Al-Mukhtar Journal of Sciences 37 (2): 138-149, 2022
ISSN: online 2617-2186 print 2617-2178
Journal Homepage https://omu.edu.ly/journals/index.php/mjsc/index

Morphological Description of Some Megachilidae Species in Aljabal Alakhder, Libya

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Received: 08 December 2021/ Accepted: 19 May 2022
Doi: https://doi.org/10.54172/mjsc.v37i2.373

Abstract: Bees are a large and diverse species of insects belonging to the Hymenoptera order. The family Megachilidae represents a large part of most of the bee fauna all over the world as a result of their importance as pollinators. The study aimed to describe the morphological characteristics of three species of wild bees belonging to *Megachile parientina* (Geoffroy, 1785), *Rhodanthidium sticticum* (Fabricius, 1787), and *Anthidium diadema* Latreille, 1809 in Aljabal Alakder, Libya. Specimens were collected by hand net from different locations in the Aljabal Alakder area (Albayda and Alwastia). The morphological characters were described by using the OPTIC microscope. Measurements were taken at full body length (in cm), front wings length, thorax and abdomen width, body color was taken (head, abdomen, thorax, wings), and the study described in details the morphology of mouthparts, wings venation, antenna and abdominal structure for all species. The morphological structures vary between the different species in color, size, and wings. The body length of *M. parientina* was 19 mm, *R. sticticum* was 12 mm, and *A. diadema* was 13 mm. The study's conclusion insists on the importance of morphological description studies to facilitate the identification of wild bees species in Libya.

Keywords: Wild Bees, Megachilidae, Morphological Description, Aljabal Alakader, Libya.

INTRODUCTION

The importance of bees as key ecosystem service providers cannot be overemphasized. There are 20,000 bee species in the world that provide pollination services for many wild and cultivated plants for reproduction(Khalifa et al., 2021). The bee family Megachilidae is found in a wide diversity of habitats on all continents except Antarctica (Litman et al., 2011).The genus Megachile Latreille, 1802 represents a large part of most of the bee fauna (Michener, 2007). There are around 1400 species in this genus (Ascher & Pickering, 2020), divided into 55 subgenera (Michener, 2007; Trunz et al., 2016).

The Mediterranean region, especially North Africa, contains a wide diversity of bee species (Ascher & Pickering, 2020; Grace, 2010; Guiglia, 1942; Shebl et al., 2021), distributed in a wide variety of habitats (Gonzalez et al., 2012; Sakenin et al., 2020). *Megachile* species are solitary, and many species are highly seasonal. Their preferred host plants have a

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short flowering season, and this species is an important pollinator for grasses, crops, and fruit plants in different parts of the world (Zakikhani et al., 2021).These solitary bees are both ecologically and economically relevant; they include many pollinators of natural, urban, and agricultural vegetation (Gonzalez et al., 2012). Some species are effective pollinators (Bosch & Blas, 1994; Vicens & Bosch, 2000), and a polylectic pollinator that is native to North Africa (Henson et al., 2019).

The Megachilidae is one of two families of long-tongued bees characterized by having two marginal cells, and the stigma is small in the front wings (Michener, 2007). The pollen-collecting scopa of all nonparasitic females is located on the abdominal sterna (Özbek & Zanden, 1992; Stephen et al., 1969). Most Megachile nest opportunistically in a variety of pre-existing cavities that they line with external materials such as resin or neatly cut and folded leaves, and these are potentially manageable through deployment of trap-nests. Others, such as species of subgenus Creightonella instead, excavate burrows in soil that they line with folded leaves (Michener, 2007).

The taxonomic keys of bees give important to the morphological characters, in particular, distinctive characters (Praz, 2017).Libya possesses an extensive and rich bee fauna (Zavattari, 1934); few studies were conducted in Libya and investigated the presence and taxonomic characteristics of wild bees, but in spite of these findings, the faunistic data on wild bees in Libya is still not complete (Almabrouk & Bataw, 2019). Until recently, little was known about Apoidea fauna in Libya, and findings were fragmentary. Since the works of (Guiglia, 1942; Zavattari, 1934), no taxonomic studies of bees has been published for Libya. Recently studies were performed by (Almabrouk & Bataw, 2019).

