomum*, and other, but were also found on the flowers of *Pimpinella* sp. (Apiaceae), *Potentilla humifusa* (Rosaceae) and *Taraxacum officinale* (Asteraceae) (Osytshnjuk 1977).

Distribution. Bulgaria, Macedonia, Turkey, Russia, Bulgaria, Ukraine and Romania (Warncke 1973, 1974b, Gusenleitner & Schwarz 2002, Wood 2021, Ascher & Pickering 2022).

Subgenus *Notandrena* Pérez, 1890

Andrena chrysosceles **(Kirby, 1802)***

Material examined: Iran, Razavi Khorasan, Bazangan (36°18'28''N, 60°22'54''E), 20.IV.2018, 1♂.

Associated plants. This study: *Astragalus* sp. (Fabaceae). Literature data: *Leucanthemum vulgare* (Asteraceae), *Taraxacum officinale* (Asteraceae), *Euphorbia* sp. (Euphorbiaceae), *Isatis tinctoria* (Brassicaceae), *Salix* sp. (Salicaceae), *Lamium* sp. (Lamiaceae), *Onobrychis* (Fabaceae), *Fragaria vesca*, *Crataegus* sp. (Rosaceae), *Veronica chamaedrys* (Plantaginaceae) (Kocourek 1966, Chambers 1968, Osytshnjuk 1977).

Distribution. Turkey, Bulgaria, Kazakhstan, Ukraine, Belarus, Lithuania, Hungary, Italy, Spain, Belgium, France and United Kingdom (Warncke 1967, Gusenleitner & Schwarz 2002, Wood 2021, Ascher & Pickering 2022).

Subgenus *Pallandrena* Brullé, 1832

Andrena braunsiana **Friese, 1887***

Material examined: Iran, Razavi Khorasan, Bazangan (36°18'28''N, 60°22'54''E), 20.IV.2018, 1♂.

Associated plants. This study: *Astragalus* sp. (Fabaceae). Literature data: *Taraxacum officinale* (Asteraceae), *Lepidium draba* (Brassicaceae), *Ranunculus repens* (Ranunculaceae), *Veronica austriaca*, *V. chamaedrys* (Plantaginaceae) (Kocourek 1966, Osytshnjuk 1977).

Distribution. Georgia, Russia, Turkey, Greece, Ukraine, Hungary, Poland, Bosnia and Herzegovina,

