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ARTÍCULO DE INVESTIGACIÓN

Knowledge of wild bees (Hymenoptera, Apoidea) in the Northwest region of Morocco

Conocimiento sobre las abejas silvestres (Hymenoptera, Apoidea) en la región noroeste de Marruecos

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ABSTRACT

The current knowledge of wild bees remains limited within natural and semi-natural areas in Morocco, particularly in the northwestern region, including the Larache cork oak forest and the agricultural landscapes of the Gharb plain. Over three consecutive years (2021, 2022 and 2023), an inventory was conducted across various vegetative landscapes (forest, edge and agricultural fields) using diverse trapping methods and direct observation techniques. This study recorded a total of 531 individuals, representing 80 species and 21 genera distributed across six families. Notably, 71 species were identified in the Larache cork oak forest, while 14 species were documented in the agricultural lands of the Gharb plain, including two endemic species *Andrena insignis* and *Eucera nadigi* and one species newly reported for Morocco *Nomada stigma*. These findings highlight the urgent need for conservation and management strategies to safeguard the diversity of wild bees in both forest and agricultural ecosystems of the region.

Keywords: cork oak, diversity, Gharb plain, knowledge, Larache, Morocco, Northwest, wild bees.

RESUMEN

El conocimiento actual sobre las abejas silvestres sigue siendo limitado en los espacios naturales y semi-naturales de Marruecos, particularmente en la región noroeste, que incluye el bosque de alcornoques de Larache y los paisajes agrícolas de la llanura del Gharb. Durante tres años consecutivos (2021, 2022 y 2023), se llevó a cabo un inventario en diversos paisajes vegetales (bosque, bordes y campos agrícolas) utilizando métodos de captura variados y técnicas de observación directa. Este estudio registró un total de 531 individuos, representando 80 especies y 21 géneros distribuidos en seis familias. En particular, se identificaron 71 especies en el bosque de alcornoques de Larache y 14 en las tierras agrícolas de la llanura del Gharb, incluyendo dos especies endémicas (*Andrena insignis* y *Eucera nadigi*) y una especie especie nueva para Marruecos (*Nomada stigma*). Estos hallazgos destacan la necesidad urgente de implementar estrategias de conservación y manejo para preservar la diversidad de las abejas silvestres en los ecosistemas forestales y agrícolas de la región.

Palabras clave: alcornoque, diversidad, llanura del Gharb, conocimiento, Larache, Marruecos, noroeste, abejas silvestres.

INTRODUCTION

The degradation of biodiversity has become a major global issue, attracting considerable media attention. The consequences of this environmental deterioration are profound and encompass the alteration of ecosystem structure, the delicate imbalance of biodiversity and the disruption of interactions between plant and animal species (SANTINI *et al*., 2021). Among the key species whose decline deeply concerns the scientific community are insects pollinators (LE FEON, 2010). The decline of pollinators, a notable consequence of the intensification of modern agriculture, is largely attributed to landscape simplification and the disappearance of natural and semi-natural habitats (LANGLOIS, 2019; SANCHEZ-BAYO & WYCKHUYS, 2019). Indeed, insects pollinators provide ecosystem services to over 80% of the world's flowering plants, including cultivated crops (NATH *et al*., 2023). They are responsible for 35% of agricultural production (KLEIN *et al*., 2007).

Wild bees are among the pollinators most affected by human activities and the effects of climate change (BURKLE *et al*., 2013). Studying the status of bees, their populations, diversity and densities can serve as indicators of the overall state of biodiversity (DUELLI *et al*., 1999; ZAYED & PACKER, 2005).

Due to its diverse biogeographical influences, Morocco has developed a highly biodiverse flora and fauna, including a rich bee fauna with nearly 1000 species (LHOMME *et al*., 2020). However, it is still poorly studied due to its extensive spatial distribution and the diversity of its habitats (WOOD, 2023a). Therefore, it is important to emphasize that comprehensive inventories of bees remain to be completed in certain regions of the country, particularly those in the northwestern region of Morocco. For example, regional diversity data indicate the presence of 250 species throughout the northern region of Morocco (LHOMME *et al*., 2020).

In North Africa, and particularly in Morocco, most pollinator studies have focused on agroecosystems (EL ABDOUNI *et al*., 2022; BENCHARKI *et al*., 2023; SENTIL *et al*., 2022a,b, 2025). Yet, the role of natural habitats in sustaining pollinator communities is often underestimated, despite growing evidence of the ecological importance of forests as reservoirs of resources and refuges for these insects (ULYSHEN *et al.*, 2023). The Larache cork oak forest (*Quercus suber* L.) and the Gharb plain represent a strategic region for studying cork oak ecosystems along Morocco's Atlantic coast. This landscape is a mosaic of natural forests and modern agricultural fields (including eucalyptus, sugarcane, and sunflower plantations) undergoing rapid urbanization and agricultural intensification (SAMIH *et al.*, 2024).

Our study aims to fill the gap in information regarding wild bees in the northwestern region of Morocco, specifically the cork oak of Larache and the agricultural lands adjacent to this emblematic area, notably those in the Gharb plain. An inventory was conducted over three consecutive years (2021 to 2023), using various traps and direct prospecting techniques. The objective of this study is to inventory the species of wild bees associated with the different vegetative landscapes (forests, edges and agricultural fields) present in the region and to propose management measures to preserve this community of wild bees.

MATERIALS AND METHODS

Study area

The study area is located in the northwestern region of Morocco (Fig. 1). Ten stations were selected in the Northwest of Morocco: five stations in the forest sector (S1, S2, S3, S4 and S5) located in the cork oak of Larache and five stations in the agricultural sector (S6, S7, S8, S9 and S10) situated in the Gharb Plain.

The cork oak forest of Larache, located in northwestern Morocco, forms a geographical ensemble around the Loukkos River plain, bordered by the Sahel and R'Mel plateaus to the north and south (BALLOUCHE, 2013). The region experiences a Mediterranean climate. Bioclimatically, the area is classified as subhumid thermomediterranean, featuring mild to temperate winters. The regional vegetation is largely characterized by cork oak forests, classified as "subhumid cork oak forests on sand" (SAUVAGE, 1961). The Gharb plain is one of the main agricultural areas in Morocco, benefiting from a network of rivers and irrigation