Therefore, it is necessary to plan a comprehensive project to sample many localities and provide a need to focus on the taxonomy, diversity, ecology, and biology of native bees, The study aims to identify and describe the morphological characteristics of some species of Megachilidae bee species in northeastern Libya to facilitate further studies concerning the distribution map of Libyan bee pollinator species and their conservation.

MATERIALS AND METHODS

The specimens were collected from two nature areas in northeastern Libya (Albayda 32°45′40.4″N: 21°44′51.4″E (619m) and Alwastia 32°51′080.83″N: 21°43′91″E (336m)) from March 2014 to May 2018. The areas are characterized by a rich fauna of wildflowers and economic plants.

The bees were collected by a net and placed in glass bottles with wet papers containing some drops of ethyl acetate alcohol to kill bees, then pinned and labeled for each specimen with bee special information (the area from which the bees were collected, date of collection, name of collector) and stored in wooden boxes in entomology laboratory of the Zoology Department, Faculty of Science, Omar Al Mukhtar University. The available keys were used for bees' identification: (Michener, 2007; Michener & Griswold, 1994; Praz, 2017). Identifications were confirmed with help of bee specialists (e.g. Georg Els, Robert Stuart - NHM UK). The various body characteristics of specimen bees were measured and described according to terminology used by Michener (2007). A stereomicroscope (OPTECH, modular stereomicroscope, Optical Technology, Germany) was used in the description process supplied with an Olympus digital camera.

RESULTS

***Megachile (chalicodama) parietina* (Geoffry, 1785)**

Examined material: ♀ 2 Alwasita, 16.iii.2017; Albaida, 16.iv.2014, 27.iii.2018,

1.iv.2018, 2.iv.2018, 3.iv.2018, 4.iv.2018, 6.iv.2018, 11.iv.2018, 15.v.2018.
Measurements: 19 mm body length.

Head: black, triangular-shaped, slightly narrower than body, with long black setae, densely punctate, vertex curved to the inside with long black setae erected to the outside (Fig. 1).

Figure (1). The head of (♀) *Megachile parientina* (♀).

Compound eyes: bright black, with densely long black setae between compound eyes, paraocular carina clear, genal area narrow.
Ocelli: arranged in a triangle shape, dark brown, lateral ocelli at same level of posterior margin of compound eyes (Fig. 2).

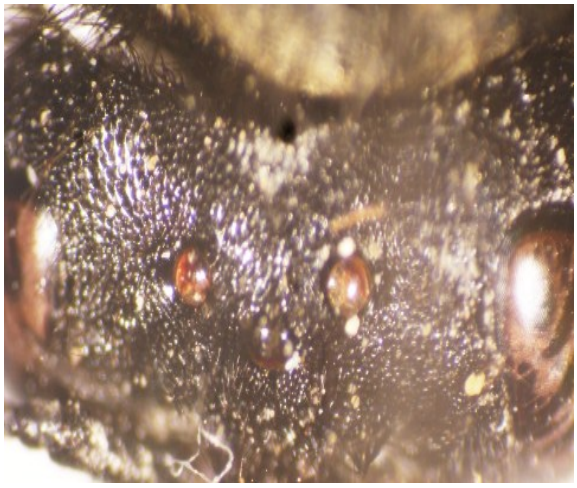

Figure (2). Ocelli of *Megachile parientina* (♀).

Clypeus: black, the end of the apical ciliated with dark brown setae, densely punctate.
Mandibles*:* rectangular, wider at apical, black with long little light brown setae, inner mandible with cutting edge (Fig.3).