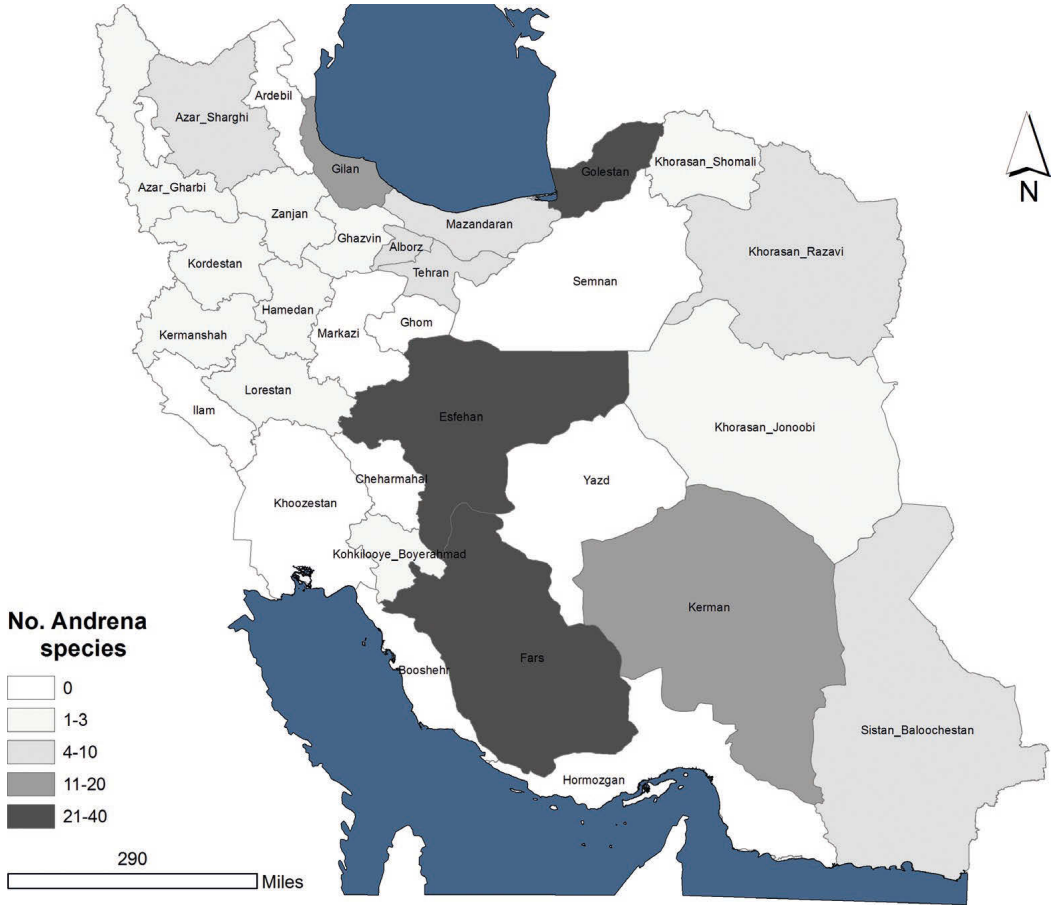

Fig. 2. Species richness of the genus *Andrena* in the provinces of Iran.

Slovakia and Austria (Friese 1887, Stoeckhert 1933, Gusenleitner & Schwarz 2002, Ascher & Pickering 2022).

Subgenus *Parandrenella* Popov, 1958

Andrena dentiventris Morawitz, 1874

Material examined: Iran, Roshtkhar (34°29'45''N, 59°39'29''E), 29.IV.2018, 2♂♂.

Associated plants. *Astragalus* sp. (Fabaceae).

Distribution. Iran: Tehran (Popov 1967, Gusenleitner & Schwarz 2002); Azerbaijan, Turkey, Kazakhstan and Georgia (Gusenleitner & Schwarz 2002, Maharramov 2009, Shebl & Tadauchi 2011, Proshchalykin et al. 2017, Lhomme et al. 2020, Ascher & Pickering 2022).

Andrena figurata Morawitz, 1866

Material examined: Iran, Razavi Khorasan, Neishabur, Soleimani (34°29'45''N, 59°39'29''E), 16.IV.2017, 1♂.

Associated plants. This study: *Medicago sativa* (Fabaceae). Literature data: Females predominantly collect pollen on the flowers of Brassicaceae such as *Erucastrum armoracioides*, *Lepidium draba*, *Sinapis arvensis*, *Sisymbrium loeselii*, *S. orientale*, *Barbarea vulgaris*, *B. arcuata*, and very rare on other plants, e. g., *Potentilla humifusa* (Rosaceae), *Euphorbia* (Euphorbiaceae), *Caragana arborescens* (Fabaceae), *Achillea leptophylla* (Asteraceae) (Osytshnjuk 1977).

Distribution. Iran, Azerbaijan, Russia, Turkey, Kazakhstan, Georgia, Cyprus, Ukraine, Bulgaria, Romania, Macedonia, Hungary, Slovakia, Poland, Croatia and Italy (Ban & Tomozei 2006, Ascher & Pickering 2022).

Subgenus *Plastandrena* Hedicke, 1933

***Andrena bimaculata* (Kirby, 1802)**

Material examined: Iran, Razavi Khorasan, Neishabur, Soleimani (34°29'45'' N, 59°39'29'' E), 16.IV.2017, 1♂; 35 km to Soltan abad (36°13'59'' N, 58°21'00'' E), 15.IV.2017, 1♀.

Associated plants. This study: *Medicago sativa* (Fabaceae) and unknown for the second location. Literature data: Polylege, females collect pollen from the flowers of a variety of unrelated plants such as Salicaceae, Cornaceae, Rosaceae, Ranunculaceae, Brassicaceae, Hypericaceae, Asteraceae and Cistaceae (Osytshnjuk 1977).