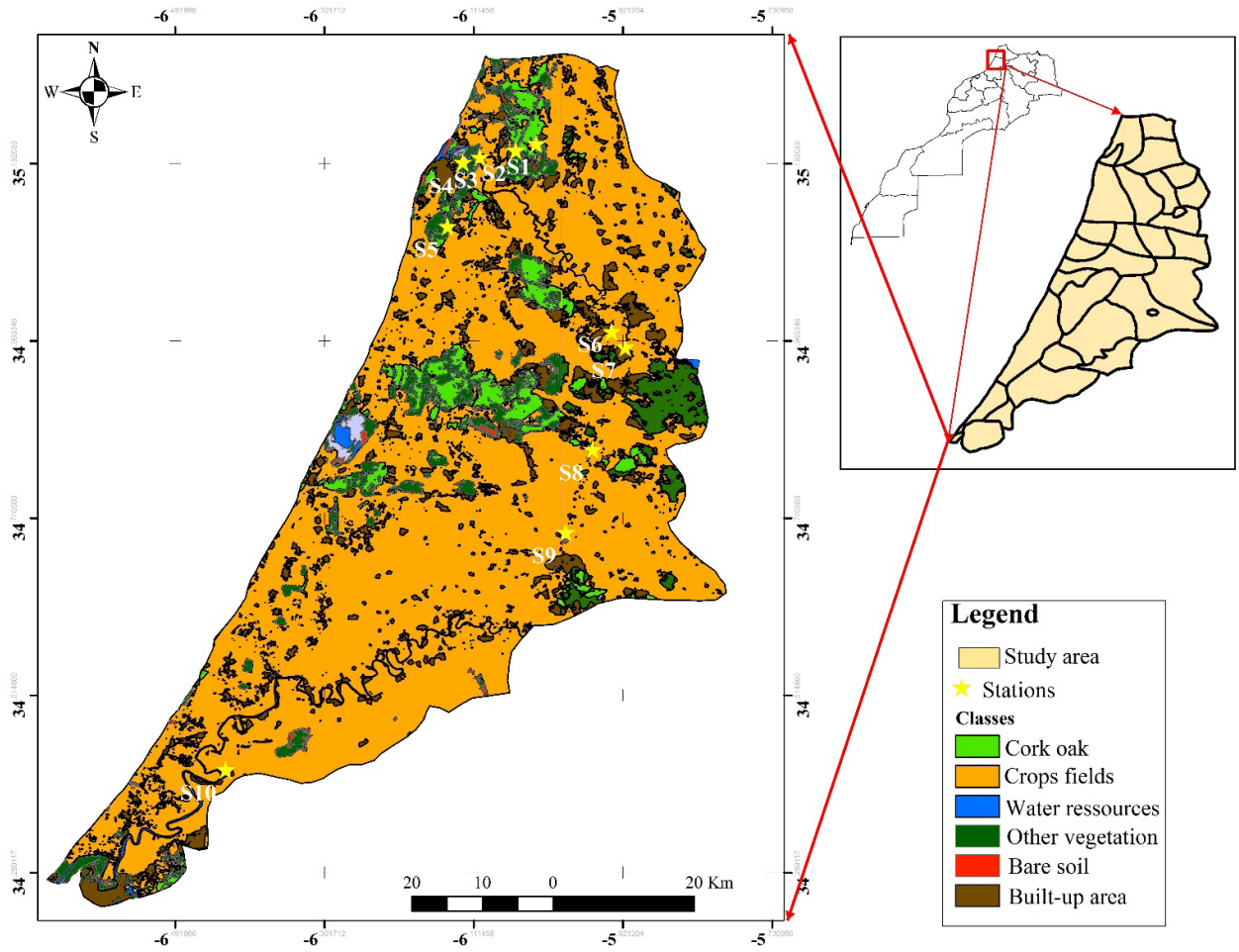

Fig. 1. Presentation of the study area and sampled stations.
Fig. 1. Presentación del área de estudio y estaciones de muestreo.

canals flowing from the Oued Sebou and its tributaries (ZAMRANE, 2016). The region enjoys a Mediterranean climate with mild winters and hot summers, making it conducive to intensive agriculture. Farmers in the region cultivate a wide variety of crops (such as tomatoes, onions, zucchinis, carrots, peppers, oranges, lemons and oilseeds) to meet the country's food needs and for export (CHBIKA, 2021).

The various sampled stations (Table I) are established in contrasting sectors: Edge habitats, vegetation strips along forest tracks, forests and flowered vegetation strips in agricultural areas.

The selection of stations was based on the presence of plant species providing pollen and nectar resources, which suggests an interesting diversity of the local pollinating entomofauna essential for the functional integrity of ecosystems (Fig. 2).

Methodology for wild bees inventory

During this study, various passive and active trapping systems were designed. The trapping method using pan traps was used to passively sample bees (ACHARYA *et al*., 2021; DUNLAP *et al*., 2023) (particularly the Andrenidae and Halictidae families and especially species of small to medium size) (PAULY, 2019), with 4 pan traps (blue, white, yellow and orange) per station.

Table I. Geographical coordinates of the different sampled stations.
Tabla I. Coordenadas geográficas de las diferentes estaciones muestreadas.

Sector	Station	Biotope	Latitude	Longitude
Forest	S1	Forest edge	35,21125	–6,03254
	S2	Dense forest	35,208901	–6,057496
	S3	Flowering forest track	35,200616	–6,099863
	S4	Flowering strip of vegetation	35,194685	–6,126354
	S5	Flowering roadside	35,111676	–6,147248
Agricultural	S6	Flowering strip of vegetation in a maize field	34,975211	–5,936347
	S7	Flowering roadside next to a cereal field	34,965498	–5,926937
	S8	Edge of an avocado field	34,828096	–5,961945
	S9	Sunflower field	34,729699	–5,990363
	S10	Edge of a cereal field	34,418241	–6,428204

The colors are the most commonly chosen because they cover a diverse range of wavelengths in the visual spectrum and partly correspond to the colors of flowers and the different color preferences varying among bee species (LEONG & THORP, 1999; WILSON *et al*., 2008). An important complement to passive trapping is the use of a Malaise trap (Fig. 3) per station for capturing certain bee species. The Malaise traps were constructed of black and white material and handmade. Each trap measured approximately 1.5 meters in height, 1.2 in width and 1.5 in length. As noted by PAULY (2019), Malaise traps are particularly effective in capturing large species such as bumblebees or Megachilidae.

Notethat the pan traps were installed on tree branches 1 meter above the ground and placed along a transect parallel to each Malaise trap. The pan traps and the collecting bottle of the Malaise traps were filled halfway with a mixture of soapy saltwater. Surveys of trap contents were conducted once every 20 days, for 7 months (March-October), over tree consecutive years (2021-2022-2023).

These collections were supplemented by observations and captures during the year 2023, during which active trapping was practiced for the direct capture of individuals encountered on flowers; using a sweep net and a bottle along straight transects in the various sampled sites.

Specimen identification

The collected specimens were spread out, ensuring that the characters for identification are clearly visible. These specimens were classified to the family and genus levels, then carefully grouped into collection boxes and subsequently sent to the Zoology Laboratory at the University of Mons in Belgium for identification (UMONS).

Species identification was conducted by a team of taxonomists. Ahlam Sentil and William Flordaliso handled general identification and other families. Pierre Rasmont focused on *Bombus* Latreille, 1802 and *Anthophora* Latreille, 1803, while Simone Flaminio specialized in *Lasioglossum* Curtis, 1833. Thomas James Wood was responsible for *Andrena* Fabricius, 1775, *Osmia* Panzer, 1806, *Megachile* Latreille, 1802, and additional genera including *Nomiapis* Cockerell, 1919. Achik Dorchin identified *Eucera* Scopoli, 1770, Guillaume Ghisbain worked on *Dasypoda* Latreille, 1802, and Romain Le Divelec on *Hylaeus* Fabricius, 1793. Michael Terzo, Max Kasparek and Andreas Müller addressed the other genera.

Additionally, samples of each visited plant were collected, identified to species level by Hassan Fougrach and Mohammed Hsaine (botanists of the Hassan II University in Casablanca) and included

Fig. 2. Examples of surveyed landscapes: A) Flowering roadside, B) Forest edge, C) Dense forest, D) Sunflower field. Photos by Amine Samih.
Fig. 2. Ejemplos de paisajes muestreados: A) Flora de borde de camino, B) Borde de bosque, C) Bosque denso, D) Campo de girasoles. Fotografías de Amine Samih.

Fig. 3. Installation and anchoring of the Malaise trap. Photos by Amine Samih.
Fig. 3. Instalación y anclaje de la trampa Malaise. Fotografías de Amine Samih.

in a herbarium for scientific documentation purposes under the auspices of the CIRF (Center for Innovation, Research, and Training).

RESULTS

The inventory of wild bees conducted over three consecutive years, 2021, 2022 and 2023, at various sampled stations in the northwestern region of Morocco, resulted in a total of 531 individuals corresponding to 80 species and 21 genera belonging to 6 families.

In terms of abundance, the Melittidae family is the most abundant, representing 32.14% of the captures (170 individuals), represented by the genus *Dasypoda* Latreille, 1802. In terms of species richness, the genus *Andrena* Fabricius, 1775 is the most diversified, with 22 species representing 26.92% of the total number of species recorded, followed by the genus *Lasioglossum* Curtis, 1833 with 15 species (19.23% of the species recorded) from the Halictidae family. The most diversified families in this inventory are Halictidae and Andrenidae, each comprising 22 species, and toghether accounting for 28.20% of all species recorded.

Our study revealed the presence of 71 species of wild bees in the forested area of the cork oak of Larache and 14 species in the agricultural lands of the Gharb plain. The families as well as the species are presented below in alphabetical order:

Andrenidae Latreille, 1802

Andrena aerinifrons Dours, 1873 (Fig. 4a) Thomas James Wood det.

Material studied: S10; 16.III.2023, 1♀, sweep net (collected on *Asphodelus ramosus* L., 1753).

Global distribution: Palearctic (Lhomme *et al.*, 2020).

Regional distribution: Oriental, Fès-Meknès, rabat-Salé-Kénitra, Béni Mellal-Khénifra, Marrakech-Safi, Souss-Massa and Guelmim-Oued Noun (LHOMME *et al.*, 2020).

Andrena antigana Pérez, 1895 (Fig. 4d) Thomas James Wood *det.*

Material studied: S2; 11.IV.2023, 1♂, bottle (collected on *Rapistrum rugosum* (L.) All., 1785).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Casablanca-Settat, Fès-Meknès, Guelmim-Oued Noun, Rabat-Salé-Kénitra, Souss-Massa and Tanger-Tétouan-Al Hoceima (LHOMME *et al.*, 2020).

Andrena avara Warncke, 1967 (Fig. 4b) Thomas James Wood det.