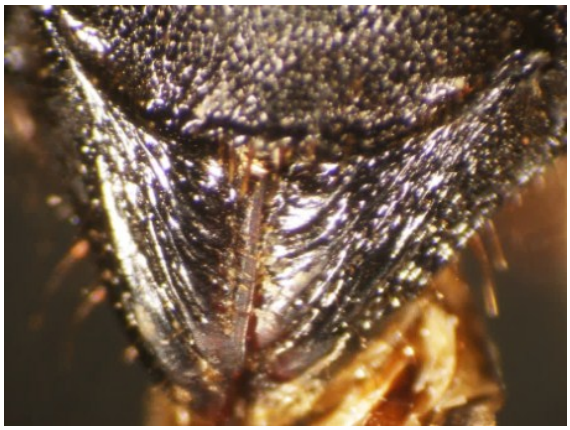

Figure (3). Mandible of *Megachile parietina* (♀).

Mouthparts: elongated, light brown, galea brown color, wider than glossa; end of apical glossa with dense setae erected downward, paraglossa with short setae at edges (Fig. 4).

Figure (4). Mouthparts of *Megachile parientina* (♀).

Antennae: twelve segments, black, antennal socket dark brown, scape elongated, rectangular, narrower at the base, wider at apical; pedicel short, rounded, first flagellomere narrower at the base, wider at apical, other flagellomeres equal in the shape and size, terminal flagellomere rounded.

Thorax: width 5 mm, prothorax larger than mesothaorax and metathorax, black, with densely long black setae especially on meta-

thorax; tegula clear, dark brown.

Wings*:* forewings length 13 mm, dark brown, veins with dark brown color; marginal cell elongated and broadtwo submarginal cell, vein 2rs-m curved outward, vein 2m-cu meets median vein opposite third submarginal cell, basal vein straight, the lower end meeting the longitudinal vein at an acute angle (Fig.6a), jugal lobe of hindwing very short, much less than half length of vannal lobe and not reaching anywhere near as far as vein closing cubital cell (Fig. 5).

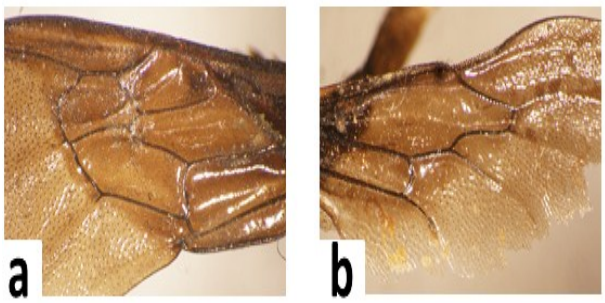

Figure (5). a- Forewing, b- Hindwing of *Megachile parientina* (♀).

Legs: coxa triangular, black and covered by black setae at outside; trochanter rectangular, narrower at the base, wider at apical, black, apical edge dark brown, black setae; femur elongated, wider at base, narrow apically, black with dense and long black setae erected downwards at outside and outer surface, internal surface with a few black setae; tibia narrower at base, wider at apical part, black with dense short black setae erected downwards, dark brown area at the edge of internal tibia, dense long black setae erected downwards at the edges and outer surface, little black setae on the internal surface, tibial spur ciliated from each side, forelegs with one tibial spur, short, dark brown, mid legs with one tibial spur, long, light brown (Fig. 6a), hind legs with two tibial spur, long, light brown (Fig. 6b), tarsus five segments each leg, basitarsus longer than mediotarsus and distitarsus, narrower at the base, wider at the apical, black with dense long black setae erected downwards, mediotarsus three segments equal in the shape and size, clear, dark brown with dark brown robust setae at the apical, distitarsus narrower at the base, wider at the apical, dark brown with little long dark brown setae.

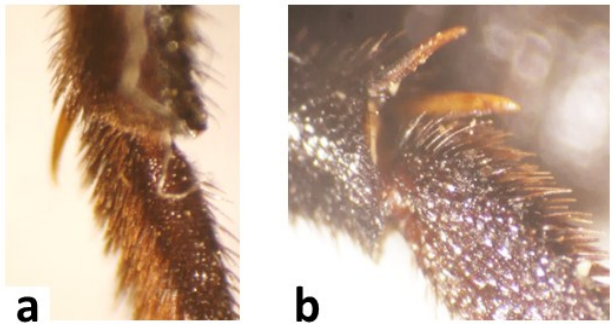

Figure (6). Tibial spur a- midleg, b- hind leg of (♀) *Megachile parientina.*

Pair of long tarsal claws the base dark brown, apical black, arolium absent (Fig. 7).