Distribution. Iran: Guilan and Mazandaran (Morice 1921, Alfken 1935); Mongolia, Tajikistan, Kazakhstan, Kyrgyzstan, Uzbekistan, Afghanistan, Turkmenistan, Azerbaijan, Georgia, Iraq, Syria, Israel, Turkey, Greece, Bulgaria, Romania, Russia, Ukraine, Belarus, Lithuania, Estonia, Finland, Sweden, Poland, Czech Republic, Hungary, Switzerland, Austria, Germany, Denmark, France, Tunisia, Algeria, Morocco, Portugal, Spain, France and United Kingdom (Gusenleitner & Schwarz 2002, Scheuchl & Willner 2016, Sidorov et al. 2020, Lhomme et al. 2020, Wood 2021, Ascher & Pickering 2022).

***Andrena tibialis* (Kirby, 1802)**

Material examined: Iran, Razavi Khorasan, Neishabur, Eshq abad (35°58'46'' N, 59°40'50'' E), 4.V.2017, 1♂.

Associated plants. This study: *Cardaria draba* (Brassicaceae). Literature data: Polylege, females collect pollen from the flowers of a variety of unrelated plants such as Rosaceae, Euphorbiaceae, Fabaceae Salicaceae, Brassicaceae, Asteraceae, Apiaceae, Papaveraceae and Hypericaceae (Osytshnjuk 1977).

Distribution. Iran: Golestan and Mazandaran (Alfken 1935, Popov 1967, Allahverdi et al. 2016, Ascher & Pickering 2022); Russia, China, Kyrgyzstan, Kazakhstan, Georgia, Armenia, Turkey, Russia, Germany, Greece, Cyprus, Malta, Macedonia, Romania, Ukraine, Bosnia and Herzegovina, Italy, Belarus, Spain, France, United Kingdom, Netherlands, Czech Republic, Austria, Switzerland, Germany, Slovakia, Hungary, Norway, Sweden, Denmark, Bulgaria, Estonia and Lithuania (Alfken 1935, Osytshnjuk 1977, Gusenleitner & Schwarz 2002, Tadauchi 2008, Grace 2010, Hazir et al. 2014, Scheuchl & Willner 2016, Sidorov et al. 2020, Wood 2021, Ascher & Pickering 2022).

Subgenus *Poliandrena* Warncke, 1968

***Andrena limbata* Eversmann, 1852**

Material examined: Iran, Razavi Khorasan, Neishabur, Soleimani (34°29'45'' N, 59°39'29'' E), 16.IV.2017, 1♂; 20 km to Faruj (37°03'43'' N, 58°18'12'' E), 18.V.2017, 1♂; 35 km to Soltan abad (36°13'59'' N, 58°21'00'' E), 15.IV.2017, 16♂♂.

Associated plants. This study: *Medicago sativa* (Fabaceae), *Consolida* sp. (Ranunculaceae) and unknown for the third locality. Literature data: Oligolege of Campanulaceae (Kocourek 1966).

Distribution. Iran, Turkmenistan, Georgia, Russia, Turkey, Ukraine, Syria, Greece, Romania, Croatia, France and Spain (Gusenleitner & Schwarz 2002, Ascher & Pickering 2022).

Subgenus *Simandrena* Pérez, 1890

***Andrena combinata* (Christ, 1791)**

Material examined: Iran, Razavi Khorasan, Neishabur, Soumea (36°16'59'' N, 58°50'12'' E), 10.V.2017, 1♂.

Associated plants. This study: *Cardaria draba* (Brassicaceae). Literature data: Polylege, females collect pollen from the flowers of a variety of unrelated plants (Osytshnjuk 1977).

Distribution. Iran: Isfahan (Khodarahmi Ghahnavieh & Monfared 2019); Azerbaijan, Georgia, Turkmenistan, Uzbekistan, Tajikistan, Kazakhstan, Kyrgyzstan, China, Mongolia, Russia, Turkey, Israel, Cyprus, Greece, Romania, Ukraine, Belarus, Lithuania, Albania, Serbia, Slovakia, Poland, Germany, Austria, Switzerland, Czech Republic, Austria, Italy, Algeria, Spain, Portugal, Netherland and France (Gusenleitner & Schwarz 2002, Scheuchl & Willner 2016, Ascher & Pickering 2022).