Material studied: S2; 14.III.2023, 1♀, bottle (collected on *Leontodon maroccanus* Pomel, 1868), 13.III.2023, 2♀ and 1♂, bottle (collected on *Otospermum glabrum* (C.C. Gmel.) Lag., 1839 and *Matricaria chamomilla* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Marrakech-Safi, Souss-Massa and Guelmim-Oued Noun (LHOMME *et al.*, 2020).

Andrena bellidis Pérez, 1895 Thomas James Wood det.

Material studied: S2; 13.III.2023, 2♂, bottle (collected on *Otospermum glabrum* (C.C. Gmel.)

Lag., 1839 and *Raphanus raphanistrum* L., 1753), 14.III.2023, 1♂, bottle (collected on *Otospermum glabrum* (C.C. Gmel.) Lag., 1839). S7; 16.III.2023, 1♂, bottle (collected on *Raphanus raphanistrum* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al HOCEIMA, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra and Casablanca-Settat (Lhomme *et al.*, 2020).

Andrena discors Erichson, 1841 Thomas James Wood det.

Material studied: S2; 12.V.2022, 1♂, pan trap.
Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Béni Mellal-Khénifra, Fès-Meknès, Oriental and Tanger-Tétouan-Al Hoceima (LHOMME *et al.*, 2020).

Andrena djelfensis Pérez, 1895 Thomas James Wood *det.*

Material studied: S2; 13.VI.2023, 2♀, bottle (collected on *Cistus salviifolius* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Béni Mellal-Khénifra, Fès-Meknès, Oriental and Tanger-Tétouan-Al Hoceima (LHOMME *et al.*, 2020).

Andrena flavipes Panzer, 1799 Thomas James Wood *det.*

Material studied: S2; 01.VII.2021, 1♀, pan trap, 12.V.2022, 1♀, malaise trap, 01.VI.2022, 1♀, malaise trap, 13.III.2023, 5♀, bottle (collected on *Glebionis coronaria* (L.) Cass. ex Spach, 1841 and *Rapistrum rugosum* (L.) All., 1785), 1♀, sweep net (collected on *Leontodon maroccanus* Pomel, 1868), 14.III.2023, 1♀, bottle (collected on *Rapistrum rugosum* (L.) All., 1785), 5♂, sweep net, 11.IV.2023, 3♀, bottle (collected on *Biscutella didyma* L., 1753 and *Raphanus raphanistrum* L., 1753), 1♂, sweep net (collected on *Glebionis coronaria* (L.) Cass. ex Spach, 1841), 15.V.2023, 11 ♀, bottle (collected on *Leontodon maroccanus* Pomel, 1868). S7; 16.III.2023, 1♂, bottle (collected on *Matricaria chamomilla* L., 1753), 2♂, sweep net (collected on *Matricaria chamomilla* L., 1753 and *Raphanus raphanistrum* L., 1753).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi, Drâa-Tafilalet and Souss-Massa (LHOMME *et al.*, 2020).

Andrena fulvicornis Schenck, 1853 Thomas James Wood *det.*

Material studied: S7; 16.III.2023, 2♀, sweep net (collected on *Raphanus raphanistrum* L., 1753), S9; 15.VI.2023, 1♀, bottle (collected on *Ammi majus* L., 1753). S2; 16.V.2023, 1♂, bottle (collected on *Melilotus indicus* (L.) All., 1773).

Global distribution: Palearctic (Lhomme *et al.*, 2020).

Regional distribution: Béni Mellal-Khénifra, Casablanca-Settat, Drâa-Tafilalet, Fès-Meknès, Marrakech-Safi, Rabat-Salé-Kénitra, Souss-Massa and Tanger-Tétouan-Al Hoceima (LHOMME *et al.*, 2020; WOOD *et al*., 2020).

Andrena insignis Warncke, 1974 (Fig. 4c) Thomas James Wood *det.*

Material studied: S2; 13.III.2023, 1♀, bottle (collected on *Hypochaeris glabra* L., 1753), 14.III.2023, 1♀, sweep net (collected on *Leontodon saxatilis* L., 1753).

Global distribution: Morocco. Endemic (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat and Marrakech-Safi (LHOMME *et al.*, 2020).

Andrena labialis (Kirby, 1802) Thomas James Wood *det.*

Material studied: S2; 10.IV.2023, 1♀, bottle (collected on *Lotus arenarius* Desf, 1798), 16.V.2023,

1♀, bottle (collected on *Melilotus indicus* (L.) All., 1773).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Béni Mellal-Khénifra, Drâa-Tafilalet, Fès-Meknès, Marrakech-Safi, Oriental, Rabat-Salé-Kénitra and Tanger-Tétouan-Al Hoceima (LHOMME *et al.*, 2020).

Andrena lagopus Latreille, 1809 Thomas James Wood *det.*

Material studied: S2; 11.IV.2023, 2♀, bottle (collected on *Rapistrum rugosum* (L.) All., 1785).

Global distribution: West-Palearctic (Lhomme *et al.*, 2020).

Regional distribution: Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat and Marrakech-Safi (LHOMME *et al.*, 2020).

Andrena miegiella Dours, 1873 Thomas James Wood *det.*

Material studied: S9; 15.VI.2023, 3♀, bottle (collected on *Ammi majus* L., 1753), S6; 15.VI.2023, 1♀, bottle (collected on *Ammi majus* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Marrakech-Safi and Drâa-Tafilalet (LHOMME *et al.*, 2020).

Andrena morio Brullé, 1832 (Fig. 4g) Thomas James Wood *det.*

Material studied: S3; 29.IV.2021, 1♀, pan trap, 01.VI.2022, 5♀, malaise trap, 12.IV.2023, 1♀, bottle (collected on *Halimium calycinum* Boiss. & Reut., 1852). S2; 12.V.2022, 6♀, malaise trap, 14.III.2023, 1♀, sweep net (collected on *Otospermum glabrum* (C.C. Gmel.) Lag., 1839).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Béni Mellal-Khénifra, Casablanca-Settat, Drâa-Tafilalet, Fès-Meknès, Guelmim-Oued Noun, Marrakech-Safi, Oriental, Rabat-Salé-Kénitra, Souss-Massa and Tanger-Tétouan-Al Hoceima (LHOMME *et al.*, 2020).

Andrena oraniensis Lepeletier, 1841 Thomas James Wood *det.*

Material studied: S2; 16.V.2023, 1♀, bottle (collected on *Lotus arenarius* Desf, 1798).

Global distribution: West-Palearctic (LHOMME et *al.*, 2020).

Regional distribution: Fès-Meknès, Rabat-Salé-Kénitra, Tanger-Tétouan-Al Hoceima (LHOMME et *al.*, 2020).

Andrena orbitalis Morawitz, 1871 Thomas James Wood *det.*

Material studied: S2; 11.IV.2023, 1♀, bottle (collected on *Erodium moschatum* (L.) L'Hér., 1789 and *Erodium cicutarium* (L.) L'Hér., 1789).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi, Drâa-Tafilalet and Souss-Massa (LHOMME et *al.*, 2020).

Andrena poupillieri Dours, 1872 Thomas James Wood *det.*

Material studied: S2; 16.V.2023, 1♀ and 1♂, bottle (collected on *Melilotus indicus* (L.) All., 1773 and *Lotus arenarius* Desf, 1798).

Global distribution: Morocco, Algeria, Tunisia, Spain (mainland and Balearic Islands) (WOOD, 2023b).

Regional distribution: Marrakech-Safi, Taroudant, Fès-Meknès, Azrou (WOOD, 2023b).

Andrena propinqua Schenck, 1853 Thomas James Wood *dét.*

Material studied: S2; 14.III.2023, 1♂, sweep net (collected on *Melilotus indicus* (L.) All., 1773).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès, Rabat-Salé-Kénitra, Marrakech-Safi and Drâa-Tafilalet (LHOMME et *al.*, 2020).

Andrena ranunculi Schmiedeknecht, 1883 Thomas James Wood *det.*

Material studied: S2; 13.III.2023, 1♂, sweep net (collected on *Ranunculus granatensis* Boiss. & Reut., 1842), 14.III.2023, 3♂, bottle (collected on *Ranunculus granatensis* Boiss. & Reut., 1842), 10.IV.2023, 2♀, sweep net (collected on *Otospermum glabrum* (C.C. Gmel.) Lag., 1839).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès et Rabat-Salé-Kénitra (LHOMME et *al.*, 2020).