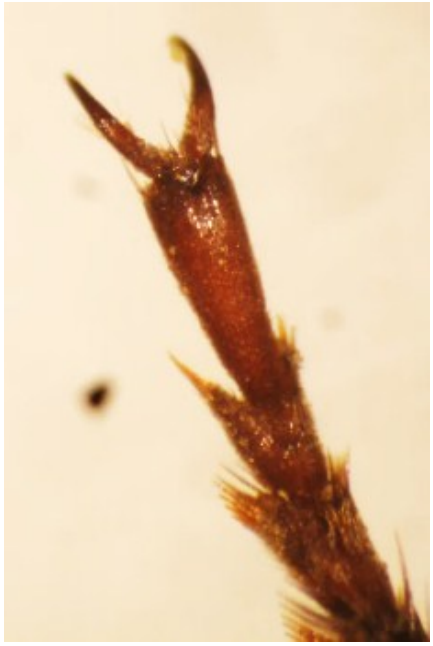

Figure (7). Tarsal claws of (♀) *Megachile parientina.*

Abdomen: width across abdomen 6 mm, six segments, black, dense punctates, tergum I clear curvature at the base, compressed and narrower at the middle, tergum VI triangle shape, narrower than the rest of the other terga, dense long black setae erected downwards (Fig. 8a), sternum black with dense long black setae, dense short black setae at the

edges (Fig. 8b).

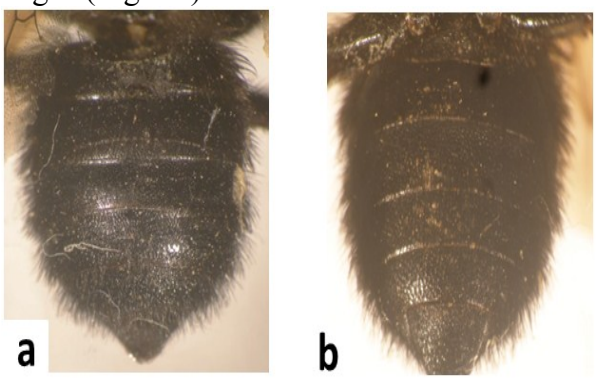

Figure (8). Abdomen of *Megachile parientina* a- Dorsal view, b- Venteral view of (♀) *Megachile parietina.*

***Rhodanthidium sticticum* (Fabricius, 1787).**
Examined material: ♀1 Albaida, 15.5.2018 12 mm body length .

Head: rounded and slightly narrower than the body (Fig. 9a), vertex with band curved in the middle at the apical, orange color with dense long orange setae, dense punctates (Fig. 9b).

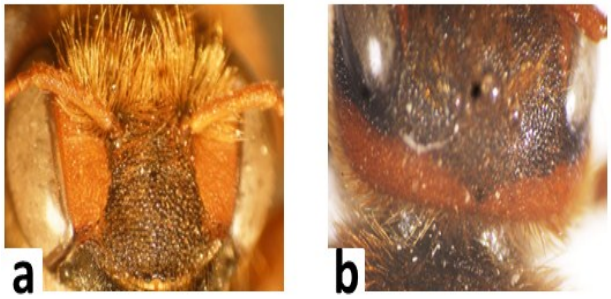

Figure (9). a- The head, b- Vertex of (♀) *Rhodanthidium sticticum.*

Compound eyes: bright black, orange spot between compound eyes and antennae, paraocular carina clear, genal area wide.
Ocelli: triangle shape, light brown, the lateral ocelli slightly higher than the height level of compound eyes, the median ocellus with frontal line.

Clypeus: dark brown, the end of apical ciliated with long orange setae erected downwards, dense punctates.