Andrena susterai* Alfken, 1914

Material examined: Iran, Razavi Khorasan, Qare su (36°58'21'' N, 59°40'50'' E), 10.VII.2018, 1♀.

Associated plants. This study: Asteraceae or Fabaceae. Literature data: Polylege, females collect pollen from the flowers of a variety of unrelated plants such as Rosaceae, Brassicaceae, Asteraceae, Salicaceae, Ranunculaceae and Geraniaceae (Osytshnjuk 1977).

Distribution. Russia, Greece, Bulgaria, Moldova, Ukraine, Hungary, Romania, Slovakia, Germany, Austria, Italy and Slovenia (Alfken 1933, Warncke 1967, Móczár & Warncke 1972, Gogala 2011, Ascher & Pickering 2022).

Subgenus *Tarsandrena* Osytshnjuk, 1984*

Andrena tarsata* Nylander, 1848

Material examined: Iran, Razavi Khorasan, Neishabur, Soleimani (34°29'45'' N, 59°39'29'' E), 16.IV.2017, 1♂.

Associated plants. This study: *Medicago sativa* (Fabaceae). Literature data: Oligolege on *Potentilla* and *Spirea* (Rosaceae) (Osytshnjuk 1977, Rasmont et al. 2013).

Distribution. Azerbaijan, China, Georgia, Mongolia, Russia, Turkey, and nearly all European countries (Gusenleitner & Schwarz 2002, Rasmont et al. 2013, Scheuchl & Willner 2016, Ascher & Pickering 2022).

Subgenus *Trachandrena* Robertson, 1902

***Andrena haemorrhoa* (Fabricius, 1781)**

Material examined: Iran, Razavi Khorasan, Neishabur, Soumea (36°16'59'' N, 58°50'12'' E), 10.V.2017, 1♂.

Associated plants. This study: *Cardaria draba* (Brassicaceae). Literature data: Frequently polylege, females collect pollen from the flowers of a variety of unrelated plants such as *Tussilago farfara*, *Salix*, *Campanula patula*, *Rubus idaeus*, *Carum carvi*, *Potentilla impolita*, *Taraxaccum officinale*, *Prunus spinosa*, *Crataegus*, *Pyrus communis*, *Rapistrum perenne*, *Ficaria verna*, *Barbarea arucata* (Osytshnjuk 1977). In Finland, the species was found on the flowers of 80 species of plants (Elfving 1968).

Distribution. Iran: Mazandaran, Isfahan and Khoram Abad (Alfken 1935, Gusenleitner & Schwarz 2002, Khodarahmi Ghahnavieh & Monfared 2019, Ascher & Pickering 2022); South Korea, Japan, Russia, China, Mongolia, Kazakhstan, Turkmenistan, Syria, Libya, Algeria, Azerbaijan, United State, Turkey, France, Spain, Bosnia and Herzegovina, England, Ireland, Denmark, Germany, Austria, Switzerland, Belgium, Norway, Estonia and Lithuania (Popov 1958, Hirashima 1965, Gusenleitner & Schwarz 2002, Scheuchl & Willner 2016, Ascher & Pickering 2022).

Subgenus *Truncandrena* Lanham, 1949

***Andrena oulskii* Radoszkowski, 1867**

Material examined: Iran, Razavi Khorasan, Neishabur, 35 km to Soltan abad (36°13'59'' N, 58°21'00'' E), 15.IV.2017, 3♀♀.

Associated plants. Unknown.

Distribution. Iran: Isfahan and Fars (Khodaparast & Monfared 2012, Ascher & Pickering 2022); Afghanistan, Azerbaijan, Turkey, Bulgaria and Morocco (Gusenleitner & Schwarz 2002, Wood 2021, Ascher & Pickering 2022).