Andrena rhyssonota Pérez, 1895 Thomas James Wood *det.*

Material studied: S2; 13.III.2023, 1♀, sweep net (collected on *Leontodon maroccanus* Pomel, 1868).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Béni Mellal-Khénifra, Casablanca-Settat, Fès-Meknès, Oriental, Rabat-Salé-Kénitra and Tanger-Tétouan-Al Hoceima (LHOMME et *al.*, 2020).

Andrena simontornyella Noskiewicz, 1939 Thomas James Wood *det.*

Material studied: S2; 14.III.2023, 1♀, sweep net (collected on *Biscutella didyma* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Béni Mellal-Khénifra, Fès-Meknès, Rabat-Salé-Kénitra and Tanger-Tétouan-Al Hoceima (LHOMME et *al.*, 2020).

Andrena spreta Pérez, 1895 Thomas James Wood *det.*

Material studied: S2; 10.IV.2023, 1♀, sweep net (collected on *Cardamine pratensis* L., 1753), 11.IV.2023, 3♀, bottle (collected on *Raphanus raphanistrum* L., 1753).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Drâa-Tafilalet, Fès-Meknès, Marrakech-Safi, Oriental, Rabat-Salé-Kénitra, Souss-Massa, Tanger-Tétouan-Al Hoceima (LHOMME et *al.*, 2020

Andrena vulcana Dours, 1873 Thomas James Wood *det.*

Material studied: S4; 13.III.2023, 1♀, bottle (collected on *Leontodon maroccanus* Pomel, 1868).

Global distribution: Morocco, Algeria, Tunisia, Canary Islands and Portugal (LHOMME *et al.*, 2020).

Regional distribution: Larache (SAMIH *et al.*, 2025).

Apidae Linnaeus, 1758

Anthophora blanda (Percy, 1812) Pierre Rasmont *det.*

Material studied: S2; 15.V.2023, 1♀, bottle (collected on *Echium plantagineum* L., 1753).

Global distribution: West-Palearctic; Spain, Italy, Greece, Istria, Algeria, Tunisia and Turkey (Wood, 2023a).

Regional distribution: Southern Morocco (Drâa-Tafilalet) (WOOD, 2023a).

Anthophora senescens Lepeletier, 1841 Pierre Rasmont *det.*

Material studied: S5, 18.III.2021, 1♀, sweep net (collected on *Echium plantagineum* L., 1753), 21.VII.2022, 1♀, pan trap. S2; 12.V.2022, 1♀, malaise trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Casablanca-Settat, Drâa-Tafilalet and Souss-Massa (LHOMME *et al.*, 2020).

Bombus terrestris (Linnaeus, 1758) Pierre Rasmont *det.*

Material studied: S3; 28.X.2021, 2♀, pan trap. S2; 15.IX.2021, 1♂, pan trap, 01.VII.2021, 1♀, pan trap, 12.V.2022, 1♀, malaise trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi and Souss-Massa (LHOMME *et al.*, 2020).

Tetralonia ruficornis (Fabricius, 1804) (Fig. 5g) Ahlam Sentil *det.*

Material studied: S2; 01.VII.2021, 1♀, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental and Marrakech-Safi (LHOMME *et al.*, 2020).

Ceratina cucurbitina (Rossi, 1972) Michael Terzo *det.*

Material studied: S2; 15.IX.2021, 1♀, pan trap, 01.VI.2022, 1♀, pan trap, 1♂, malaise trap, 12.V.2022, 2♀, malaise trap, 21.VII.2022, 2♀, pan trap, 27.IX.2022, 2♀, pan trap. S1; 12.V.2022, 3♂, pan trap, 21.VII.2022, 1♀, pan trap. S9; 29.IX.2022, 2♀, pan trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi, Drâa-Tafilalet and Souss-Massa (LHOMME *et al.*, 2020).

Ceratina maghrebensis Daly, 1983 Michael Terzo *det.*

Material studied: S1; 15.IX.2021, 1♀, pan trap. S2; 15.IX.2021, 1♀, pan trap.

Global distribution: Morocco, Algeria and Tunisia (LHOMME *et al.*, 2020).

Regional distribution: Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi, Drâa-Tafilalet and Souss-Massa (LHOMME *et al.*, 2020).

Eucera collaris Dours, 1873 Achik Dorchin *det.*

Material studied: S2; 01.VII.2021, 5♀, pan trap, 29.IV.2021, 2♀, pan trap, 04.VIII.2021, 1♀, pan trap, 12.V.2022, 3♀, malaise trap, 01.VI.2022, 4♀, pan trap, 1♀, malaise trap, 22.VI.2022, 1♀, pan trap, 14.III.2023, 1♂, bottle (collected on *Glebionis coronaria* (L.) Cass. ex Spach, 1841), 14.III.2023, 1♂, sweep net (collected on *Leontodon marccanus* Pomel, 1868), 15.V.2023, 1♀, bottle (collected on *Otospermum glabrum* (C.C. Gmel.) Lag., 1839), 13.VI.2023, 1♀, bottle (collected on *Leontodon marccanus* Pomel, 1868). S3; 01.VII.2021, 1♀, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Rabat-Salé-Kénitra (LHOMME *et al.*, 2020).

Eucera dentata Germar, 1839 Achik Dorchin *det.*

Material studied: S3; 01.VII.2021, 2♀, pan trap, 12.V.2022, 1♀, malaise trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Rabat-Salé-Kénitra, Fès-Meknès, Drâa-Tafilalet, Marrakech-Safi et Souss-Massa (LHOMME *et al.*, 2020).

Eucera elongatula Vachal, 1907 (Fig. 4f) Achik Dorchin *det.*

Material studied: S2; 13.III.2023, 1♂, sweep net (collected on *Leontodon marccanus* Pomel, 1868).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès, Rabat-Salé-Kénitra, Marrakech-Safi and Souss-Massa (LHOMME *et al.*, 2020).

Eucera grisea (Fabricius, 1793) Achik Dorchin *det.*

Material studied: S2; 14.VI.2023, 2♀, bottle (collected on *Scolymus hispanicus* L., 1753).

Global distribution: Palearctic (LHOMME *et al.*, 2020; DORCHIN, 2023).

Regional distribution: Tanger-Tetouan-Al Hoceima, Rabat-Salé-Kénitra, Marrakech-Safi and Fès-Meknès (LHOMME *et al.*, 2020).

Eucera nadigi Friese, 1924 (Fig. 4e) Achik Dorchin *det.*

Material studied: S4; 18.III.2021, 1♀, sweep net (collected on *Echium plantagineum* L., 1753). S2; 07.IV.2021, 1♀, sweep net (collected on *Echium plantagineum* L., 1753), 15.V.2023, 1♂, bottle (collected on *Echium plantagineum* L., 1753).

Global distribution: Morocco. Endemic (LHOMME *et al.*, 2020).

Regional distribution: Rabat-Salé-Kénitra (LHOMME *et al.*, 2020).

Eucera nigrilabris Lepeletier, 1841 Achik Dorchin *det.*

Material studied: S10; 16.III.2023, 1♂, sweep net (collected on *Raphanus raphanistrum* L., 1753).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Oriental, Fès-Meknès and Marrakech-Safi (LHOMME *et al.*, 2020).

Eucera obliterata Pérez, 1895 Achik Dorchin *det.*

Material studied: S10; 16.III.2023, 1♀, sweep net (collected on *Calendula arvensis* L., 1753), S9; 13.IV.2023, 1♂, bottle (collected on *Silybum marianum* (L.) Gaertn., 1791).

Global distribution: Morocco, Algeria, Tunisia, Spain and Portugal (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès and Souss-Massa (LHOMME *et al.*, 2020).

Eucera strigata Lepeletier, 1841 Achik Dorchin *det.*

Material studied: S2; 01.VII.2021, 1♂, pan trap, 12.V.2022, 19 individuals, malaise trap. 22.VI.2022, 1♂, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès and Marrakech-Safi (LHOMME *et al.*, 2020).

Nomada accentifera Pérez, 1895 J.Straka *det.*

Material studied: S2; 13.III.2023, 1♀, sweep net (collected on *Lavandula stoechas* L., 1753).

Global distribution: Morocco, Tunisia, Spain and Portugal (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima (LHOMME *et al.*, 2020).

Nomada bifasciata Olivier, 1811 J.Straka *det.*

Material studied: S7; 16.III.2023, 1♀, bottle (collected on *Matricaria chamomilla* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Casablanca-Settat, Marrakech-Safi and Drâa-Tafilalet (LHOMME *et al.*, 2020).

Nomada numida Lepeletier, 1841 J.Straka *det.*

Material studied: S2; 16.V.2023, 1♀, bottle (collected on *Lavandula stoechas* L., 1753).