Mandibules: rectangular, wide, robust, elongated, ends with five sharp teeth, apical tooth long, dark brown with dark brown lope at the connect area with the malar area (Fig. 10).

Figure (10). Mandible of (♀) *Rhodanthidum sticticum.*.

Mouthparts: long, light brown (Fig. 11)

Figure (11). Mouthparts of (♀) *Rhodanthidum sticticum.*

Antenna: twelve segments, scape long, rectangular, orange, pedicel short, rectangular, orange, flagellum ten segments, the first flagellomere longer than the rest of the other flagellomeres, wider at the apical, narrower at the base, the other ninth flagellomeres equal in the shape and size, flagellomeres from first to third orange color, flagellomeres from fourth to tenth dark brown color, the terminal flagellomere of antennae rounded shape (Fig.12).

Figure (12). Antennae of (♀) *Rhodanthidum sticticum.*.

Thorax: width across thorax 4 mm, dark brown, prothorax larger than mesothorax and metathorax, dense long orange setae, dense punctates, tegula clear large, orange (Fig.13).

Figure (13). Thorax of (♀) *Rhodanthidum sticticum.*

Wings: forewings length 11 mm, light brown, the veins dark brown, marginal cell long and broad, apical edge of marginal cell darker brown, the apical of marginal cell not jointed with costa vein, two submarginal cells, vein 1rs-m with the same line vein 1m-cu, vein 2rs-m curved outward, vein 2m-cu meets median vein at the second submarginal cell, basal vein straight, the lower end meeting the longitudinal vein at an acute angle (Fig. 14), jugal lobe of hindwing very short, much less than half length of vannal lobe and not reaching anywhere near as far as vein closing cubital cell.

Figure (14). Forewing of (♀) *Rhodanthidum sticticum.*

Legs: coxa triangle, dark brown with dense long orange setae erected to down at the edges, trochanter narrower at the base, wider at the apical, dark brown with dense orange setae, fumer rectangular, wider dark brown at base, narrower orange at the apical, dense short orange setae erected to down, tibia narrower at the base, wider at the apical, dense short orange setae erected to down, tibial spur ciliated at the inner edge, sharp at the outer edge, forelegs with one tibial spur, short, light brown, midlegs with one tibial spur, long, orange, hind legs with two tibial spur, long, orange (Fig. 15a), tarsus five segments each leg, basitarsus longer than mediotarsus and distitarsus, orange with dense long orange setae erected to down, mediotarsus three segments equal in the shape and size, orange with dense long orange robust setae erected to down at the apical, distitarsus narrower at the base, wider at the apical, orange with little long orange setae erected to down at the apical (Fig. 15b).

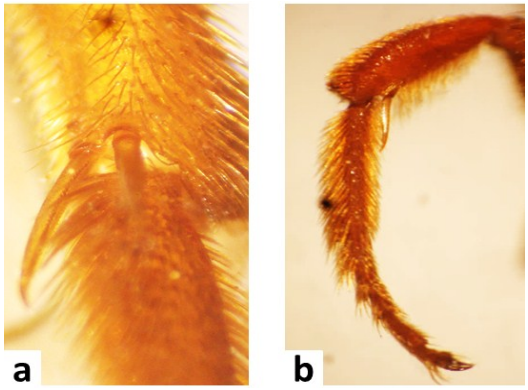

Figure (15). a- Tibial spur of hind legs, b-Midleg of (♀) *Rhodanthidum sticticum.*.

Pair of longed tarsal claws, branched at apical, the lateral longer than internal one, the base orange, apical dark brown, arolium clear, dark brown (Fig.16).

Figure (16). Tarsal claws of. (♀) *Rhodanthidum sticticum*.

Abdomen: width across abdomen 5 mm, six segments, dense punctates, short light orange setae erected to down, contact area of terga I, II clear dark brown, the color of segments black at the middle, orange color from each side, tergum VI triangle shape with two pairs of posteriorly projecting spines (Fig. 17a), sternum dark brown ends with light orange edges, long light orange setae (Fig. 17b).