***Andrena truncatilabris* Morawitz, 1877**

Material examined: Iran, Razavi Khorasan, Neishabur, 35 km to Soltan abad (36°13'59'' N, 58°21'00'' E), 15.IV.2017, 1♂.

Associated plants. This study: Unknown. Literature data: Females predominantly collect pollen on the flowers of Brassicaceae (Kocourek 1966), but were also found on the Lamiaceae, Asteraceae, Fabaceae, Rosaceae and Euphorbiaceae (Osytshnjuk 1977).

Distribution. Iran: Mazandaran, Golestan and Tehran (Popov 1967, Ascher & Pickering 2022); Turkmenistan, Kazakhstan, Morocco, Algeria, Russia, Georgia, West Bank, Syria, Cyprus, Turkey, Israel, Bulgaria, Greece, Ukraine, Serbia, Slovakia, Moravia, Slovenia, France, Italy, Austria and Spain (Warncke 1969, 1974a, 1974b, Gusenleitner & Schwarz 2002, Lhomme et al. 2020, Ascher & Pickering 2022).

Discussion

Including the newly reported *Andrena* species in this study, a total of 587 ST bee species and 160 *Andrena* species are recorded for Iran. According to the latest updated classification of *Andrena* subgenera (Pisanty et al. 2021) and based on the list of the subgenera of the genus *Andrena* (Allahverdi et al. 2015) and also considering the newly recorded subgenus *Tarsandrena*, the total number of *Andrena* subgenera of the country reached to 39. The Palearctic subgenus *Tarsandrena* comprises 8 species and is distributed from Europe to Eastern Asia (Michener 2007, Ascher & Pickering 2022). Nearly 58 % of 65 subgenera of the genus *Andrena* in the Palearctic region have been reported from Iran so far (Allahverdi et al. 2015, Pisanty et al. 2021).

A. chersona which is presented within the European red list of bees is recorded hereby for the third time from Asia (Nieto et al. 2014). The common habitats of *A. chersona* are in xeric areas and it is oligolegtic on Brassicaceae (Osytshnjuk et al. 2005). However, we found this species on *Tamarix* sp. (Tamaricaceae) and *Astragalus* sp. (Fabaceae).

The species *A. humilis* is an endangered solitary bee and has declined in recent decades throughout Western Europe (Franzén & Larsson 2007). *A. humilis*

is an oligolectic bee, it feeds on Asteraceae as already recorded (Osytshnjuk et al. 2005). Nevertheless, we caught this species on Brassicaceae (*Cardaria draba*).

A. hystrix is another species in the European red list of bees (Nieto et al. 2014). This species prefers xeric biotopes and mountains and occurs at altitudes up to 1600 m. The females of this species visit flowers of the Brassicaceae and Asteraceae (Osytshnjuk et al. 2005). We caught this species around *Cardaria draba* (Brassicaceae).

A. tridentata is one of the critically endangered bee species in Europe (Nieto et al. 2014). Although the species was previously only found in the humid biotopes (Osytshnjuk et al. 2005), in the current study, it was found in a semi-arid area around a hydrophilic plant farm (Alfalfa).

A. oulskii is a scatter distributed species in the world but interestingly, it is reported here from Iran for the third time (Khodaparast & Monfared 2012, Ascher & Pickering 2022).

The species *A. chrysosceles*, as a polylectic bee (Wood et al. 2020), is strongly at risk of extinction due to the impacts of insecticides on it, as a non-target species (Mancini et al. 2019). On the contrary, Burger et al. (2020), with the study on the numerous records of *A. bimaculata*, assessed that the population of this sand bee which was extinct for a period of 65 years in South-West Germany, is increasing in Rhine valley, Germany.

Figure 2 shows that the highest richness of Iranian *Andrena* species is related to Fars, Isfahan and Golestan provinces and unfortunately as yet, there have been no records for 10 provinces of the country. According to the map (Fig. 2) and considering the number of reported species in each province of Iran, the most suitable potential areas in terms of species diversity which can be prioritized for future studies are revealed. We hope that the current study helps to fill the representing gap of our knowledge on the *Andrena* bees of Iran to some extent and can be used as a reliable source for oncoming researches.

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