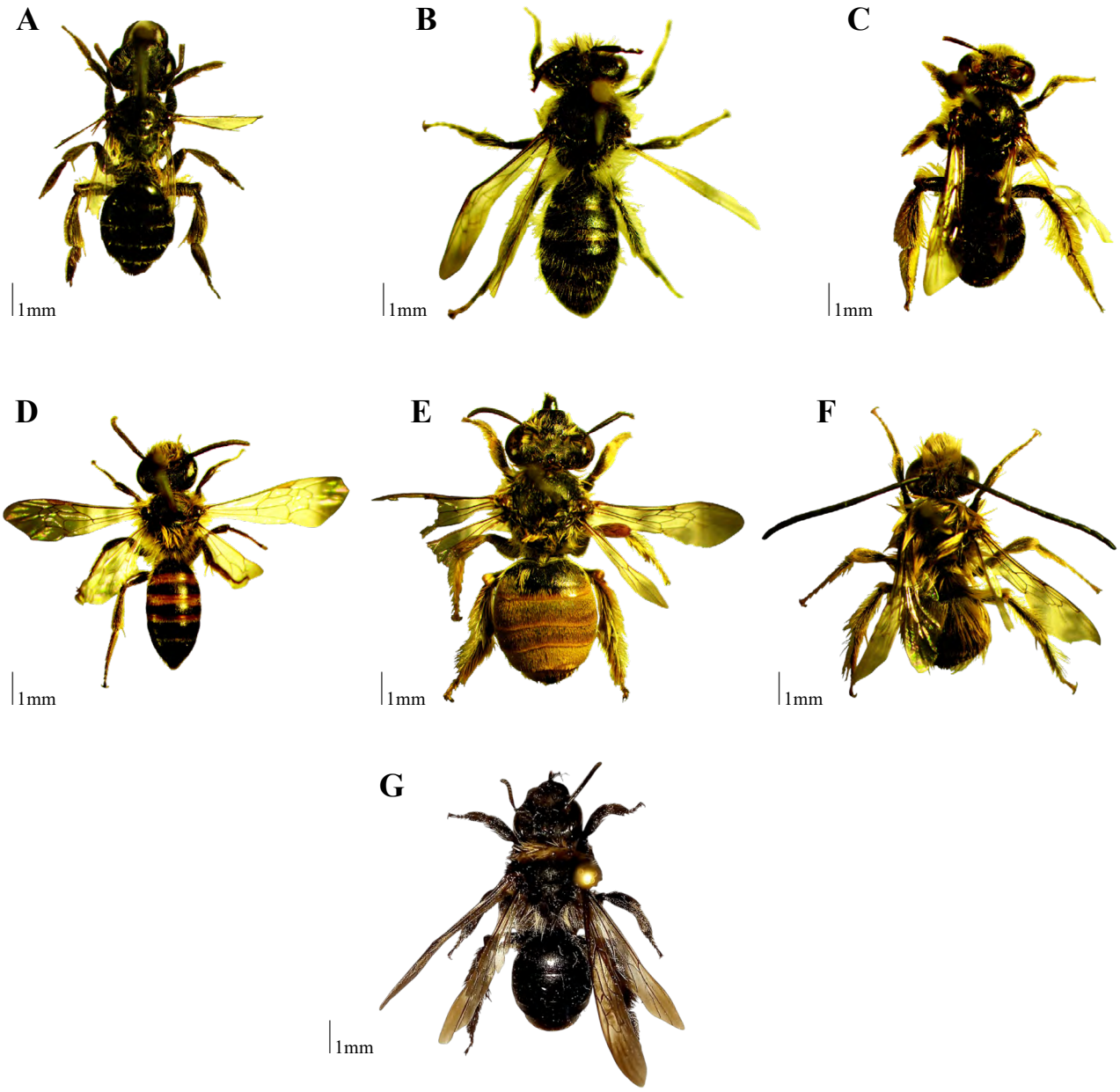

Fig. 4. Images of some wild bee species: A) *Andrena aerinifrons* Dours, 1873, B) *Andrena avara* Warncke, 1967, C) *Andrena insignis* Warncke, 1974, D) *Andrena antigana* Pérez, 1895, E) *Eucera nadigi* (Friese, 1924), F) *Eucera elongatula* (Vachal, 1907), G) *Andrena morio* Brullé, 1832. Photos by Amine Samih and Noureddin Maatouf.

Fig. 4. Imágenes de algunas especies de abejas silvestres: A) *Andrena aerinifrons* Dours, 1873, B) *Andrena avara* Warncke, 1967, C) *Andrena insignis* Warncke, 1974, D) *Andrena antigana* Pérez, 1895, E) *Eucera nadigi* (Friese, 1924), F) *Eucera elongatula* (Vachal, 1907), G) *Andrena morio* Brullé, 1832. Fotografías de Amine Samih y Noureddin Maatouf.

Global distribution: Palearctic (LHOMME et *al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès and Marrakech-Safi (LHOMME et *al.*, 2020).

Nomada panurginoides Saunders, 1908 J. Straka *det.*

Material studied: S2; 11.IV.2023, 1♂, sweep net (collected on *Hypochaeris glabra* L., 1753).

Global distribution: Morocco, Algeria and Tunisia (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Casablanca-Settat, Marrakech-Safi and Drâa-Tafilalet (LHOMME *et al.*, 2020).

Nomada stigma (Fabricius 1804) J. Straka *det.*

Material studied: S2; 10.IV.2023, 1 ♂, sweep net (collected on *Lavandula stoechas* L., 1753).

Global distribution: West-Palearctic (STRAKA *et al*., 2024).

Regional distribution: Second record (SAMIH *et al*., 2024).

Xylocopa pubescens Spinola, 1838 Ahlam Sentil *det.*

Material studied: S10; 27.IX.2022, 1♀, pan trap.

Global distribution: Palearctic; Sub-Saharan Africa (LHOMME *et al.*, 2020).

Regional distribution: Casablanca-Settat, Drâa-Tafilalet, Fès-Meknès, Marrakech-Safi, Oriental, Rabat-Salé-Kénitra, Souss-Massa and Tanger-Tétouan-Al Hoceima (LHOMME *et al.*, 2020).

Xylocopa violacea (Linnaeus, 1758) Michael Terz *det.*

Material studied: S2; 01.VII.2021, 1♀, pan trap, 04.VIII.2021, 2 individuals, pan trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat and Marrakech-Safi (LHOMME *et al.*, 2020).

Colletidae Lepeletier, 1841

Hylaeus cornutus Curtis, 1831 Romain Le Divelec *det.*

Material studied: S2; 14.VI.2023, 1♂, sweep net (collected on *Ammi majus* L., 1753). S8; 15.VI.2023, 3♀, bottle (collected on *Ammi majus* L., 1753).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima and Fès-Meknès (LHOMME *et al.*, 2020).

Hylaeus purpurissatus (Vachal, 1895) Romain Le Divelec *det.*

Material studied: S1; 18.III.2021, 1♀, sweep net (collected on *Ammi majus* L., 1753). S2; 14.VI.2023, 1♀, sweep net (collected on *Ammi majus* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020); Western Europe and North Africa (LE DIVELEC, 2022).

Regional distribution: Fès-Meknès (LHOMME *et al.*, 2020).

Halictidae Thomson, 1869

Halictus scabiosae (Rossi, 1790) (Fig. 5a) Simone Flaminio *det.*

Material studied: S2; 27.V.2021, 1♀, pan trap, 13.VI.2023, 1♀, bottle (collected on *Andryala intergifolia* L., 1753). S3; 15.VI.2023, 1♀, bottle (collected on *Scolymus hispanicus* L., 1753).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Casablanca-Settat, Marrakech-Safi and Souss-Massa (LHOMME *et al.*, 2020).

Lasioglossum algericolellum (Strand, 1909) Simone Flaminio *det.*

Material studied: S2; 13.III.2023, 1♀, bottle (collected on *Andryala intergifolia* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra and Casablanca-Settat (LHOMME *et al.*, 2020).

Lasioglossum brevicorne (Schenck, 1868) Simone Flaminio *det.*

Material studied: S1; 15.IX.2021, 1♂, pan trap, 01.VI.2022, 1♀, pan trap. S2; 01.VII.2021, 3♀, pan trap, 12.V.2022, 16♀, malaise trap, 01.VI.2022, 4♀, pan trap, 2♀, malaise trap. S10; 01.VI.2022, 3♀, pan trap, 27.IX.2022, 1♂, pan trap, 22.VI.2022, 2♀, pan trap, 21.VII.2022, 3♀, pan trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès, Marrakech-Safi, Oriental and Souss-Massa (LHOMME *et al.*, 2020).