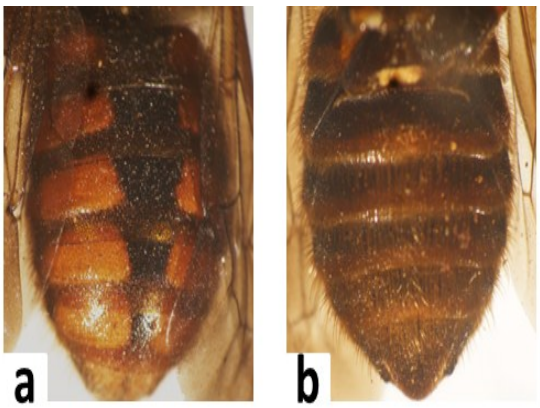

Figure (17). a- Dorsal view, b- Venteral view of (♀) *Rhodanthidum sticticum*..

***Anthidium diadema Latreille,* 1809**

Examined material: ♀ 1 Albaida, 30.v.2018.

13 mm body length.

Head: rounded with clear yellow spots, white setae, dense punctates, vertex curved slightly to the inside, black with two elongated bands, and clear long yellow setae (Fig. 18).

Figure (18). The head of (♀) *Anthidium diadema*.

Compound eyes: large, dark brown.

Ocelli: triangular shape, dark brown, the lateral ocelli less than the height level of compound eyes (Fig. 19).

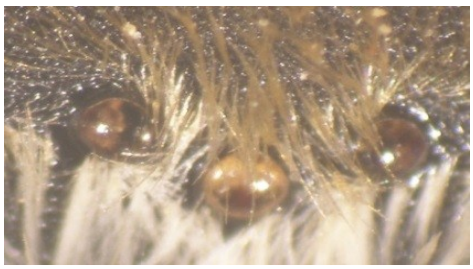

Figure (19). Ocelli of (♀) *Anthidium diadema.*

Clypeus: yellow color, wider than the length.

Mandibules: cylindrical, yellow color, ends with three sharp dark brown teeth, lower tooth long, strong edges (Fig. 20).

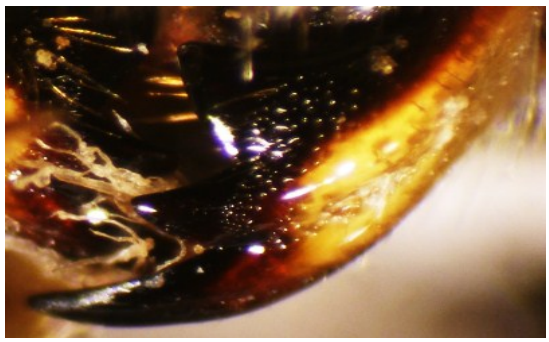

Figure (20). Mandible of (♀) *Anthidium diadema*.

Mouthparts*:* long, light brown.
Antenna: thirteen segments, scape long, narrower at the base, wider at the apical, black with white setae, pedicel short, rounded, dark brown, flagellum eleven segments, dark brown, the first flagellomere narrower at the base, wider at the apical, the second and third flagellomeres wider than the length, flagellomeres from fourth to eleventh equal in the shape and size, the terminal flagellomere of antennae rounded shape (Fig. 21).

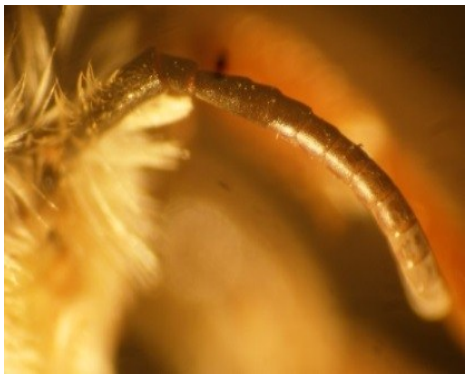

Figure (21). Antennae of (♀) *Anthidium diadema.*

Thorax: width across thorax 5 mm, pronotal lobe cream with a dorsal anterior carina, covered with long white setae, omaulus rounded, scutum with recumbent dense short setae, almost totally black and with reversed J-shaped cream, marking along anterior and lateral edges, axilla rounded, scutellum with cream subapical band, triangular area of propodema large, impunctate shining, mesepisternum and metepisternum with small cream spots, tegula large, reddish-brown, with cream spot anteriorly (Fig. 22).

Figure (22). Thorax of (♀) *Anthidium diadema.*

Wings*:* forewings length 10 mm, transparent brown, the veins dark brown, marginal cell broad with a dark brown line at the apical of margin cell, two submarginal cells, 2smc slightly larger than 1smc, vein 2m-cu meets median vein beyond point where 3rs-m dose, basal vein straight, the lower end meeting the longitudinal vein at an acute angle (Fig. 23), jugal lobe of hindwing very short, much less than half length of vannal lobe and not reaching anywhere near as far as vein closing cubital cell.

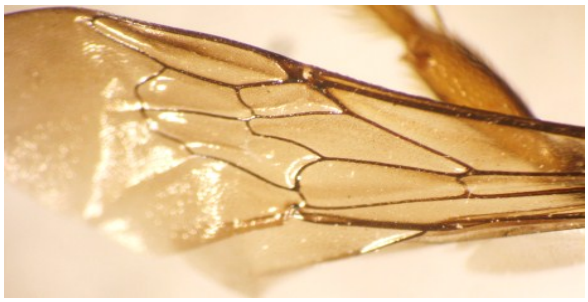

Figure (23). Forewing of (♀) *Anthidium diadema.*

Legs: coxa black, dense punctates, forecoxa and hindcoxa longer than midcoxa, apical edge light brown, dense long white setae erected downwards, midcoxa short, black, long white setae erected downwards, trochanter black, narrower at the base, wider at the apical, dense punctates, dense long white setae erected downwards, fumer elongated, wide, internal surface dark brown with little white setae erected to down, external surface black, apical edge light brown, short black setae, dense punctates, dense long white setae erected downwards at the edges, tibia internal surface wide, dark brown with white setae erected downwards, external surface yellow with white setae, dense punctates, tibial spur ciliated from each side, long, light brown, forelegs and midlegs with one tibial spur (Fig. 24a), hind legs with two tibial spur (Fig. 24b), tarsus five segments each leg, reddish brown with dense long yellow setae erected downwards, basitarsus longer than mediotarsus and distitarsus, mediotarsus three segments equal in the shape and size, distitarsus long, narrower at the base, wider at the apical

reddish brown with short little reddish brown setae erected downwards at the apical.

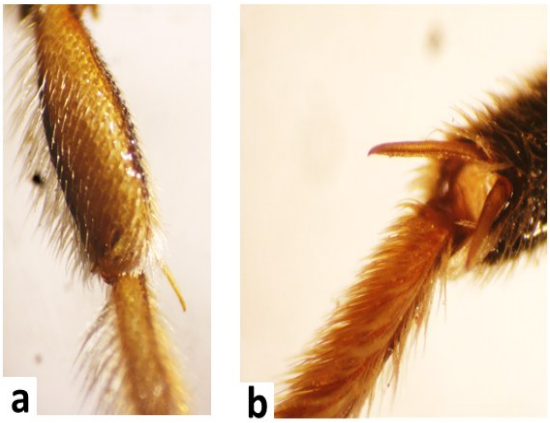

Figure (24). Tibial spur a-midleg, b- hind leg of (♀) *Anthidium diadema.*

Pair of elongated tarsal claws, branched at apical, the lateral longer than the internal one, the base light brown, apical dark brown, arolium absent (Fig. 25).

Figure (25). Tarsal claws of (♀) *Anthidium diadema.*

Abdomen: width across abdomen 5 mm, seven segments with dense punctates.
Tergum I black with a yellow spot on each side.

Tergum II black with a yellow band along the tergum, two dark brown spots with curvature yellow band at middle to down.
Tergum III black with yellow band, two dark brown marks on each side.