Lasioglossum callizonium (Pérez, 1895) Simone Flaminio *det.*

Material studied: S2; 13.VI.2023, 1♀ , bottle (collected on *Andryala intergifoli*a L., 1753).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi, Drâa-Tafilalet and Souss-Massa (LHOMME *et al.*, 2020).

Lasioglossum cedri (Ebmer, 1976) Simone Flaminio *det.*

Material studied: S2; 15.IX.2021, 1♀, pan trap, 04.VIII.2021, 1♀, pan trap, 28.X.2021, 2♀, pan trap, 01.VI.2022, 2♀, pan trap. S1; 01.VI.2022, 1♂, pan trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès, Marrakech-Safi and Souss-Massa (LHOMME *et al.*, 2020).

Lasioglossum fertoni (Vachal, 1895) Simone Flaminio *det.*

Material studied: S1; 01.VII.2021, 1♀, pan trap. S2; 12.V.2022, 14♀, malaise trap, 01.VI.2022, 1♀, pan trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Global distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Marrakech-Safi and Drâa-Tafilalet (LHOMME *et al.*, 2020).

Lasioglossum glabriusculum (Morawitz, 1872) Simone Flaminio *det.*

Material studied: S3; 15.VI.2023, 1♀, bottle (collected on *Andryala intergifolia* L., 1753).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Marrakech-Safi (LHOMME *et al.*, 2020).

Lasioglossum immunitum (Vachal, 1895) Simone Flaminio *det.*

Material studied: S1; 01.VII.2021, 1♀, pan trap, 12.V.2022, 1♀, pan trap, 01.VI.2022, 1♀, pan trap. S2; 04.VIII.2021, 1 individual, pan trap, 21.IX.2022, 1♂, pan trap, 10.IV.2023, 1♂, sweep net (collected on *Andryala intergifolia* L., 1753). S9; 21.VII.2022, 2♀, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Rabat-Salé-Kénitra, Marrakech-Safi and Souss-Massa (LHOMME *et al.*, 2020).

Lasioglossum leucozonium (Schrank, 1781) Simone Flaminio *det.*

Material studied: S2; 01.VII.2021, 1♀, pan trap, 01.VI.2022, 1♀, pan trap. S1; 12.V.2022, 1♀, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès, Marrakech-Safi and Souss-Massa (LHOMME *et al.*, 2020).

Lasioglossum malachurum (Kirby, 1802) Simone Flaminio *det.*

Material studied: S2; 15.IX.2021, 1♂, pan trap, 28.X.2021, 1♂, pan trap, 11.IV.2023, 2♀, bottle (collected on *Andryala intergifolia* L., 1753), 15.V.2023, 1♀, bottle (collected on *Leontodon maroccanus* Pomel, 1868), 16.V.2023, 3♀, bottle (collected on *Leontodon maroccanus* Pomel, 1868*, Leontodon saxatilis* L., 1753 and *Matricaria chamomilla* L., 1753*)*. S4; 17.V.2023, 2♀, bottle (collected on *Hypochaeris glabra* L., 1753 and *Andryala intergifolia* L., 1753). S1; 01.VI.2022, 1♀, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès, rabat-Salé-Kénitra and Souss-Massa (LHOMME *et al.*, 2020).

Lasioglossum mediterraneum (Blüthgen, 1925) (Fig. 5b) Simone Flaminio *det.*

Material studied: S2; 13.III.2023, 1♀, bottle (collected on *Hypochaeris glabra* L., 1753), 14.III.2023, 1♀, sweep net, 1♀, bottle (collected on *Otospermum glabrum* (C.C. Gmel.) Lag., 1839).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Marrakech-Safi, Drâa-Tafilalet and Souss-Massa (LHOMME *et al.*, 2020).

Lasioglossum pauperatum (Brullé, 1832) Simone Flaminio *det.*

Material studied: S7; 16.III.2023, 1♀, bottle, 14.III.2023, 1♀, sweep net (collected on *Leontodon saxatilis* L., 1753), 1♀, bottle (collected on *Leontodon maroccanus* Pomel, 1868).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Marrakech-Safi, Drâa-Tafilalet and SoussMassa (LHOMME *et al.*, 2020).

Lasioglossum prasinum (Smith, 1848) Simone Flaminio *det.*

Material studied: S2; 01.VII.2021, 2♂, pan trap, 28.X.2021, 2♂, pan trap, 27.V.2021, 1♀, pan trap, 15.IX.2021, 1♀, pan trap, 12.V.2022, 10♀, malaise trap. S1; 01.VII.2021, 2♀, pan trap, 12.V.2022, 3♀, pan trap, 15.III.2023, 3♀, bottle (collected on *Andryala intergifolia* L., 1753, *Leontodon saxatilis* L., 1753 and *Scolymus hispanicus* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès, Rabat-Salé-Kénitra and Béni Mellal-khénifra (LHOMME *et al.*, 2020).

Lasioglossum punctatissimum (Schenck, 1853) Simone Flaminio *det.*

Material studied: S2; 01.VI.2022, 2♀, malaise trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Drâa-Tafilalet and Souss-Massa (LHOMME *et al.*, 2020).

Lasioglossum puncticolle (Morawitz, 1872) Simone Flaminio *det.*

Material studied: S1; 01.VII.2021, 1♂, pan trap, 12.V.2022, 1♂, pan trap. S2; 15.IX.2021, 1♀, pan trap.

Global distribution: Palearctic; Morocco, Algeria, Europe up to the Ural Mountains and Iran (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès, Tiguelmamine and Col du Zad (LHOMME, 2023).

Lasioglossum virens (Erichson, 1835) (Fig. 5f) Simone Flaminio *det.*

Material studied: S2; 15.09.2021, 2♀, pan trap, 28.X.2021, 1♀, pan trap, 22.VI.2022, 1♀, pan trap.

Global distribution: Morocco, Spain, Canary Islands, Algeria and Tunisia (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Rabat-Salé-Kénitra, Casablanca-Settat, Marrakech-Safi and Souss-Massa (LHOMME *et al.*, 2020).

Nomiapis rufiventris (Spinola, 1838) Thomas James Wood *det.*

Material studied: S2; 04.VIII.2021, 2♀, pan trap, 01.VI.2022, 1♀, pan trap, 27.IX.2022, 1♀, pan trap. S1; 01.VI.2022, 1♀, pan trap. S6; 15.VI.2023, 1♀, bottle (collected on *Ammi majus* L., 1753). S8; 15.VI.2023, 1♀, bottle (collected on *Scabiosa semipapposa* Salzm. ex DC., 1830).

Global distribution: Morocco, Algeria, Tunisia, Italy (Sicily and southern Italy), Libya and Egypt (WOOD & LE DIVELEC, 2022).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès, Béni Mellal-Khénifra, Marrakech-Safi, Drâa-Tafilalet, Souss-Massa and Guelmim (WOOD & LE DIVELEC, 2022).

Nomioides minutissimus (Rossi, 1790) Thomas James Wood *det.*

Material studied: S1; 16.V.2023, 1♀, bottle (collected on *Tolpis barbata* (L.) Gaertn., 1788).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi and Drâa-Tafilalet (LHOMME *et al.*, 2020).

Seladonia gemmea (Dours, 1872) Thomas James Wood *det.*

Material studied: S4; 15.VI.2023, 1♀, bottle (collected on *Andryala integrifolia* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi and Souss-Massa (LHOMME *et al.*, 2020).

Sphecodes albilabris (Fabricius, 1793) Thomas James Wood *det.*

Material studied: S2; 01.VI.2022, 1♀, malaise trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès and Rabat-Salé-Kénitra (LHOMME *et al.*, 2020).

Sphecodes rubripes Spinola, 1838 (Fig. 5c) Thomas James Wood *det.*

Material studied: S2; 12.V.2022, 2♀, malaise trap, 01.VI.2022, 1♂, pan trap, 21.VII.2022, 1♂, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Rabat-Salé-Kénitra and Oriental (LHOMME *et al.*, 2020).

Sphecodes rubicundus Hagens, 1875 Thomas James Wood *det.*

Material studied: S7; 16.III.20223, 2♀, sweep net (collected on *Matricaria chamomilla* L., 1753).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima and Drâa-Tafilalet (LHOMME *et al.*, 2020).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès and Marrakech-Safi (LHOMME *et al.*, 2020).