Terga IV and V black, yellow band. Tergum VI less wide than other terga with paired, lateral, bright yellow spots. Tergum VII with prominent, hook like projections (Fig. 26a).
Sternum: each sterna with dense long white setae erected downwards (Fig. 26b).

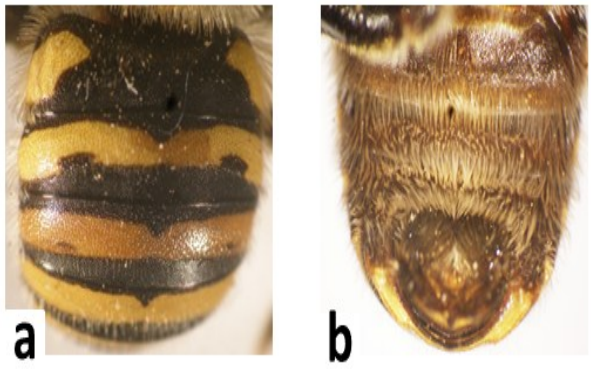

Figure (26). a- Dorsal view, b- Venteral view of (♀) *Anthidium diadema.*

DISCUSSION

The bee fauna of Libya is rich but relatively little known biologically and taxonomically (Almabrouk & Bataw, 2019; Zavattari, 1934). The study of morphological structures of wild bees is conceded as one of the important topics as a results of the importance of bees in the ecosystem.

Undoubtedly, the current study described three species *Megachile (chalicodama) parientina, Rhodanthidium sticticum,* and *Anthidium diadema*. Each of them is a separate species and differs in morphological features. However, we hope to draw more attention and encourage melittologists to investigate and document these morphological structures as well as the floral associations and foraging behavior of all bees that have them in Libya.

CONCLUSION

The current study insists that the Aljabal Alakder region of Libya has an important bee diversity that serves the ecosystem as pollinators of agricultural flowers. The study provides valuable information about Mega-

childae that could help to construct taxonomic keys for the Libyan bee species, and more investigation is needed for the study of wild bees.

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الوصف المورفولوجي لبعض أنواع النحل من عائلة Megachilidae في الجبل الأخضر، ليبيا

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تاريخ الاستلام: 08 نوفمبر 2021/ تاريخ القبول: 19 مايو 2022

Doi:https://doi.org/10.54172/mjsc.v37i2.373

المستخلص : يعد النحل من الحشرات ذات التنوع الكبير، التي تنتمي إلى رتبة غشائيات الأجنحة. تمثل عائلة Megachilidae جزءًا كبيرًا من النحل في جميع أنحاء العالم؛ نتيجة لأهميتها كملقحات. هدفت الدراسة إلى وصف الخصائص المورفولوجية لثلاثة أنواع من النحل البري تنتمي إلى *Megachile parientina* (Geoffroy 1785) ، و *Rhodanthidium sticticum* (Fabricius 1787)، و *Anthidium diadema* Latreille 1809، في منطقة الجبل الأخضر بليبيا. جمعت العينات بالشباك اليدوية من مواقع مختلفة في منطقة الدراسة (البيضاء، والواسطية). وصفت الصفات المورفولوجية باستخدام المجهر البصري، وأخذت القياسات بطول الجسم بالكامل (سم)، وطول الأجنحة الأمامية، وعرض الصدر، والبطن، ولون الجسم (الرأس، والبطن، والصدر، والأجنحة) ، ووصفت الدراسة بالتفصيل شكل أجزاء الفم، تعرق الأجنحة، وقرون الاستشعار، وتركيب البطن لجميع الأنواع. أوضحت الدراسة أن التركيبات المورفولوجية تختلف بين الأنواع سواء في اللون، والحجم، والأجنحة. كان طول جسم *M. parientina* 19 ملم، *R. sticticum*، 12 ملم و *A. diadema* كان 13 ملم. يؤكد استنتاجنا أن دراسة الوصف المورفولوجي من الدراسات المهمة التي تساهم في تعريف أنواع النحل في ليبيا.

الكلمات المفتاحية : النحل البري، ميجاكيليدي، الوصف المورفولوجي الجبل الأخضر، ، ليبيا.

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