Megachilidae Latreille, 1802

Anthidiellum strigatum (Panzer, 1805) (Fig. 5e) Thomas James Wood *det.*

Material studied: S2; 16.V.2023, 1♂, bottle (collected on *Lotus arenarius* Desf, 1798).

Anthidium diadema Latreille, 1809 Max Kasparek *det.*

Material studied: S2; 01.VII.2021, 1♀, pan trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

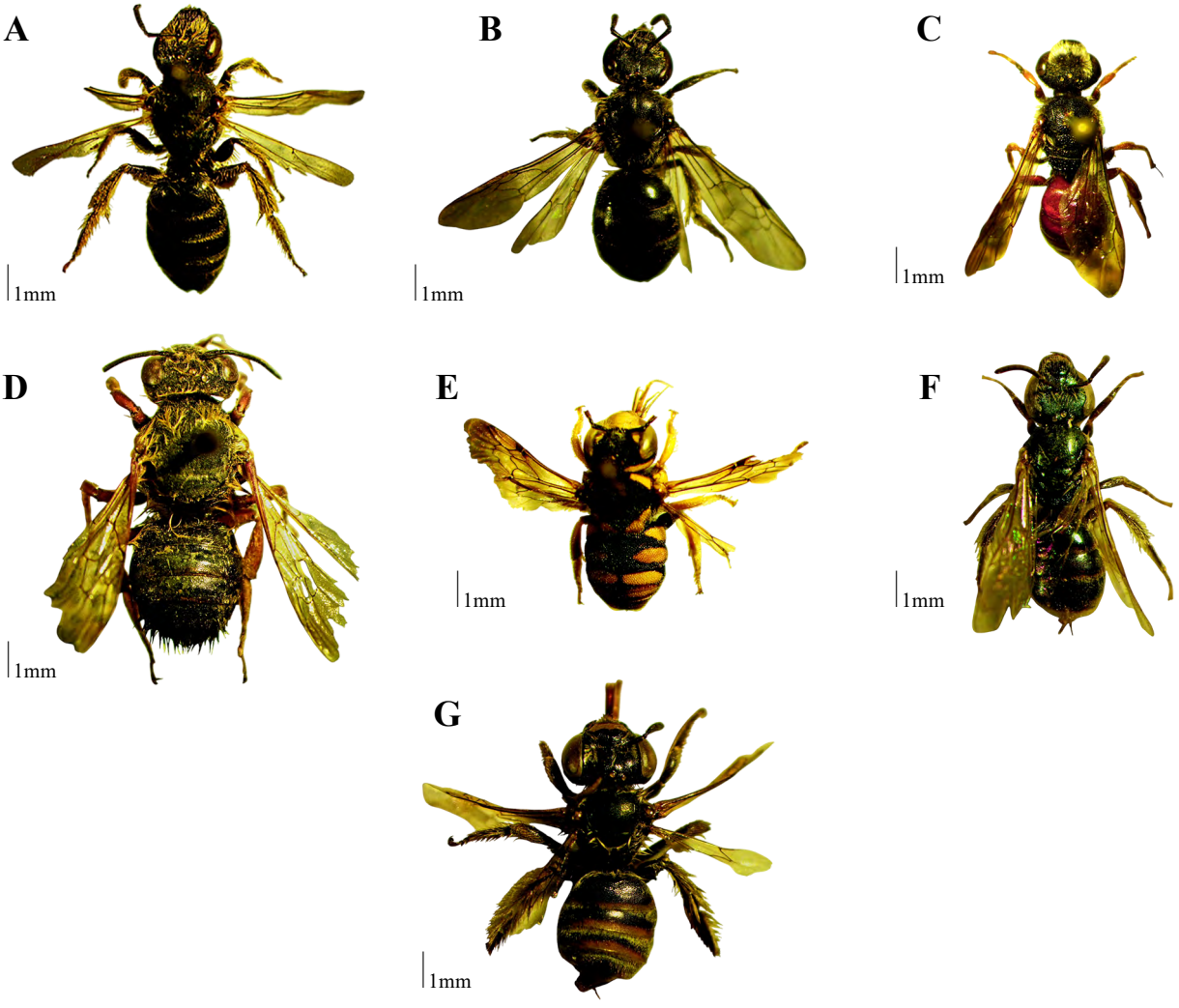

Fig. 5. Images of some wild bee species: A) *Halictus scabiosae* (Rossi, 1790), B) *Lasioglossum mediterraneum* (Blüthgen, 1925), C) *Sphecodes rubripes* Spinola, 1838, D) *Megachile sicula* (Rossi, 1792), E) *Anthidiellum strigatum* (Panzer, 1805), F) *Lasioglossum virens* (Erichson, 1835), G) *Tetralonia ruficornis* (Fabricius, 1804). Photos by Amine Samih and Noureddin Maatouf.
Fig. 5. Imágenes de algunas especies de abejas silvestres: A) *Halictus scabiosae* (Rossi, 1790), B) *Lasioglossum mediterraneum* (Blüthgen, 1925), C) *Sphecodes rubripes* Spinola, 1838, D) *Megachile sicula* (Rossi, 1792), E) *Anthidiellum strigatum* (Panzer, 1805), F) *Lasioglossum virens* (Erichson, 1835), G) *Tetralonia ruficornis* (Fabricius, 1804). Fotografías de Amine Samih y Noureddin Maatouf.

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès, Marrakech-Safi and Souss-Massa (LHOMME *et al.*, 2020).

Dioxys pumilus (Gerstäcker, 1869) Thomas James Wood *det.*

Material studied: S1; 01.VII.2021, 1♀, pan trap. S2; 12.V.2022, 1♀, malaise trap.

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès, Marrakech-Safi, Drâa-Tafilalet, Souss-Massa and Guelmim-Oued Noun (LHOMME *et al.*, 2020).

Megachile ericetorum (Lepeletier, 1841) Thomas James Wood *det.*

Material studied: S2; 16.V.2023, 3♂, bottle (collected on *Lotus arenarius* Desf, 1798).

Global distribution: Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Fès-Meknès, Marrakech-Safi, Drâa-Tafilalet, Souss-Massa and Guelmim-Oued Noun (LHOMME *et al.*, 2020).

Megachile sicula (Rossi, 1792) (Fig. 5d) Thomas James Wood *det.*

Material studied: S1; 29.IV.2021, 3♀, pan trap, 15.III.2023, 1♂, bottle (collected on *Echium plantagineum*). S2; 07.IV.2021, 1♀, sweep net (collected on *Cistus salviifolius* L., 1753), 12.V.2022, 5♀, malaise trap, 11.IV.2023, 2♀, bottle (collected on *Halimium calycinum* Boiss. & Reut., 1852 and *Cistus salviifolius* L., 1753), 15.V.2023, 1♀, bottle (collected on *Cistus salviifolius* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès, Rabat-Salé-Kénitra, Guelmim-Oued Noun, Tanger-Tétouan-Al Hoceima, DrâaTafilalet and Souss-Massa (LHOMME *et al.*, 2020).

Heriades crenulata (Nylander, 1856) Andreas Müller *det.*

Material studied: Cork oak of Larache (Edge) (35.208901 N, -6.057496 W); 01.VII.2021, 1♀, pan trap.

Global distribution: Palearctic (LHOMME et al., 2020).

Regional distribution: Tanger-Tetouan-Al hoceima, Fès-Meknès, Rabat-Salé-kénitra, Béni Mellal-Khénifra, Marrakech-Safi, Drâa-Tafilalet, Souss-Massa (LHOMME *et al.*, 2020).

Osmia niveata (Fabricius, 1804) Thomas James Wood *det.*

Material studied: S1; 27.V.2021, 1♂, pan trap, 12.V.2022, 1♀, pan trap, 21.VII.2022, 1♀, pan trap. S2; 21.VII.2022, 2♀, pan trap. S10; 22.VI.2022, 1♂, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Marrakech-Safi, Drâa-Tafilalet and SoussMassa (LHOMME *et al.*, 2020).

Osmia notata (Fabricius, 1804) Andreas Müller *det.*

Material studied: S2; 01.VII.2021, 2♂, pan trap, 04.VIII.2021, 1♂, pan trap. S7; 13.IV.2023, 1♀, bottle (collected on *Carduus bourgeanus* Boiss. & Reut., 1852). S8; 15.VI.2023, 1♀, bottle (collected on *Leontondon saxatilis* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Rabat-Salé-Kénitra, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi, Drâa-Tafilalet, Souss-Massa and Guelmim-Oued Noun (LHOMME *et al.*, 2020).

Osmia submicans Morawitz, 1870 Thomas James Wood *det.*

Material studied: S2; 16.V.2023, 1♀, bottle (collected on *Lotus arenarius* L., 1753).

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima, Oriental, Fès-Meknès, Béni Mellal-Khénifra, Casablanca-Settat, Marrakech-Safi, Drâa-Tafilalet, Souss-Massa and Guelmim Oued Noun (LHOMME *et al.*, 2020).

Melittidae Schenck, 1860

Dasypoda cingulata Erichson, 1835 Guillaume Ghisbain *det.*

Material studied: S2; 01.VII.2021, 7♀, pan trap, 01.VII.2021, 1♀, pan trap, 12.V.2022, 18♀, malaise trap, 01.VI.2022, 2♀, malaise trap, 4♀, pan trap. S1; 29.IV.2021, 4♀, pan trap, 12.V.2022, 59♀, pan trap, 01.VI.2022, 35♀, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Fès-Meknès, Guelmim-Oued Noun, Rabat-Salé-Kénitra and Tanger-Tétouan-Al Hoceima (LHOMME *et al.*, 2020).

Dasypoda dusmeti Quilis, 1928 Guillaume Ghisbain *det.*

Material studied: S2; 01.VII.2021, 1♀, pan trap. S1; 01.VI.2022, 5♀, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Marrakech-Safi, Rabat-Salé-Kénitra and Tanger-Tétouan-Al Hoceima (LHOMME *et al.*, 2020).

Dasypoda maura Pérez, 1896 Guillaume Ghisbain *det.*

Material studied: S2; 01.VII.2021, 1♀, pan trap. S5; 12.V.2022, 16♀, pan trap, 01.VI.2022, 12♀, pan trap, 17.V.2023, 3♀, sweep net (collected on *Scolymus hispanicus* L., 1753).

Global distribution: Morocco and Algeria (LHOMME *et al.*, 2020).

Regional distribution: Casablanca-Settat, Drâa-Tafilalet, Fès-Meknès, Marrakech-Safi, Oriental, Rabat-Salé-Kénitra, Souss-Massa and Tanger-Tétouan-Al hoceima (LHOMME *et al.*, 2020).

Dasypoda visnaga (Rossi, 1790) Guillaume Ghisbain *det.*

Material studied: S2; 01.VII.2021, 2♀, pan trap, 13.VI.2023, 1♀, sweep net (collected on *Scolymus hispanicus* L., 1753). S1; 29.IV.2021, 3♀, pan trap. 13.VI.2023, 1♀, sweep net (collected on *Scolymus hispanicus* L., 1753). S10; 01.VI.2022, 1♀, pan trap.

Global distribution: West-Palearctic (LHOMME *et al.*, 2020).

Regional distribution: Tanger-Tetouan-Al Hoceima and Rabat-Salé-Kénitra (LHOMME *et al.*, 2020).

DISCUSSION

Our sampling campaigns, across all environments, resulted in the enumeration of nearly 531 individuals, totaling 21 genera and 80 identified species. This number is notably higher than in two other sites of the Mediterranean region: 58 species reported by AZEVEDO *et al.* (2022) in Portugal (Lisbon) and 46 species documented by BENARFA *et al*. (2025) in Algeria. However, it is comparable to the recent findings of VOMMARO *et al*. (2025) in Southern Italy, who recorded a similar number of species. The higher species richness observed in our study may be attributed to the region's diverse habitat mosaic, combining well-preserved cork oak forests and varied agricultural landscapes, which provide a wide range of nesting and foraging resources (SAMIH *et al.*, 2024). Additionally, the biogeographical position of northwestern Morocco, influenced by both Mediterranean and Atlantic climates, may contribute to greater habitat heterogeneity and floral resource availability (CHEBLI *et al.*, 2023).

Our results reveal that the various sampled stations in the northwestern region of Morocco exhibit a remarkable diversity of wild bees (SAMIH *et al*., 2024), representing approximately 8.12% of the total number of bee species recorded nationwide (961 species) (LHOMME *et al*., 2020). The

number of species that was found is lower than that reported in a previous catalogue by LHOMME *et al*. (2020), which documented the presence of 250 species throughout the northern region of Morocco. This disparity can be attributed to various factors, including seasonal variations, differences in sampling methods and specific characteristics of the habitats studied.

The presence of 71 bee species in the forested area of the cork oak of Larache represents the first in-depth investigation of wild bee diversity in the region, providing a significant contribution both locally and nationally, offering valuable insights into Morocco forest ecosystems. This species richness can be attributed to several favorable environmental factors. Firstly, the presence of water resources in this area suggests a diversity of flowering plants with pollen and nectar value. Indeed, bees rely closely on flowers for their food and reproduction and the availability of a wide variety of flowering plants can support a high diversity of bee species (CHRISTMANN, 2019). Furthermore, the cork oak of Larache offers a diversity of habitats and ecological niches, such as woodlands, meadows, wetlands and edges, which provide unique conditions for different bee species based on their specific needs (SAMIH *et al*., 2024). Additionally, the soil provides an ideal substrate for the nesting of solitary bees (CHRISTMANN *et al*., 2022), particularly species of the genera *Lasioglossum* and *Andrena*, the bee genera richest in number of species in this study. Our findings confirm the predominance of *Lasioglossum* and *Andrena* species, echoing patterns observed in Mediterranean habitats, where these genera are dominant and central to pollination networks due to their generalist behavior and nesting preferences in well-drained soils (POLIDORI *et al*., 2010, 2025).

However, we identified two endemic species of Morocco, namely *Andrena insignis* Warncke, 1974 and *Eucera nadigi* (Friese, 1924), collected in the cork oak of Larache. Their restricted geographical distribution contrasts with that observed in other regions of the country, which constitutes a relatively modest number in comparison. For example, the three regions with the largest number of recorded endemic species, namely Marrakech-Safi (39 species), Souss-Massa (38 species) and Drâa-Tafilalet (33 species), are all located along the Atlas Mountains (LHOMME *et al*., 2020). This suggests that mountainous regions such as those bordering the Atlas offer particular environmental conditions conducive to endemism (MEDAIL & DIADEMA, 2009; RANKOU *et al*., 2013). Additionally, this research reports a new record of *Nomada stigma* (Fabricius, 1804). This species was first reported from Morocco by SAMIH *et al*. (2024). These findings reveal gaps in our knowledge regarding the distribution of this species, suggesting that it may have been misidentified or undocumented in the study region due to the complexity of the genus. Furthermore, this species was found in samples from the Larache cork oak forest (SAMIH *et al*., 2024), emphasizing the importance of this ecosystem as a refuge for potentially rare and threatened species. Therefore, intensifying collection efforts and diversifying sampling campaigns in forest habitats and beyond, across different times of the year, are essential to detect these cryptic species and accurately assess their conservation status.

Contrary to the forest area, the agricultural sector in our region exhibits significantly less diverse wild bee diversity, with only 14 identified species. Although our study did not explicitly analyze the causal factors for this reduced diversity, it is reasonable to assume that agricultural intensification play a role. This intensification is characterized by the conversion of agricultural land into monocultures in the sampled stations, which could have a negative impact on natural habitats and floral resources necessary to support pollinators (DEGUINES *et al*., 2014; AIZEN *et al*., 2019; REILLY *et al*., 2020). Furthermore, the removal of natural landscape elements such as edges and wooded areas limits nesting and foraging options for many bee species (MARZINZIG *et al*., 2018; SENTIL *et al*., 2022a). Additionally, the use of insecticides, particularly neonicotinoid insecticides, can reduce pollination services (PARK *et al*., 2015; STANLEY *et al*., 2015) and negatively affect pollinator populations (RUNDLÖF *et al*., 2015; WOODCOCK *et al*., 2017).

RECOMMANDATIONS

This study emphasizes the urgent need to protect wild bee biodiversity in the Northwestern

region of Morocco, which is vital for maintaining ecosystem services and ensuring food security. Effective conservation and management require integrated measures tailored to both forest and agricultural landscapes.

In forested areas such as the Larache cork Oak forest, preserving fine-textured soils, particularly sandy substrates, is essential for nesting. Encouraging native vegetation diversity through seed mixes of indigenous flowering plants further supports wild bee populations. In agricultural settings, reducing pesticide use and adopting sustainable practices, such as crop rotation, polyculture and floral buffer zones, are crucial. Strengthened regulations, regular inspections and incentives for sustainable farming are necessary to mitigate threats to wild bees.

Investment in long-term monitoring, scientific research and training programs is essential to evaluate the effectiveness of conservation efforts. Collaborations between academic institutions and international laboratories can further enhance these initiatives.

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